# IMPACT OF DIFFERENT AGE GROUPS ON NERVE CONDUCTION VELOCITY IN HEALTHY INDIVIDUALS: A CROSS-SECTIONAL STUDY

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**Author's Contribution:**
S.A. and H.S. designed the model and the computational framework and analyzed the data. H.M. and U.N. carried out the implementation. H.A. performed the calculations. R.N. and H.S. wrote the manuscript with input from all authors. H.M. and U.N. conceived the study and were in charge of overall direction and planning.

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## ABSTRACT:

**Background:**

Nerve conduction studies are used to evaluate peripheral nervous system diseases. The NCV is affected by biological variables such as age, temperature, height, and gender. Moreover, very few studies have been conducted to determine the age groups in which these variations become noticeable.

**Aim and Objectives:**

The goal of the research was to collect electrophysiological data from various age groups to determine when variations in nerve conduction velocity occur.

**Methodology:**

The study groups were divided into five age groups: Group A (18-23 years), Group B (24-29 years), Group C (30-35 years), Group D (36-40 years), and Group E (41-45 years). There were 250 male participants and 250 female participants. The NCVs of the ulnar (motor and sensory) and common peroneal nerves were determined (motor component).

**Results:**

The mean and standard deviation of ulnar velocities for both sensory and motor components, as well as peroneal motor nerves, were investigated. Patients who were older had slower conduction velocities than those who were younger.

**Conclusion:**

Conduction velocities in various peripheral nerves can be affected by age.

## INTRODUCTION:

Nerve conduction study (NCS) is the measure of electrical activity of the motor and sensory nerves that aids in determining the location of the lesion. Peripheral nerves are used most commonly to measure nerve conduction velocities (NCVs)(1). Nerve conduction studies (NCS) are used to diagnose peripheral nervous system diseases. These allow healthcare providers to distinguish between the two primary types of peripheral diseases: demyelination and axonal degeneration (2).

Nerve impulses are triggered by the electrical stimulation. Once a nerve fiber's action potential threshold is achieved, its electrical activity distribute at a rate of hundreds of meters per second (3). The velocity is proportional to the diameter of the myelinated fibers and the temperature (4).

Nerve damage and destruction can be determined using NCS. A variety of physiological factors affect it, such as age, gender, temperature, BMI, upper limb versus lower limb, and variables such as nerve diameter, myelination, and inter-nodal distance (5).

It is commonly recognized that age has an effect on nerve velocity. The process of aging that is frequently accompanied by modifications such as slower muscle contractions, changes in muscle metabolic activities and neuromuscular junction, and a decrease in NCV(6). According to research, motor and sensory conduction velocities in newborns were 40% to 50% of adult values, and at three years of age, average range for all motor and sensory nerve conduction velocity were in the adult range (7). According to Awang et al., the decline in conduction velocity to age is not particularly substantial. Although, accepted that ageing alters nerve conduction however, the age range in which these change happens is not clearly defined (2).

The ulnar nerve is the most vital nerve in the upper limb. It is in control of the hand's movements as well as sensation. Trapping of this nerve will result in a reduction in these modalities, as in carpal tunnel syndrome. Moreover, the nerve most widely researched in the lower limbs is the peroneal nerve. It supply a few of the lower extremity and cutaneous sensation(8).

Numerous studies have been conducted to assess the impact of personal characteristics such as age, height, and body mass index on nerve velocities. The majority of these researches, however, are focused on Caucasian participants.

## MATERIALS AND METHOD:

The study was conducted in the Department of Physiology at Baqai Medical University, Karachi, between January to July 2017 using a non-invasive method of Power-lab 8/30 series with dual Bio-amplifier (AD Instruments Australia, Model No.ML870). The Ethical Committee of Baqai Medical University approved this study. The study included 500 participants ranging in age from 18 to 45 years. All participants were informed about the study process and its significance, and those who were willing to provide written consent were enrolled before the study. The study included all normal and healthy subjects willing to participate in research study of either sex, age ranges from 18-45 years. However, participants with diabetes, neurological disorder, previous history of neurological disorder, systemic diseases with neurological disorder were excluded from the study.

**Assessment of Nerve Conduction Velocity:**

All tests were carried out using Power Lab, an HTML-based software package that controls the sampling, digitizing, and storage of experimental data, as well as the display, manipulation, and analysis of the data. The basic hardware unit is a multichannel recording instrument for the measurement of electrical signals that includes an isolated stimulator for electrical stimulation of nerve and muscle, as well as integrated two channel Bio Amplifiers for optimal recording of biological signals (9-11).

**Ulnar Sensory Conduction**:

Sensory recording electrodes for ulnar sensory conduction were placed on the proximal and distal phalanxes of the fifth digit, with the proximal electrode serving as the active recording electrode. At the wrist, the ulnar nerve was stimulated (12).

**Ulnar Motor Conduction**:

The ulnar nerve was stimulated over the flexor carpi-ulnaris tendon proximal to the wrist crease. The proximal stimulation site at the elbow was over the ulnar nerve, just proximal to the medial epicondyle (12).

**Peroneal Motor Conduction:**

The active recording electrodes were positioned over the extensor digitorum brevis muscle, distal to the bony prominence of the talus over the metatarso-phalangeal joint. The reference electrodes were mounted on the fifth digit's lateral surface. The ground electrodes were attached on the ankle's dorsum. Distally over the anterior ankle, the peroneal nerve was stimulated(12).

## RESULTS:

Of 500 subjects, 250 subjects (50%) were male and 250 (50%) were females. The average age, height and BMI were 31.38 ± 11.79, 161.95± 8.35 (cm) and 29.01± 7.3 (kg/m2) respectively as mentioned in **Table 1**.

| Table 1: Demographic of the study Participants | |
|---|---|
| **PARAMETERS** | **MEAN ± SD** |
| **Age (years)** | 31.38 ± 11.79 |
| **Height (cm)** | 161.95± 8.35 |
| **BMI (kg/m2)** | 29.01± 7.3 |

Total subjects: 500
Data is presented as Mean ± SD

The mean velocities for ulnar sensory nerves in males and females were: 54.61± 2.1 m/s and 53.7 ± 3.65 m/s however, mean velocities for ulnar motor nerves in males and females were: 54.29 ± 4.20 and 52.86 ± 3.60 respectively.

The mean velocities for the common peroneal (motor) nerves in males and females were 54.34 ± 2.41m/s and 47.95 ± 4.20 m/s respectively.

**Table 2** summarizes the conduction velocities of ulnar nerves, both motor and sensory, at various age ranges, as well as the conduction velocities of common peroneal nerves.

**Table 2: Conduction velocities of ulnar nerves for both motor and sensory and peroneal motor nerve across different ages**

| Ages (Years) | Ulnar Sensory Nerve mean ± SD (m/s) | | Ulnar Motor Nerve mean ± SD (m/s) | | Peroneal Motor Nerve mean ± SD (m/s) | |
|---|---|---|---|---|---|---|
| | Male (n=250) | Female (n=250) | Male (n=250) | Female (n=250) | Male (n=250) | Female (n=250) |
| **18-23 (n=120)** | 59.87 ± 2.02 | 66.64±3.75 | 59.11 ± 2.80 | 59.14 ±5.31 | 58.99 ± 3.98 | 51.37 ± 1.27 |
| **24-29 (n=105)** | 57.93 ± 2.30 | 52.84±3.45 | 51.90 ± 4.83 | 51.93 ± 3.91 | 57.59 ± 2.87 | 50.68 ± 4.51 |
| **30-35 (n=110)** | 53.44 ± 1.33 | 51.91±2.48 | 57.37 ± 3.93 | 51.88±3.96 | 55.33 ± 1.93 | 47.58 ± 2.91 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **36-40 (n=90)** | 51.8 ± 2.55 | 49.37±3.50 | 51.78 ± 6.62 | 51.13±1.84 | 50.97 ± 2.11 | 45.91 ± 3.23 |
| **41-45 (n=75)** | 50.06 ± 2.28 | 48 ± 5.09 | 50.93 ± 2.81 | 50.25±3.01 | 48.86 ± 1.26 | 44.25 ± 1.06 |
| | <0.001 | <0.001 | <0.001 | 0.003 | 0.003 | 0.001 |
| Data is presented as Mean ± SD<br>Anova Test was applied<br>p value < 0.05 was considered significant | | | | | | |

## DISCUSSION:

The nerve conduction study is an essential clinical practice procedure that has been extensively accepted. There are studies published on nerve conduction research. These include the variables that influence nerve velocities (13). These variables are classified as biological (age, height, gender) and physical (associated to the physiological state of the nerve and the muscle)(14, 15).

Our focus was on the effect of age on NCV. Other factors like temperature for instance was kept at the recommended level by most neurophysiology laboratories in order to reduce variability (16). Aging is defined as a progressive, generalized loss of function that leads to a loss of adaptive response to stress and an increase in the risk of age-related diseases (17). Conduction velocity is nearly 50% of adult values in infants and gradually increases to adult values by the age of 3. Then with advancing age in life, nerve velocity declines with age, mostly in the lower extremities than in the upper (7). In our research, we discovered a decrease in nerve conduction velocity in the ulnar sensory and motor nerves with advance aging process. We also noticed a similar pattern in peroneal nerve velocity with advancing age.

According to one study, age has a significant impact on sensory nerve conduction (18). Similarly, other study conducted comparable evaluations of motor nerve conduction (6, 19). Furthermore, Ton et al. investigated the effect of ageing on sensory NCV and discovered that parameter variation was significantly faster in the median nerve than in the ulnar nerve (20). In contrast Awang et al. deduced that there was no substantial impact on NCVs with the exception of median motor conduction velocity (2). There are several cross - sectional investigations which have approximated the decrease in NCV ranging between 0.13 m/sec and 0.22 m/sec these seem to refer to the reality that ageing has a significant impact on nerve conduction parameters (14). Werner et al. in his research reported a decline in conduction velocity at a rate of 0.41 m/s each year of age in their article (21).

In the current study the participants were grouped into five groups depending on age. Attempting to compare the conduction velocities between all the five age groups, the declining trend was well witnessed in the age category of ≥ 40 years. As a result, it is clear that scores begin to decline as early as 40 years. Likewise according to some researches, conduction velocity began to decrease between the ages of 30 and 40, but the quantitative change of 10 m/s occurs between the ages of

60 and 80 (2, 22-24). Another study witnessed that a similar usual 10% decline in conduction rate at age 60 years (25). Senthilkumari et al. mentioned that age has a distinct significant relation with nerve conduction in median motor and sensory nerves therefore, it is critical to have age-related reference range (26). Moreover, the loss of myelinated and unmyelinated nerve fibres in peripheral nerves with ageing may account for the decrease in nerve conduction (20).

## CONCLUSION:

Aging has a definite correlation with the NCV and late responses of different peripheral nerves. There is a need to have reference values with relation to age.

### CONFLICT OF INTEREST:

We all authors have no conflicts of interest among us to disclose.

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