Original Article

Effect of BMI on Nerve Conduction Velocities Among Healthy Individuals

BMI on Nerve Conduction Velocities

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ABSTRACT

Objective: To evaluate the influence of BMI on Nerve Conduction Velocity (NCV), particularly in the peripheral sensory (ulnar) and motor (ulnar and peroneal) nerves of the upper and lower limbs among healthy individuals. As we know NCV is affected even by physiological factors.

Study Design: Cross-sectional study

Place and Duration of Study: This study was conducted at the Physiology department of Baqai Medical University, Karachi from January 2017 to July 2017.

Materials and Methods: Subjects included in this study were 500 healthy adult male and females of Gadap town, Karachi, age ranges between 18-45years. Power Lab was used to record the NCV after stimulation of ulnar and peroneal nerve at wrist and at lateral aspect of knee respectively. Obtained data and basic parametric values were calculated by using the 'Statistical package for Social science' (SPSS) software version 22.0.

Results: Results showed that, Ulnar sensory nerve have highest mean in obese class, than in overweight and among underweight samples, (p=< 0.01). It showed that, there were significant mean differences in ulnar sensory nerve with respect to BMI, Ulnar motor nerve were also found higher among obese class samples but these results were statistically insignificant, Peroneal motor nerves gave high mean among normal BMI samples, and underweight samples, these results were found statistically significant (p=<0.02).

Conclusion: The study showed inverse relationship of ulnar sensory, ulnar motor and peroneal motor nerve conduction velocity with body mass index (BMI).

Key Words: Nerve conduction velocity (NCV), BMI = Body mass index & Statistical package for social sciences (SPSS).

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INTRODUCTION

Nerve conduction study (NCS) is a test that commonly used to evaluate the patency of a nerve by examining the capacity of human motor and sensory nerves to conduct electricity. [1] In order to gauge how quickly electrical impulses travel through a nerve, nerve conduction velocity (NCV) tests are frequently conducted. [2] It is found to be a major tool in diagnosis of any damage or destruction that occurred in peripheral nerves.

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NCS is influenced by a number of factors, including age, gender, temperature, BMI, the proportion of upper to lower extremities, and a number of physiological factors, including the nerve's diameter, myelination, and internodal distance. As a result, there is no global standard reference value for any given nerve that can be taken into account due to climate variations around the world. As a result, various areas and laboratories utilize their own standard reference values. [3,4] By observing the generated response to electrical stimulation of the peripheral nerves, NCS is a crucial method for estimating peripheral nerve functioning.[5] Nerve impulses can be triggered by enough stimulation from an electrical stimulator. Electrical impulses will propagate at a rate of 100 m/s after a nerve fiber's action potential threshold is reached, albeit the velocity of the impulse varies depending on the diameter of the fiber, the degree of myelination of the nerve, and the temperature. [6,7] Conduction velocity and latency are NCS parameters that measure the speed of nerve impulse propagation. Any condition that results in demyelination of the nerve affects the conduction capacity of both the motor and sensory nerves.

Amplitude, which measures the quantity of active nerve fibers, is diminished under conditions that lead to axonal degeneration. [8]

The evoked response to electrical stimulation of peripheral nerves, which helps in determining the extent and distribution of the neuronal lesion and provides a measure of the degree of nerve damage by which demyelination and axonal degeneration can be distinguished between two major peripheral nerves, is recorded using the NCV, which is regarded as the gold standard in clinical assessment of motor and sensory functions. [9] The locations of the stimulation and recording sites as well as the distances between these locations are clearly described in normative papers. [10]

NCV has been used clinically for many years to determine the precise location and extent of the lesion in a single nerve and for differentiating disorders of the muscles and the neuromuscular junctions. It not only aids in localizing the sites of the lesions but also allows us to accurately characterize the functions of the peripheral nerves.[8,11] Poor physical function, which can result in diminished mobility, impairment, hospitalization, and mortality, is a result of poor strength in old age. Given its significant significance, it is imperative to look at the risk factors for deteriorating strength in older persons. Power Lab is the instrument utilized in the investigation. It is a piece of HTML-based software that manages experimental data sampling, digitization, and storage while enabling data editing and analysis.[4] Nerve conduction studies (NCS) can be used to assess the health and function of peripheral nerves. Demyelination and axonal degeneration are the two main kinds of peripheral nerve illnesses that are distinguished by NCS, which aids in determining the degree and distribution of neural lesions. [1] The procedures have been improved and standardized, making NCV a reliable test in clinical settings.

MATERIALS AND METHODS

This study was conducted in the Department of Physiology at Baqai Medical University, Karachi, from January 2017 to July 2017 utilising a comparative cross-sectional, analytical method using a non-invasive Power Lab 8/30 series with dual Bio-amplifier (AD Instruments Australia, Model No. ML870). The Baqai Medical University Ethical Committee gave their approval for this investigation. 500 local Gadap town inhabitants were the 500 subjects who were a part of this investigation.

Sample Technique: The sampling method used was practical sampling.

Electrophysiological Methods: The Power Lab, multichannel recording equipment for measuring electrical signals, was used for all of the testing. It features two-channel Bio-amplifiers for the best biological signal recording as well as an isolated stimulator for electrical stimulation of nerves and muscle. [4,10,11] Instead of using anatomical landmarks for near-nerve recording, the NDTF advises using the orthodromic technique, which involves conventional fixed distances and precise electrode placement. [13]

Analysis:

1. Two points A & B were marked at a measured distance between the elbow and the wrist, the stimulation, and the recording site.
2. The conduction velocities were obtained by stimulating the nerve at two different points at least 10 cm apart between marks A & B.
3. Conduction velocities were calculated by dividing the difference of latencies of two stimulating point by the distance between the stimulating and recording site (mark A & B), expressed in meters per second.
4. The peroneal nerve recording procedure was carried out using the same techniques as described before.
5. Enter the value of the latency in the table.
6. Onset latency or latency 2 (proximal) - latency 1 (distal) (m/sec).
7. The following formula was used to determine the nerve conduction velocity, which was given in meter/second;

$$\text{Velocity} = \frac{\text{Distance between stimulation sites (mm)}}{\text{Difference between latencies (m/sec.)}}$$

To convert mm into m, divided the value from 1000. Similarly for tenth of second, multiplied with 10.

RESULTS

Table No.1: Age and BMI distribution in males and females

Characteristics	Males (n=250) Mean ± SD	Female (n=250) Mean ± SD	p-Value
Age (Years)	31.04±2.48	29.70±3.39	0.0001
BMI Normal (18.5-24.9) Kg/m^2	21.8±1.76	22.2±1.79	0.012
BMI Underweight (<18.5) Kg/m^2	16.9±0.92	16.91±1.44	0.92
BMI Overweight (25-29) Kg/m^2	26.4±1.17	26.83±1.34	0.0001
BMI Obese (30-40) Kg/m^2	32.03±1.4	31.33±1.05	0.001

P<0.05 significant
P>0.05 non-significant

Table No.2: Mean Comparison of Nerves Responses with BMI

Nerve(s)	BMI CATEGORIZATION				p-value
	Normal (A)	Underweight (B)	Overweight (C)	Obese Class-I (D)	
	Mean ± SD	Mean ±SD	Mean ±SD	Mean ±SD	
Ulnar Sensory Nerve	55.99 ± 3.91	54.29 ±2.05	57 ± 4.3	58 ± 5.63	<0.01*
Ulnar Motor Nerve	54.13 ± 5.8	54.69 ±6.78	55.76 ± 6.19	57.1 ± 6.93	0.05
Peroneal Motor Nerve	48.72 ±4.2	50.2 ±4.57	48.12 ± 3.93	47.55 ± 4.99	0.02*

*p<0.05 was considered significant using ONE WAY ANOVA

DISCUSSION

Peripheral nerves are an excellent location to test nerve conduction velocities (NCVs). Nerve impulses can be triggered by enough stimulation from an electrical stimulator. A nerve fiber's electrical impulses will spread at a rate of 100 meters per second if the action potential threshold is crossed. [11] The velocity is a direct function of the myelination and fiber diameter.[12] In the past, numerous studies were conducted to assess the impact of body mass index on nerve speeds.[13] However, the majority of these studies were based on populations in the west. Therefore, the purpose of this study was to investigate how BMI affected the NCVs of the ulnar sensory, ulnar motor, and peroneal motor nerves in the local Gadap Town population.

The crucial technique of nerve conduction studies, which has received extensive validation, is employed in clinical practice.[14] Numerous investigations and reviews on nerve conduction studies that take into account the variables influencing nerve velocities have already been published. These variables were separated into biological variables (such as age, height, and gender) and physical variables that have an impact on the health of the nerve and the muscle.[15] We concentrated on the impact of BMI, one of the biological determinants, on NCV. As advised by the majority of neurophysiology laboratories, factors like temperature were maintained constant to limit findings variability.

A study was conducted[16] to ascertain the impact of BMI on NCV. The researcher came to the conclusion that there was no relationship between NCV plus H reflex latency and BMI. We observed a slowing of NCVs across various BMI categories.[17].

CONCLUSION

In summary, BMI can have an impact on conduction velocities. We noticed a slowing down of the typical motor peroneal nerves' speeds. There was a statistically significant decrease in Nerve Conduction Velocities with increasing BMI. The opposite outcome of the weaker sensory nerve is caused by other factors, such as age and gender, whose discussion is outside the scope of this article.

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Author's Contribution:

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Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

1. Kim JY, Kim E, Shim HS, Lee JH, Lee GJ, Kim K, et al. Reference Standards for Nerve Conduction Studies of Individual Nerves of Lower Extremity With Expanded Uncertainty in Healthy Korean Adults. Annals Rehabilitation Med 2022;46(1):9.
2. Munawar F, Haq F, Ishaq N, Bhatti T. Study of Nerve Conduction Velocity in non-diabetic and type II diabetic individuals. Biomedica 2016; 32(4):253.
3. Chouhan S. Normal Motor and Sensory Nerve Conduction Velocity of Radial Nerve in Young Adult Medical Students. J Clin Diagnostic Research : JCDR 2016;10(1):CC01.
4. Bennal AS, Pattar MY, Taklikar RH. Effect of Height and BMI on Nerve Conduction Velocity. Ind J Clin Anatomy Physiol 2015;2(4):231-4.
5. Kumari SK, Kannan U, Patil AB. Influence of age, height, gender on median and ulnar nerve conduction study. National J Physiology, Pharmacy Pharmacol 2018;8(2):202-6.
6. National Institute of Neurological Disorders and Stroke. Peripheral Neuropathy Fact Sheet.2012. Accessed February, 2013.
7. Pawar SM, Taksande AB, Singh R. Normative data of upper limb nerve conduction in Central India. Ind J Physiol Pharmacol 2011;55(3):241.
8. Benatar M, Wuu J, Peng L. Reference data for commonly used sensory and motor nerve conduction studies. Muscle Nerve 2009;40: 772–794.

9. Dillingham T, Chen S, Andary M, Buschbacher R, Del Toro D, Smith B, et al. Establishing high quality reference values for nerve conduction studies: a report from the Normative Data Task Force of the AANEM. Muscle Nerve 2016.
10. Chen S, Andary M, Buschbacher R, Toro DD, Smith B, So Y, et al. Electrodiagnostic reference values for upper and lower Limb nerve conduction studies in adult populations. Muscle Nerve 2016; 54:371–377.
11. Amato AA, Barohn RJ. Peripheral Neuropathy. In: Longo DL, Fauci AS, Kasper DL,Hauser SL, Jameson JL, Loscalzo JL, editors. Harrison's Principles of Internal Medicine.18th ed. New York: Mc Graw-Hills;2012.p.3448-86.
12. Lee HJ, Delisa JA. Manual of Nerve Conduction Study and Surface Anatomy of Needle Electromyography. 4th ed. Philadelphia: Lippincott Williams & Wilkins; 2009.p.16.
13. Saeed S, Akram M. Impact of anthropmetric measures on sural nerve conduction in healthy subjects. J Ayub Med Coll Abbottabad 2008;20(4): 112-4.
14. Garg R, Bansal N, Kaur H, Arora KS. Nerve conduction studies in upper limb in Malwa Region-Normative Data. J Clin Diagnostic Res 2013;7(2): 201-204.
15. Franceschi C, Garagnani P, Morsiani C, Conte M, Santoro A, Grignolio A, et al. The continuum of aging and age-related diseases: common mechanisms but different rates. Frontiers Med 2018;5:61
16. Hamdan FB. Nerve Conduction Studies in Healthy Iraqis: Normative Data. Iraqi J Med Sci 2009;7(2): 75-92.
17. Pawar SM, Taksande AB, Singh R. Normative data of upper limb nerve conduction in Central India. Ind J Physiol Pharmacol 2011;55(3):241-45.