

## Assessment of Median Nerve Conduction Parameters in Obese Population



### Medical Science

**KEYWORDS :** Conduction velocity, Body Mass Index, Amplitude, Obesity

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### ABSTRACT

*It is a well established fact that nerve conduction studies are influenced by age, gender, height, limb dominance and temperature. As it is a rapid painless procedure not requiring much expertise, nerve conduction studies are finding wider scope in research and clinical practice. The present study was performed to determine the effect of obesity on motor conduction velocity and amplitude of the compound nerve action potential of median nerve in adults. The study included 60 subjects in the age group of 18–30 years, divided in two groups according to their body mass index (BMI). Parameters were recorded using NEUROCARE TM 2000, a computerized EMG/NCV/EP Equipment. It was observed that with obesity there is a decrease in both conduction velocity and amplitude of the median nerve*

### INTRODUCTION:

Nerve conduction study establishes diagnosis very early and more accurately than the other electro diagnostic techniques because of its sensitivity to detect the conduction slowing. It is an early indicator for nerve entrapment or peripheral neuropathy even before the appearance of clinical signs and symptoms and aids in its early diagnosis and management. The most important investigations indicating peripheral nerve damage are motor and sensory nerve conduction studies and electromyography. Motor nerve conduction studies assess motor axons by selectively recording muscle responses to nerve stimulation.

Obesity is a state of excess adiposity and a disorder of nutrition and energy homeostasis. It affects motor nerve conduction by altering the metabolism and by creating a variety of co-morbid conditions such as insulin resistance, diabetes, hypertension, hyperlipidemia and hyperandrogenism, which can affect the motor neuron function.<sup>(1)</sup> Body mass index (BMI) is a good indicator of body fat content and it can be calculated as  $\text{weight/height}^2$  (in  $\text{kg/m}^2$ ). According to WHO classification, obesity is graded into three categories, normal (18.5 - 24.99  $\text{Kg/sq.m}$ ); overweight (25-29.99  $\text{Kg/sq.m}$ ) and obese ( $>30 \text{ kg/sq.m}$ ).<sup>(2)</sup>

It has been observed that there is a strong correlation between obesity & carpal tunnel syndrome(CTS). Simpson & Carpendale (1956) were the first to show that motor distal latencies were prolonged in patients with carpal tunnel syndrome.<sup>(3)</sup> Various authors like Melvin, Schuman & Richard (1973)<sup>(4)</sup> George & Glen (1983)<sup>(5)</sup> Sture Hansson (1994)<sup>(6)</sup>, Kouyoumdjian, Dirce & Maria (2002)<sup>(7)</sup>, Witt, Hentz & Stevens (2004)<sup>(8)</sup> have shown a strong relationship between obesity and development of carpal tunnel syndrome.

In the present study we compared the motor nerve conduction velocity & amplitude of compound nerve action potential of normal subjects with obese individuals. The current work was conducted to explore whether increasing weight influences median nerve function.

### MATERIALS AND METHODS:

Electroneurography is the study and measurement of conduction velocity and response latency of the peripheral nerves. In the present study only motor nerve conduction velocity across the median nerve was studied using NEU-

ROCARE™ 2000 which is a computerized EMG/NCV/EP Equipment.<sup>(9)</sup>

In our study for comparing the BMI 60 subjects were taken from the age group of 18 - 30; of which 30 (13 females; 17 males) belonged to normal group (18.5-24.99  $\text{Kg/sq.m}$ ) and 30 (16 females;14 males) to obese ( $>30 \text{ kg/sq.m}$ ).<sup>(9)</sup>

Subjects were called in the morning after light breakfast. They were made to sit for half an hour in an air-conditioned room with temperature being maintained at 21 - 23 degree Centigrade.<sup>(10)</sup> All the measurements were taken with the subject sitting up comfortably on a wooden stool. Dominant limb was selected for the study.<sup>(11)</sup> The procedure was fully explained to the subject and written informed consent was taken. Detailed history with preliminary details was taken for each subject.

Exclusion criteria included any metabolic disorder, fracture, deformity, radiculopathy, nerve compression, neurological disorder, intake of certain drugs, any addictions etc. The exclusion criterion was done with the help of detailed history and examination.

In the present study both motor nerve conduction velocity and amplitude of the nerve action potential across the median nerve were studied using NEUROCARE™ 2000 which is a computerized EMG/NCV/EP Equipment.<sup>(9)</sup> The nerve was stimulated at two points along its course. A supramaximal strength of stimulus was used.

For Motor Studies: Sensitivity: 2–5  $\text{mv/mm}$ , low frequency filter: 2–5 Hz, high frequency filter: 10 KHz, sweep speed: 2–5  $\text{ms/mm}$ . The muscle action potential was recorded using a pair of surface electrodes, which were in the form of small discs around 1 cm in diameter. The amplitude was measured from the baseline to the peak of the muscle action potential for both the nerves.<sup>(12)</sup>

Conduction Velocity = Distance (mm) / Lp-Ld millisecond

D – Distance between two stimulating points

Lp - Proximal lat

Ld - Distal latency

Results were expressed as  $\text{mean} \pm \text{S.D}$ . Comparisons for effect of increasing BMI on nerve conduction velocity and

amplitude were made using students unpaired

t test.  $P < 0.05$  was taken as significant.

## RESULTS:

**Table I: Anthropometric parameters of subjects**

PARAMETERS	Normal	Obese	P Value
Age (yrs)	23.6±4.031	24.43±3.72	0.40
Height (cm)	159.13±7.664	159.8±7.346	0.73
Weight (kg)	59.53±6.93	89.63±12.5	<0.0001*
BMI ( Kg/m <sup>2</sup> )	23.41±0.73	34.93±2.61	<0.0001*

Values are mean±SD. \* $P < 0.05$

**Table II: Comparison of Median Nerve Conduction Velocity between Normal and Obese**

	Normal	Obese
Mean	63.7615	62.8765
S.D	1.74	1.034
P Value	0.0199*	

Values are mean±SD. \* $P < 0.05$

**Table III: Comparison of Median Nerve Amplitude between Normal and Obese**

	Normal	Obese
Mean	9.9255	8.1275
S.D	2.931	2.786
P Value	0.0453*	

Values are mean±SD. \* $P < 0.05$

## DISCUSSION

This study evaluates comparison between nerve conduction parameters of median nerve of upper limbs in healthy adult population with obese group. Obesity is a globally emerging nutrition disorder. It was earlier thought to be a disease of the developed countries but the trend has changed and both developed as well as underdeveloped countries are equally affected. In India it affects around more than 1.4 billion adults, with the incidence being higher in females as compared to males.<sup>(2)</sup> The prevalence is higher among the economically better off and in people with sedentary lifestyle. The primary cause of global obesity lies in lifestyle and behavioral changes

60 subjects divided into 2 groups were taken to study the effect of increase in weight on motor conduction velocity and amplitude of compound nerve action potential of median nerve. Table I compares the anthropometric data between the groups in which weight and BMI show a significant difference. In the present study the mean conduction velocity in normal is  $63.7615 \pm 1.74$  m/sec and in obese is  $62.8765 \pm 1.034$  m/sec (Table II) which is statistically significant ( $p < 0.05$ ). The amplitude of median nerve in normal is  $9.9255 \pm 2.931$  mV, and in obese is  $8.1275 \pm 2.786$  mV (Table III) which is statistically significant ( $p < 0.05$ ).

Our study is in accordance with Letz & Gerr (1994) who found nerve conduction of the median nerve to decrease with increase in weight.<sup>(13)</sup>

Naik BM et al also observed that in obesity, there was increase in motor nerve latencies, decrease in the amplitude of action potentials and conduction velocity, which indicate slow transmission in peripheral nerve fibers.<sup>(14)</sup>

Ralph Buschbacher (1998) evaluated effect of body mass index on common nerve conduction measurements. He found no correlation between nerve conduction studies and BMI, whereas the sensory and mixed nerve amplitudes cor-

related significantly with BMI i.e. with an increase in BMI the nerve conduction decreased due to increase in subcutaneous fat. According to him, obese individuals have a thicker subcutaneous layer, and as most routine nerve conduction studies employ percutaneous stimulation and recording techniques, hence there is a decrease in their amplitude.<sup>(15)</sup>

Nair DS and Dubey DK (2006) studied 15 obese (BMI > 30 Kg/m<sup>2</sup>); 15 overweight (BMI 25 - 29.9 Kg/m<sup>2</sup>) and 15 control (BMI < 25 Kg/m<sup>2</sup>) armed forces personnel. They reaffirmed that there is no relationship between BMI and nerve conduction velocity. They attributed it to the active lifestyle of armed forces personnel.<sup>(16)</sup> McHugh et al. also reported that BMI has no influence on nerve excitability.<sup>(17)</sup>

Normally, the motor conduction velocity depends on many physiological factors like thickness of the nerve fiber (degree of myelination), mechanical compression from surrounding peripheral tissues, ionic changes, temperature, age, height of the individual and gender.<sup>(18)</sup> The decrease in conduction velocity observed in our study could be due to mechanical compression leading to conduction impairment or due to endoneurial edema, which is proposed to be a metabolic complication of obesity.<sup>(19,20)</sup> The decrease in amplitude can be due to thicker subcutaneous layer of fat in obese individuals.<sup>(15)</sup>

It has been reported that obesity is associated with higher incidence of carpal tunnel syndrome (CTS), which was suggested to be induced due to mechanical compression of the median nerve in carpal tunnel.<sup>(19,21,22,23)</sup> However, later it was found that the slowing of nerve conduction in CTS was due to endoneurial edema a metabolic complication of obesity rather than mechanical compression per se.<sup>(19,20)</sup>

Hence obesity poses as a predisposing factor for developing carpal tunnel syndrome. Various studies on the effect of BMI on nerve conduction parameters have been performed but the data obtained is insufficient. A further research relating body composition and the contribution of body fat percentage to these nerve conduction parameters needs to be undertaken.

## CONCLUSION:

From the current study we conclude that with increasing BMI there is a decrease in conduction velocity and amplitude of compound nerve action potential of the median nerve. Thus we can say that obesity affects the normal functioning of the median nerve .

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