

# Median Nerve Conduction Velocity and Body Mass Index in Mechanical Job Professionals

Kashif Ali<sup>1\*</sup>, Sangeeta Singhal<sup>1</sup>, SAA Rizvi<sup>1</sup>, M Muzammil<sup>2</sup>

<sup>1</sup>Department of Physiology, JNMCH, AMU, Aligarh, India.

<sup>2</sup>Mechanical Engineering Department Z.H. College of Engineering, AMU, Aligarh, India.

## ABSTRACT

**Background:** Obesity is an epidemic in 21st century especially rising among young population of developing nations is measured in terms of BMI (Body Mass Index). It affects almost every system. In present study we aim to investigate any correlation between NCV & BMI among professionals of mechanized jobs involving repeated wrist movements.

**Method:** BMI and median nerve NCV is measured in dominant and non-dominant hand of young active professionals.

**Results:** One way ANOVA is applied and MNCV of median nerve in dominant hand and SNCV of dominant as well as non-dominant hand is found to be significantly decreased but MNCV of non-dominant shows no significant difference.

**Conclusion:** Early changes in nerve conduction due to increased carpal tunnel pressure are more pronounced in dominant hand and SNCV of median nerve could be used as an early screening and diagnostic tool for median neuropathy

**Key words:** Obesity, Body Mass Index, Nerve Conduction Velocity.

## INTRODUCTION

In the 21st century obesity is an epidemic which has doubled since 1980, especially in developing countries like India it is continuously rising and occurring at younger age. Main causes of obesity are increased intake of energy-dense foods that is high in fat, decreased physical activity changing modes of transportation, and increasing urbanization with changes in lifestyle.(WHO 1995, WHO 2000 & WHO 2004).<sup>[1-6]</sup>

### Body mass index (BMI):

BMI is an easy to use, inexpensive, and non-invasive

measure of body fat. Higher BMI predicts higher future morbidity and death. So, we can say that BMI is a suitable measure for screening for obesity and its health risks.<sup>[7]</sup>

### Nerve Conduction Velocity


Nerve conduction study is an important test used to test the functioning of nerves, especially the ability of conduction of electrical stimulus.

NCV studies can acknowledge the degree of demyelination and axonal loss in the segments of nerve examined. Demyelination of a nerve results in prolongation of conduction time (decreased conduction velocity), whereas axonal loss generally leads to the loss of nerve fiber and muscle potential amplitude.<sup>[8]</sup> Asymptomatic neuropathy is common in obese patients independent of glucose control, and impaired distal nerve function.<sup>[9]</sup>

Sensory symptoms in the hand, whether from identifiable pathology or non-specific in origin, may be rendered more prominent and distressing by hand activity, low mood, tendency to somatise, and psychosocial stressors at work.<sup>[10]</sup>

Repetitive or sustained flexion & extension of the wrist or contraction of the muscles tendons passing through the carpal tunnel, especially when doing forceful work has been found to cause inflammation of tendons which can

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### Corresponding Author

Dr. Kashif Ali, Department of Physiology, JNMCH, AMU, Aligarh, India.

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alter the space or pressure within the carpal tunnel, which compress the median nerve.<sup>[11,12]</sup>

There are multiple studies in white population regarding the effect of BMI on NCV [18,20] but it has been found that Asians had more subcutaneous fat than whites.<sup>[13]</sup> and in our Indian population the data for effect of BMI on NCV is scanty. The aim of our study is to compare the Nerve Conduction Velocity (NCV) in Healthy, Pre- Obese and Obese. In professionally active young north Indians employed in various mechanical jobs.

**MATERIALS AND METHODS**

This study was done in the Department. Of Physiology, Jawaharlal Nehru Medical College and Hospital, AMU, Aligarh. After obtaining an institutional ethical clearance from the ethics committee, 180 subjects were included for this study. Only male subjects were selected for the study after taking their valid informed consent. Most of these subjects were people living in and around Aligarh employed in various mechanical jobs involving repetitive movement at wrist joint like Drivers, mechanics, plumbers, drillers. Anthropometric measurements and nerve conduction studies were done in all subjects.

**Anthropometric measurements**

Height and weight were used to calculate a participant’s BMI according to the World Health Organization which defines BMI as: “The weight in kilograms divided by the square of the height in meters (kg/m2).” Subjects were classified according to the International Classification of adult underweight, overweight and obesity according to BMI (WHO 1995, WHO 2000 & WHO 2004) in to 3 groups.

GROUPS	BMI	NUMBER OF SUBJECTS
Healthy normal range	18.50 -24.99	60
Pre- Obese	25.00 -29.99	60
Obese	≥30.00	60

**Nerve Conduction Velocity**

The equipment used for nerve conduction study was Medicaid System’s EMG/NCV equipment with Neuroperfect software.

Supramaximal stimulation was applied to obtain reliable and reproducible evoked responses in both motor and sensory nerve conduction studies.

**MOTOR NERVE CONDUCTION VELOCITY (MNCV)**

The motor or mixed nerve was stimulated at two points along its course. The stimulation intensity was adjusted to record a Compound Muscle Action Potential (CMAP).

Nerve	Distal site of stimulation	Proximal site of stimulation	CMAP recorded from
MEDIAN	Wrist	Antecubital fossa	Abductor Pollicis Brevis (APB)

- Stimulation intensity was increased gradually and the point at which the amplitude did not increase any further was determined as the Supramaximal intensity. This was the intensity at which the response was recorded. The duration of stimuli was 0.1ms.
- The cathode of the stimulator was kept close to the active electrode. The surface recording electrodes were used and placed in belly tendon montage; keeping the active electrode close to the motor point and the reference to the tendon.
- Ground electrode was placed between the stimulating and the recording electrodes.
- A biphasic action potential with initial negativity was thus recorded.
- Filter setting was 2Hz - 5 KHz with sweep speed of 5 ms / division.

**Calculation of MNCV:**

- The onset latency is the time in milliseconds from the stimulus artefact to the first negative deflection of CMAP.
- MNCV was calculated by measuring the distance in mm between 2 points of stimulation, which was divided by latency difference between the proximal and the distal latencies (ms).The nerve conduction velocity is expressed as m/s.

$$MNCV = \frac{D}{(PL-DL)} (m/s)$$

Where

PL is the Proximal Latency (ms).

DL is the Distal Latency (ms)

D is the distance between proximal and distal stimulation sites (mm).

**SENSORY NERVE CONDUCTION VELOCITY (SNCV)**

- The sensory conduction velocity can be measured orthodromically or antidromically.
- In orthodromic conduction study, a distal portion of the nerve, e.g. digital nerve is stimulated and Sensory Nerve Action Potential (SNAP) is recorded at a proximal point along the nerve.
- In antidromic conduction study, the nerve is stimulated at a proximal point and SNAP is recorded distally. Antidromic recording was done in the present study.

Nerve	Antidromic /Orthodromic	Stimulation Site	SNAP Recorded From
MEDIAN	Antidromic	Wrist	Index finger

- The filter setting was 20Hz – 3 KHz & sweep speed was 2 ms/division.
- The signal enhancement for averaging is generally required for sensory conduction study. The signal enhancement with averaging is proportional to the sq. root of the no. of trials.

$$\text{Change in amplitude} = \sqrt{n}$$

Where 'n' is the no. of trials

- The latency of the potential was measured from the stimulus artefact to the initial positive or subsequent negative peak.
- SNCV unlike MNCV is measured by stimulating at a single stimulation site, because the residual latency which comprises neuromuscular transmission time and muscle propagation time is not applicable in sensory nerve conduction. Thus, the SNCV was calculated by dividing the distance (mm) between the stimulating and recording sites by the latency (ms).

$$\text{SNCV} = \frac{\text{Distance}}{\text{Latency}} \text{ (m/s)}$$

**Statistical Methods:** One-way ANOVA was applied using SPSS 17.0 and a p value of p<0.05 is taken as significant.

## RESULTS AND DISCUSSION

A total of 180 subjects were included in the study. All the subjects were young males active in various professions involving mechanized jobs like plumbers, drillers, power grinders, motor mechanics and heavy machine operators in Aligarh with an average age of 35 years and average BMI of 27.95.

**Table 1: Mean BMI of the study subjects in different categories.**

Study Group	BMI (mean±SD)	95% C.I. for mean	Statistical significance#
Normal* (n=60)	23.37 ±1.07	22.319-23.131	
Pre-Obese** (n=60)	27.25 ±1.30	26.967-27.683	p<0.001, F=680.579, df=2
Obese*** (n=60)	33.23 ±1.90	32.936-33.680	
Total (N=180)	27.81 ±4.65	27.131-28.501	

\*BMI=18.5-24.9 kg/m<sup>2</sup>, \*\* BMI=25-29.9 kg/m<sup>2</sup>, \*\*\*BMI≥30 kg/m<sup>2</sup>, # One way ANOVA

**Table 2: Motor Nerve Conduction Velocity (NCV) in Median Nerve among different categories (N=180)**

Study group/Side	Normal (n=60)	Pre-Obese (n=60)	Obese (n=60)	Statistics#
<b>Dominant Hand</b>	55.25 ± 5.69	54.20± 4.23	53.72 ± 3.49	p=0.035, F=3.402, df= 2
<b>Non-Dominant Hand</b>	53.02± 3.30	54.62± 5.74	53.88 ±3.86	p=0.699, F=0.402, df=2

#One way ANOVA, p<0.05 significant

Obesity exerting its effect on various organ systems and its effect on nervous system is well known.<sup>[14]</sup> Nerve conduction studies are considered to be the most sensitive, reliable, non-invasive and objective means of investigating neuropathy.<sup>[15]</sup>

**Table 3: Sensory Nerve Conduction Velocity (NCV) in Median Nerve among different categories**

Study group/Side	Normal (n=60)	Pre-Obese (n=60)	Obese (n=60)	Statistics#
<b>Dominant Hand</b>	53.04 ± 3.29	52.54 ± 3.99	51.86 ±4.27	p=0.017, F=4.179, df=2
<b>NonDominant Hand</b>	54.22± 6.65	52.51 ± 4.76	52.31± 4.69	p=0.018, F=4.126, df=2

#One way ANOVA, p<0.05 significant

In nerve conduction study speed of nerve transmission is reflected in the velocity and latency, which is the time between stimulation of the nerve and recording of the waveform.<sup>[16,17,18]</sup> Velocity is calculated by dividing the difference in the latencies, by the distance between the two stimulation sites.

Awang et al in their study on Malaysian subjects concluded that NCV of median nerve decreases with increase in BMI but there is no effect of BMI ulnar nerve conduction velocity.<sup>[19]</sup> Some studies have also reported that there is no co- relation between BMI and NCV.<sup>[20]</sup>

Wang in a study on 445 white and 242 Asian adults, on comparison of anthropometry concluded that Asians had more subcutaneous fat than did whites and had different fat distributions from whites. Observation shows that Asians had more upper-body subcutaneous fat than did whites.<sup>[13]</sup>

Due to the different findings by researchers and to study our Indian population we tried to find out effect of obesity on subjects with no neurological complaint.

We compared the MNCV of median nerve and found significant decrease in dominant hand of healthy, pre-obese and obese subjects while there was no significant difference in MNCV of median nerve in non-dominant hand (Table 2).

We also compared the SNCV of median nerve and found significant decrease in dominant hand of healthy, pre-obese and obese subjects while there was also a significant difference in SNCV of median nerve in non-dominant hand in contrast to MNCV (Table 3).

Our findings are found to be in agreement with the findings of Awang et al who also found significant decrease in the SNCV with rise in BMI among healthy Malaysians.<sup>[19]</sup> Findings of Buschbacher et al in their study on 253 westerners were in contrast to ours and they concluded that there was no relation between BMI and NCV.<sup>[20]</sup> Possible reason behind different findings in relation of BMI & NCV of westerners and Asian population could be due to the higher distribution of fat in upper body which may produce different results in our Indian population as compared to westerners and also this fatty tissue may further cause increase in hydrostatic pressure across the carpal tunnel.<sup>[13, 17, 18]</sup>

There was no significant difference in MNCV of median nerve of non-dominant hand as non-dominant hand is less exposed to repetitive movements at wrist joint. There was significant decrease in MNCV of median nerve of dominant hand as dominant hand is more exposed to repetitive movements at wrist joint like flexion, extension,

twisting and turning might result in an increase of carpal tunnel hydrostatic pressures causing impairment of Median Nerve blood flow and leads to impaired nerve conduction.<sup>[21]</sup>

There was significant decrease in SNCV of median Nerve in different BMI groups in both dominant & non-dominant hand. Different findings in SNCV & MNCV of non-dominant hand could be due to the reason that while doing mechanized jobs non-dominant is also used although less frequently than the dominant hand this may cause increase in carpal tunnel pressure leading to earlier changes in SNCV.<sup>[22]</sup>

## CONCLUSION

We conclude that early changes of increased carpal tunnel pressure are more pronounced in dominant hand and SNCV of median nerve could be used as an early screening and diagnostic tool.

Further studies are required in our Indian population taking into consideration movements at wrist joint and other indicators of obesity also like waist to hip ratio and skin fold thickness.

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