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TO DETERMINE THE ASSOCIATION BETWEEN BODY MASS INDEX AND NERVE CONDUCTION VELOCITY IN HEALTHY YOUNG ADULTS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Nerve conduction velocity (NCV) is an important electrophysiological parameter used to assess peripheral nerve function. Several physiological and anthropometric factors can influence nerve conduction parameters, among which body mass index (BMI) has gained increasing attention. Understanding the relationship between BMI and NCV is important for accurate interpretation of nerve conduction studies and establishment of reference values. **Objective:** To evaluate the association between body mass index and nerve conduction velocity among healthy young adults.
Materials and Methods: A cross-sectional study was conducted among 75 healthy young adults aged 18–25 years. Participants were recruited using convenience sampling after screening for eligibility. Anthropometric measurements including height, weight, and BMI were recorded using standardized methods. BMI was categorized according to Asian classification criteria. Nerve conduction studies were performed using a standard electromyography and nerve conduction velocity machine under controlled laboratory conditions.
Results: BMI showed a significant positive correlation with sensory nerve conduction velocity (r=0.302, p=0.009) and motor nerve conduction velocity (r=0.278, p=0.017). Height demonstrated a weak but significant negative correlation with both sensory and motor conduction velocities. Underweight participants showed lower conduction velocity values compared with participants having normal and higher BMI categories.
Conclusion: BMI demonstrated a significant association with nerve conduction velocity among healthy young adults. These findings suggest that anthropometric characteristics may influence peripheral nerve electrophysiological parameters and should be considered during interpretation of nerve conduction studies.
Keywords: Body mass index; Nerve conduction velocity; Healthy young adults; Anthropometry; Peripheral nerve function.

INTRODUCTION

Body mass index (BMI) is a widely used anthropometric measure that reflects body composition and nutritional status. It has been associated with various physiological and metabolic changes that can influence multiple body systems, including the nervous system. Peripheral nerve function can be objectively assessed using nerve conduction studies (NCS), which evaluate the functional integrity of nerves through parameters such as latency, amplitude, and nerve conduction velocity (NCV). Among these, NCV represents the speed at which electrical impulses travel through nerve fibers and serves as an important indicator of neural function and health.[1]

Nerve conduction studies are sensitive, reliable, and non-invasive tools commonly used for evaluating peripheral nerve function. They can detect subtle physiological changes even before symptoms become clinically evident.[2] These studies assess sensory nerve action potentials (SNAPs) and compound muscle action potentials (CMAPs), providing quantitative information regarding nerve physiology. Various factors influence nerve conduction parameters, including axonal diameter, myelin thickness, temperature, metabolic state, and individual anthropometric characteristics.[1]

Among the peripheral nerves, the median nerve is frequently studied because of its important role in sensory and motor functions of the hand and its clinical relevance in nerve entrapment conditions.[3] It supplies sensation to the thumb, index finger, middle finger, and radial half of the ring finger while also innervating important thenar muscles involved in fine hand movements.[4] Even minor alterations in median nerve function may affect dexterity and hand performance, making its electrophysiological assessment clinically significant.

Previous studies have shown that nerve conduction parameters are influenced by demographic and anthropometric factors such as age, sex, height, hand dominance, and body mass index.[5] Therefore, understanding the relationship between BMI and NCV is important for proper interpretation of electrophysiological findings and for establishing appropriate reference standards.

BMI has gained attention as a factor that may influence peripheral nerve function because it reflects body composition and nutritional status. Increased BMI may affect nerve conduction through several possible mechanisms. Excess body fat can alter metabolic processes, increase inflammatory activity, and affect vascular supply to peripheral nerves. In addition, greater subcutaneous tissue thickness may influence electrode placement and recording characteristics during electrophysiological testing. On the other hand, lower BMI may also influence nerve physiology through nutritional deficiencies or reduced physiological reserves. Therefore, variations in BMI may potentially influence nerve conduction characteristics.[6]

Several studies have investigated the relationship between BMI and nerve conduction parameters. Some researchers have reported that higher BMI is associated with changes in latency, amplitude, and slower nerve conduction velocity. Possible explanations include increased adipose tissue, altered metabolic activity, and physiological changes affecting neural transmission. However, findings remain inconsistent across studies. While some authors have demonstrated an inverse relationship between BMI and NCV, others have reported weak or statistically insignificant associations.[6,7]

The differences in findings may be explained by variations in study populations, methodologies, age groups, sample sizes, and the presence of confounding factors. Many previous studies have included heterogeneous populations or individuals with medical conditions that may independently affect nerve function. Therefore, findings from these studies may not accurately represent healthy young adults.[8]

Young adults constitute an ideal population for studying the association between BMI and NCV because they are less likely to have age-related neurological changes or chronic illnesses that could influence nerve conduction measurements. Establishing baseline electrophysiological data in healthy individuals may improve understanding of normal physiological variations and help clinicians distinguish normal changes from pathological findings.[9]

Despite increasing interest in anthropometric influences on nerve conduction studies, limited data are available regarding the association between BMI and NCV in healthy young adults. Existing evidence remains inconsistent and highlights the need for further studies using standardized methodologies. Therefore, evaluating the association between BMI and nerve conduction velocity in healthy young adults may provide valuable insights into peripheral nerve physiology and improve the interpretation of electrophysiological parameters.

MATERIALS AND METHODS

Study Design and Setting: The present study was conducted as a cross-sectional study among healthy young adults to evaluate the association between body mass index (BMI) and nerve conduction velocity (NCV). The study was carried out over a period of six months in the Research Laboratory, Department of Medicine, Government Doon Medical College and Doon Hospital, Dehradun. Ethical approval was obtained from the Institutional Ethics Committee before initiation of the study, and the study was conducted according to the ethical principles of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrolment.

Study Population and Sample Size: The study population consisted of healthy young adults aged 18–25 years recruited from undergraduate students and staff members of Government Doon Medical College. A total of 75 participants were included using convenience sampling after screening for eligibility through detailed history and clinical evaluation.

Inclusion and Exclusion Criteria: Individuals aged 18–25 years who were willing to participate and provide written informed consent were included in the study. Participants with a history of peripheral neuropathy, diabetes mellitus, hypothyroidism, smoking, alcohol consumption, chronic systemic illness, or long-term use of medications known to affect nerve function were excluded. Individuals with conditions that could influence electrophysiological measurements were also excluded.

Data Collection and Anthropometric Measurements: Data were collected using a structured and predesigned proforma that included demographic details and anthropometric measurements. Age and gender were recorded for all participants. Height was measured using a standardized stadiometer with participants standing barefoot in erect posture and recorded in centimeters. Weight was measured using a calibrated digital weighing scale and recorded in kilograms.

Body Mass Index Assessment: Body mass index was calculated using the formula: BMI = Weight (kg) / Height (m²). BMI was classified according to Asian BMI criteria as underweight (<18.5 kg/m²), normal (18.5–22.9 kg/m²), overweight (23–24.9 kg/m²), and obese (≥25 kg/m²).

Nerve Conduction Study Procedure: Sensory and motor conduction velocity of median and ulnar nerve of both upper limbs was recorded in resting conditions before exposure to the mobile phone for a duration of 30 minutes. Sensory and motor conduction velocity of median and ulnar nerve of both upper limbs and baseline parameters were again recorded after the exposure.

For median nerve motor conduction: Active electrode was placed over the abductor pollicis brevis. Reference electrode was placed over the proximal phalanx of thumb, ground electrode over the dorsum of hand. Stimulation 1 was given 6-8 centimeters proximal to the active electrode over the median nerve between the flexor carpi radialis and palmaris longus tendon, stimulation 2 was given over the brachial pulse. Sensory conduction- Active electrode was placed at proximal interphalangeal joint of second digit, reference electrode was placed at the distal phalanx of second digit, ground electrode was placed over the dorsum of hand. Stimulation was given 13 cm proximal from ground electrode over the median nerve between flexor carpi radialis and palmaris longus tendon.

For ulnar nerve motor conduction: active electrode was placed over the belly of abductor digiti minimi muscle, reference electrode was placed at the base of lateral aspect of fifth digit, ground electrode was placed over the dorsum of hand. Simulation 1 was given medial to flexor carpi ulnar tendon, stimulation 2 was given at ulnar groove of elbow. Sensory conduction- active electrode was placed at the base of fifth digit, Reference electrode was placed 3-4 centimeter proximal to the active electrode, ground electrode was placed over the dorsum of hand. Stimulation 1 was given on the medial aspect of wrist, 11 centimeters proximal to the active electrode over the ulnar nerve.

Supramaximal electrical stimulation was delivered to obtain consistent responses. Parameters recorded included distal latency, compound muscle action potential (CMAP) amplitude, and motor nerve conduction velocity. Both dominant and non-dominant upper limbs were examined in all participants. Two consecutive recordings were obtained for each nerve, and the average value was taken for analysis.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using statistical software. Continuous variables were expressed as mean ± standard deviation. The association between BMI and nerve conduction velocity was assessed using Pearson's correlation coefficient. Comparisons between BMI categories were performed using appropriate statistical tests. A p-value of <0.05 was considered statistically significant.

RESULTS

The study included 75 healthy young adults, comprising 42 males and 33 females. The overall mean age of participants was 19.4 ± 1.2 years. Male participants had significantly greater height (172.4 ± 6.8 cm vs. 158.9 ± 5.2 cm; p<0.001) and body weight (65.8 ± 8.1 kg vs. 54.3 ± 6.7 kg; p<0.001) compared to females. Mean BMI was also significantly higher among males (22.1 ± 2.2 kg/m²) than females (21.0 ± 2.5 kg/m²; p=0.035). [Table 1]

Table 1: Baseline Demographic and Anthropometric Characteristics of Study Participants (N=75)

Characteristic	Male (n=42)	Female (n=33)	Total (N=75)	p-value
Age (years)	19.6 ± 1.3	19.1 ± 1.0	19.4 ± 1.2	0.078
Height (cm)	172.4 ± 6.8	158.9 ± 5.2	166.3 ± 8.5	<0.001*
Weight (kg)	65.8 ± 8.1	54.3 ± 6.7	60.7 ± 9.4	<0.001*
BMI (kg/m²)	22.1 ± 2.2	21.0 ± 2.5	21.6 ± 2.4	0.035*

Median sensory conduction velocity was 58.7 ± 4.2 m/s in the dominant limb and 59.1 ± 4.0 m/s in the non-dominant limb (p=0.412). Median motor conduction velocity was 56.3 ± 3.8 m/s and 56.8 ± 3.6 m/s respectively (p=0.336). Similar findings were observed for ulnar sensory and motor parameters. Distal latency and amplitude values were also comparable between limbs. [Table 2]

Table 2: Baseline Nerve Conduction Parameters in Dominant and Non-Dominant Limbs

Nerve Parameter	Dominant Limb (Mean ± SD)	Non-Dominant Limb (Mean ± SD)	p-value
Median Sensory CV (m/s)	58.7 ± 4.2	59.1 ± 4.0	0.412
Median Motor CV (m/s)	56.3 ± 3.8	56.8 ± 3.6	0.336
Ulnar Sensory CV (m/s)	60.2 ± 4.5	60.5 ± 4.3	0.605
Ulnar Motor CV (m/s)	58.1 ± 3.9	58.4 ± 3.7	0.569

Pearson correlation analysis demonstrated that age was not significantly associated with sensory or motor conduction velocity. Height showed a weak negative correlation with sensory conduction velocity (r = −0.254, p=0.029) and motor conduction velocity (r = −0.231, p=0.047). Weight did not demonstrate significant correlations with conduction parameters. BMI showed a statistically significant positive correlation with sensory conduction velocity (r=0.302, p=0.009) and motor conduction velocity (r=0.278, p=0.017), indicating that increasing BMI was associated with higher nerve conduction velocities among healthy young adults. [Table 3]

Table 3: Correlation Between Anthropometric Parameters and Baseline Nerve Conduction Velocity

Anthropometric Parameter	Correlation with Sensory CV (r)	p-value	Correlation with Motor CV (r)	p-value
Age (years)	0.112	0.342	0.098	0.406
Height (cm)	−0.254	0.029*	−0.231	0.047*
Weight (kg)	0.087	0.460	0.104	0.375
BMI (kg/m²)	0.302	0.009*	0.278	0.017*

Participants were categorized according to BMI using Asian classification criteria. Underweight participants (n=11) demonstrated a mean sensory conduction velocity reduction of −4.68 ± 1.05 m/s, while participants with normal BMI (n=49) showed a reduction of −3.45 ± 1.12 m/s. Overweight participants (n=15) demonstrated a smaller reduction of −2.89 ± 1.08 m/s. Compared with normal BMI participants, underweight individuals showed statistically significant differences (p=0.021), whereas differences in overweight individuals did not reach statistical significance (p=0.185). These findings suggest that BMI may influence nerve conduction characteristics among healthy young adults. [Table 4]

Table 4: Association Between BMI Categories and Nerve Conduction Velocity

BMI Category (kg/m²)	n	Mean Sensory CV Change (m/s)	p-value
Underweight (<18.5)	11	−4.68 ± 1.05	0.021*
Normal (18.5–22.9)	49	−3.45 ± 1.12	Reference
Overweight (≥23)	15	−2.89 ± 1.08	0.185

DISCUSSION

The present study was conducted to evaluate the association between body mass index (BMI) and nerve conduction velocity (NCV) in healthy young adults. Nerve conduction parameters are influenced by several physiological and anthropometric factors, and understanding these relationships is important for accurate interpretation of electrophysiological findings. Among these variables, BMI has received increasing attention because body composition and nutritional status may influence peripheral nerve function through metabolic, structural, and physiological mechanisms. The present study therefore aimed to examine the relationship between BMI and nerve conduction characteristics in a young and otherwise healthy population.

The study included 75 healthy participants, of whom 42 (56.0%) were males and 33 (44.0%) were females. The overall mean age was 19.4 ± 1.2 years. Male participants had significantly greater height, body weight, and BMI compared to females. Similar demographic findings have been reported by Dabla and Singh (2016), who observed a mean age of 22.5 ± 3.1 years and BMI of 23.1 ± 2.7 kg/m² in a young adult population, showing a generally comparable anthropometric profile.[10] Differences in anthropometric characteristics between males and females are expected and may contribute to variations in electrophysiological parameters.

The present study demonstrated no significant differences in baseline nerve conduction parameters between dominant and non-dominant limbs. Median sensory conduction velocity was approximately 58–59 m/s, whereas median motor conduction velocity was around 56 m/s. Conduction velocity of Ulnar sensory and motor was close to 60 m/s and 58 m/s respectively. Similar values have been reported in normative studies from Indian populations. Pawar et al. (2011) reported median sensory conduction velocity values of approximately 57.6 ± 4.5 m/s and motor conduction velocity values of 55.8 ± 3.9 m/s.[11] Naseem et al. (2016) also observed comparable motor conduction velocities among healthy individuals.[12] These findings suggest that the study population exhibited normal electrophysiological characteristics and provide confidence regarding the validity of the measurements.

Limb dominance did not significantly influence baseline conduction parameters in the present study. Similar findings have been reported by Bhorania and Ichaporia (2009), who found no substantial differences in motor conduction velocity between dominant and non-dominant limbs.[13] Joshi and Joshi (2019) also observed comparable sensory conduction parameters between limbs.[14] These observations suggest that nerve conduction properties in healthy individuals generally remain symmetrical and are not significantly altered by hand dominance.

The major finding of the present study was the significant positive correlation between BMI and nerve conduction velocity. BMI showed a positive association with sensory conduction velocity (r = 0.302, p = 0.009) as well as motor conduction velocity (r = 0.278, p = 0.017). These findings indicate that individuals with higher BMI values demonstrated relatively greater conduction velocities compared with those having lower BMI values. Similar observations have been reported in previous electrophysiological studies evaluating anthropometric influences on nerve conduction parameters. Robinson et al. (1993) described important associations between body measurements and nerve conduction characteristics.[15] Jagga et al. (2011) also reported significant relationships between anthropometric variables and electrophysiological findings.[16]

The study also found a weak negative correlation between height and both sensory and motor conduction velocity. Height showed correlation coefficients of r = −0.254 and r = −0.231 for sensory and motor conduction velocity respectively. These findings are consistent with the observations of Stetson et al. (1992), who reported slowing of nerve conduction velocity with increasing height due to longer conduction pathways and greater nerve length.[17] Similar relationships have been described in other normative electrophysiological studies.[15]

BMI category analysis provided additional support for the association between body composition and nerve conduction characteristics. Underweight participants demonstrated lower conduction velocity values compared with participants having normal or higher BMI values. The reduction was more pronounced among underweight individuals and reached statistical significance. Similar observations have been reported by Stetson et al. (1992), Robinson et al. (1993), and Jagga et al. (2011), who suggested that body composition may influence nerve electrophysiological properties.[15-17]

Several mechanisms may explain the association between BMI and nerve conduction velocity observed in the present study. Individuals with lower BMI may have reduced physiological reserves and altered nutritional status, which could affect myelination and nerve function. On the other hand, body composition may influence tissue characteristics surrounding nerves and alter physiological conduction properties. Metabolic and structural factors associated with body mass may therefore contribute to variations in electrophysiological measurements.[18]

The findings of the present study emphasize the importance of considering anthropometric variables while interpreting nerve conduction studies. Since BMI appears to influence NCV values, establishing reference ranges without accounting for body composition may lead to inaccurate interpretation. Recognition of such physiological variations can improve diagnostic accuracy and contribute to more individualized assessment of peripheral nerve function.

Overall, the present study demonstrated that BMI was significantly associated with nerve conduction velocity among healthy young adults. These findings support previous evidence indicating that anthropometric factors influence peripheral nerve electrophysiology and highlight the importance of considering BMI during interpretation of nerve conduction parameters. Further studies involving larger populations and broader BMI ranges may help clarify the physiological mechanisms underlying this association.

CONCLUSION

The present study demonstrated a significant association between body mass index (BMI) and nerve conduction velocity (NCV) among healthy young adults. BMI showed a positive correlation with both sensory and motor nerve conduction velocities, suggesting that anthropometric characteristics may influence peripheral nerve electrophysiological parameters. Height exhibited a weak negative association with conduction velocity, while no significant relationship was observed with age or body weight. Baseline nerve conduction parameters remained comparable between dominant and non-dominant limbs, indicating symmetrical nerve function in healthy individuals. The findings emphasize that BMI should be considered while interpreting nerve conduction studies, as body composition may contribute to physiological variations in electrophysiological measurements. The internal validity is enhanced by study because the methodology of NCV measurement is standardized, making the measurement of the NCV reliable and comparable to the existing literature. Controlled environment (temperature, electrode placement, instrumentation) improves internal validity. The results of the study need to be supported by larger sample size and multicentric studies in different populations to enhance the generalizability of the results and to improve the statistical power and external validity.

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