TO STUDY THE EFFECT OF BMI ON NERVE CONDUCTION VELOCITY

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Abstracts: **Background & objectives:** Age, height and weight are the physiological factors which influence the nerve conduction velocity. Obesity is a growing public health concern and it is associated with various disorders. Body mass index (BMI) is an important parameter to measure obesity. Present study is an effort to determine relationship between nerve conduction velocity of median, ulnar and radial nerves and obesity in healthy individuals. **Methods**: In the present study the effect of Body Mass Index (BMI) on Median, Ulnar and Radial motor and sensory nerve conduction velocities of healthy individuals is compared. Standardized protocol was followed while execution nerve conduction study in all the subjects. **Results**: Comparison of NCV findings with BMI shows the values of median motor, ulnar motor, median sensory, ulnar sensory and radial sensory nerves of left hand and median motor, median sensory, ulnar sensory and radial sensory nerve conduction velocities of right hand are significantly reduced (p value < 0.05) in obese individual as compared to normal weight individuals. **Interpretation & conclusion:** The findings of our study suggest that there is significant correlation with NCV and BMI. People with higher BMI have reduction in NCV of various motor and sensory nerves. This could be due to thicker subcutaneous tissue in persons with higher BMI.

Key Words: Nerve conduction velocity, Body mass index

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Introduction: Obesity is a growing public health concern in developed and developing countries. WHO defines Obesity as a condition in which excess body fat to the extent that health and wellbeing are adversely affected. [1]

Body mass index (BMI) not a direct measure of adiposity, but it is the most widely used method to measure obesity.

Higher BMI is associated with increasing incidence of median and ulnar nerve compression. This study is an effort to establish a relationship between nerve conduction parameters and BMI. NCV is affected by changed lipid metabolism and oxidative stress associated with obesity. Increased BMI is a risk factor for carpal tunnel syndrome and neuropathy. [2]

There is also negative correlation between BMI and sensory nerve action potential amplitude [3]. Majority of the studies assessing correlation between BMI and NCV are based on Caucasian subjects. [4]

This study is designed at deriving reference data on Indian population.

Nerve conduction tests are used to confine lesions and to describe type and severity of the pathophysiologic process. Nerve conduction is affected by altered lipid metabolism, inflammation, and oxidative stress. [5, 6, 7]

Motor nerve conduction velocity (NCV) is a routine electrodiagnostic technique for distinguishing changes in nerve conduction parameters. The results in prior studies done to investigate the association between NCV and BMI are conflicting. Some studies found increased NCV with increase in BMI whereas others discovered decrease or no change in NCV with increase in BMI.

One of the studies shows decreased sensory NAP amplitude decreases with increasing BMI. [8] Another study performed on Indian defence personnel could not find any association between NCV and BMI. [9] whereas another study conducted on Type II diabetes mellitus patients concluded that body fat was positively associated with NCV of motor and sensory ulnar nerve and motor peroneal nerve and negatively associated with distal latency of sensory ulnar nerve, sensory superficial peroneal nerve, motor peroneal nerve, and motor amplitude of peroneal nerve. [10]

The results concerning NCV and body composition in some studies are inconclusive. In this study we strained to find out the correlation of BMI with median, ulnar and radial NCV in healthy individuals.

Aims and Objectives: The objective of this study is to investigate the relationship between BMI and median, ulnar and radial NCV in healthy individuals of different age groups.

Material and Methods: Two hundred fifty-one healthy subjects were recruited in this study from, B J Medical College and Civil Hospital, Ahmedabad. They were hospital staff including doctors, nurses, medical assistants and attendants. Various parameters like age, sex, height and weight of the subjects were recorded. Digital weighing machine is used for the record of weight. Height was measured by stadiometer under standard prescribed guidelines. BMI was calculated by dividing weight by height (kg/m^2).

All the subjects do not suffer from any known neuromuscular or musculoskeletal diseases.

The ethical approval for the study was obtained from the ethical committee prior to my study.

- Pre procedure assessment of the patient including history, general examination, systemic examination with all required investigations were done. Informed and written consent was taken and baseline vitals were recorded.
- The software used for this experiment is RMS EMG EPMK II, it is one of the latest software with facilities for nerve conduction velocity.

SUBJECT SELECTION

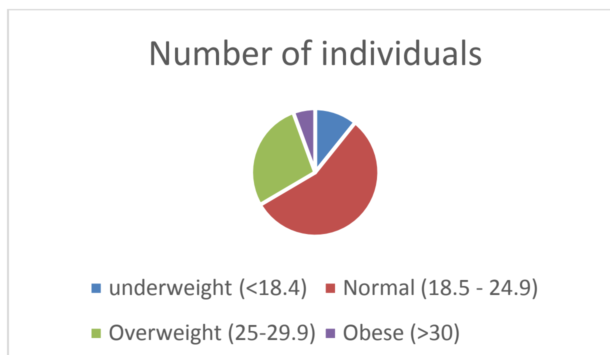
Inclusion criteria:

- Age between 10 years to 70 years
- Genders: Both
- Healthy individuals

Exclusion criteria:

- History of tobacco or alcohol consumption
- History of coronary heart diseases
- History of seizures, neuropathy, neuromuscular junction disorders and muscle disorders
- History of Leprosy, arthritis
- History of tremors, ataxia, muscle weakness, wasting of muscles
- Subject on any medication
- Presence of hypotension, valvular heart disease, pregnancy or airway obstruction
- History of Diabetes Mellitus for more than 5 years
- Presence of abnormal sensation like tingling, numbness, pain in the limbs or burning sensation
- history of injury to upper limbs, spinal cord, brain
- Presence of abnormal sensations over limbs like tingling, numbness, pain in the limbs, burning sensations
- History of familial neuromuscular disorders
- If the answer of each question is YES then subject was not included in the study. The criteria chosen to select the subjects were such that there was maximum exclusion of pathology related to disorders of the nerve which affect the measurement of nerve conduction velocity, so that nearly normal values of nerve conduction velocity were obtained.

Result: Comparison of NCV findings with BMI shows the values of median motor, ulnar motor, median sensory, ulnar sensory and radial sensory nerves of left hand and median motor, median sensory, ulnar sensory and radial sensory nerve conduction velocities of right hand are significantly reduced (p value < 0.05)



Distribution according to BMI shows 11% (27) individuals are underweight (BMI <18.4), 56% (140) individuals are of normal BMI (18.5 – 24.9), 28% (70) individuals are overweight (BMI: 25 – 29.9) and 6% (14) individuals are obese (BMI > 30)

Table – 1 Correlation of BMI and Nerve conduction velocity (Right Hand)

Nerve tested (Right Hand)	Chi-square	p Value	
Median motor	10.6009	0.004989	<0.05 significant
Ulnar motor	8.6342	0.013339	<0.05 significant
Radial motor	2.3905	0.302625	Not significant
Median sensory	6.8381	0.032744	<0.05 significant
Ulnar sensory	8.1595	0.016912	<0.05 significant
Radial sensory	8.1629	0.016883	<0.05 significant

Table – 5 B Correlation of BMI and Nerve conduction velocity (Left Hand)

Nerve tested (Left Hand)	Chi-square	p Value	
Median motor	7.433	0.024318	<0.05 significant
Ulnar motor	0.7096	0.70133	Not significant
Radial motor	1.3573	0.507304	Not significant
Median sensory	6.4891	0.038986	<0.05 significant
Ulnar sensory	15.2246	0.000494	<0.05 significant
Radial sensory	0.7028	0.703693	Not significant

Discussion:

The study shows significant reduction in conduction velocity of median motor, ulnar motor, median sensory, ulnar sensory and radial sensory nerves of left hand and median motor, median sensory, ulnar sensory and radial sensory nerve conduction velocities of right hand with increased BMI.

One of the observations has shown a predisposition towards delay or slowing in impulse transmission in nerve fibres in obese individuals in comparison to non-obese subjects, and it was proposed that obesity has some degree of detrimental influence on axonal functions.[11] One another group stated in Malaysian subjects, i.e., age and BMI can influence the conduction velocities. There is reduction in velocities of the median, ulnar (except sensory conduction), common peroneal, and sural nerves across different age and BMI groups. [12,13] Conduction current can be diminished by thicker subcutaneous tissue in obese individual which may be the reason for reduced conduction velocity and amplitude of action potential. [8]

Another reason for deleterious correlation of BMI and NCV was the inflammation or subcutaneous fat pad due to obesity causes decline of nerve function. The cause for increased NCV with higher BMI might be due to epineural fat which acts as insulator and maintains optimum temperature which is one of the most important factors affecting nerve conduction parameters. [14]

One study finding is similar with Awang MS et al [13], which revealed significant decrease in conduction velocity of median nerve with increase in BMI. The findings of this study are also in contrast with Baqai HZ et al, [15] in which there is no significant effect on BMI was observed on nerve conduction parameters.

Vessey et al. illustrated an increasing risk of developing Carpel tunnel syndrome in women with higher BMI. [16]

Kouyoumdjian et al. demonstrated in Brazilian population, that increasing BMI is correlated with a higher relative risk for evolving compressive neuropathy [17]

Werner et al. discovered that the likelihood of developing median mononeuropathy at the wrist was 2.5 times higher in obese individuals (BMI > 29) than non-obese (BMI < 20). [18]

Therefore, there is a contributory relationship between median nerve conduction parameters and increased BMI causing neuropathies. This might be due to increased hydrostatic pressure or fatty tissue within the carpal tunnel in obese individuals. [18]

The association between increased BMI and lower median sensory nerve amplitudes should be taken into account in clinical practice. Another characteristic is that the subjects with high BMI have increase in production of adipokines like plasminogen activator inhibitor-1 (PAI-1), tumour necrosis factor-alpha (TNF-α), resistin, leptin, and adiponectin [19]

Adipocytes stimulate production of reactive oxygen species initiating the process of oxidative stress. [20]

Due to increasing adiposity there is decreased activity of antioxidant enzymes such as catalase, superoxide dismutase, and glutathione peroxidase, which could be implicated in causing free radical injury. Hence to determine relationship between nerve conduction parameters and effect of adipokines and oxidative stress studies must be conducted on molecular level.

Conclusion:

The findings of our study indicate that there is significant correlation with NCV and BMI. People with higher BMI have reduction in NCV of various motor and sensory nerves.

References:

1. Deurenberg p., Deurenberg Y. M. – Ethnic and geographic influence on body composition. In: Bray GA, Bouchard C, editors, Hand book of obesity – Etiology and Pathophysiology. 2nd ed. New York: Marcel Dekker, Inc, 81 – 92, 2004
2. Landau ME, Barher KC, Campbell WW. Effect of body mass index on ulnar nerve conduction velocity, ulnar neuropathy at elbow and carpal tunnel syndrome. Muscle Nerve 2005; 32(3): 360–363.
3. Hasanzadeh P, Oveisgharan S, Sedighi N, Nafissi S. Effect of skin thickness on sensory nerve action potential amplitude. Clin Neurophysiol 2008; 119(8): 1824–1828
4. Buschbacher RM. Body mass index effect on common nerve conduction study measurements.Muscla Nerve, 1998 Nov; 21(11):1398-404
5. Bastard JP, Jardel C, Delattre J, Hainque B, Bruckert E, Oberlin F. Evidence for a link between adipose tissue interleukin-6 content and serum C-reactive protein concentrations in obese subjects. Circulation. 1999;99(16):2221-2.
6. Das UN. Obesity, metabolic syndrome X, and inflammation. Nutrition. 2002;18(5):430-2.
7. Sarvottam K, Magan D, Yadav RK, Mehta N, Mahapatra SC. Adiponectin, interleukin-6, and cardiovascular disease risk factors are modified by a short-term yoga-based lifestyle intervention in overweight and obese men. J Altern Complement Med. 2013;19(5):397-402.
8. Chadha V, Shivalkar SS. Does body mass index effect nerve conduction? A cross sectional study. Int J Curr Res Rev. 2016;8(7):4-7.
9. Nair DS, Dubey DK. Obesity affects median nerve conduction-a study in armed forces individuals. Indian Med Gaz. 2012;145(5):181-5.
10. Ting GU, Jiang BR, Ren RL, Lu YL, Qiao J. Correlation between body composition and nerve conduction velocity in patients with Type 2 diabetes mellitus. J Shanghai Jiaotong Univ Med Sci. 2013;33(6):827
11. Naik BM, Pal P, Pal GK, Balakumar B, Dutta TK. Assessment of motor nerve conduction in healthy obese Indian population. Int J Clin Exp Physiol. 2014;1(4):277-82

12. Cinar N, Sahin S, Sahin M, Okluoglu T, Karsidag S. Effect of anthropometric factors on nerve conduction. An electrophysiologic study of feet. J Am Podiatr Med Assoc. 2013;103(1):43-9
13. Awang MS, Abdullah JM, Abdullah MR, Tharkan J, Prasad A, Hussin AM, et al. Nerve conduction velocity among healthy Malays. The influence of age, height and body mass index on median, ulnar, common peroneal and sural nerves. Malays J Med Sci. 2006;13(2):19-23
14. Pawar SM, Taksande AB, Singh R. Effect of body mass index on parameters of nerve conduction study in Indian population. Indian J Physiol Pharmacol. 2012;56(1):88-93.
15. Baqai HZ, Tariq M, Din AMU, Khawaja I, Irshad M. Sural nerve conduction; Age related variation studies in our normal population. The Professional 2001; 08(04): 439–444.
16. Vessey MP, Villard-Mackintosh L, Yeates D. Epidemiology of carpal tunnel syndrome in women of childbearing age:findings in a large cohort study. Int J Epidemiol 1990; 19:655-659.
17. Joao Aris Kouyoumdjian, Maria Da Penha Ananias Morita, Paulo Ricardo Fernando Rocha, Rafael Carlos Miranda, Gustavo Maciel Gouveia. Body Mass Index and Carpal Tunnel Syndrome. Arq Neuropsiquiatr 2000;58(2-A):252-256
18. Werner RA, Albers JW, Franzblau A, Armstrong TJ. The relationship between body mass index and the diagnosis of carpal tunnel syndrome. Muscle Nerve 1994; 17:632-636.
19. Fonseca-Alaniz, M.H.; Takada, J.; Alonso-Vale, M.I.; Lima, F.B. Adipose tissue as an endocrine organ: From theory to practice. J. Pediatr. 2007, 83 (Suppl. 5), S192–S203.
20. Alba Fernandez-Sanchez, Eduardo Madrigal-Santillan, Mirandeli Bautista, Jaime Esquivel-Soto, Angel Morales-Gonzalez, Cesar Esquivel-Chirino, Irene Durante-Montiel, Graciela Sanchez-Rivera, Carmen Valadez-Vega and Jose A. MoralesGonzalez. Inflammation, Oxidative Stress, and Obesity. Int. J. Mol. Sci. 2011, 12, 3117-3132.

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