ORIGINAL ARTICLE

# EFFECT OF DEMOGRAPHIC AND PHYSICAL FACTORS ON NERVE CONDUCTION IN MEDIAN AND ULNAR NERVES IN HEALTHY SUBJECTS

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**Background:** Nerve conduction study (NCS) is an important method to assess the integrity of peripheral nervous system. It helps in diagnosis, planning of treatment, and prognosis of diseases of peripheral nerves. NCS parameters are affected by several different physical factors like temperature, demography, and ethnicity. It can also be affected by age, gender, height, weight, BMI, etc. The present study was targeted at finding out the changes in median and ulnar nerve conduction related to demographic parameters. **Methods:** Seventy-five healthy subjects aged 40–70 years undertook NCS using standard protocol. It was a cross-sectional study conducted at Institute of Basic Medical Sciences, Khyber Medical University, Peshawar and Combined Military Hospital, Abbottabad. The NCS were performed on Nion Kohden Neuropack MI EP/EMG measuring system. Various physical and demographic factors, i.e., age height, weight BMI were correlated to NCS parameters using Pearson's correlation. **Results:** A total of 75 people 32 (42.66%) females and 43 (57.33%) males were recruited for study after qualifying the inclusion criteria. A decline in all NCS parameters was observed with advancing age. Height affects sensory and motor latencies (negative correlation). Weight and BMI don't have prominent effects on NCS parameters. **Conclusion:** The sensory NCS characteristics (amplitude, latency, and Nerve Conduction Velocity (NCV) and motor NCS parameters (amplitude and NCV) of the median and ulnar nerves significantly deteriorate with age. Except for ulnar sensory amplitude and latency, there was no discernible variation in NCS characteristics between males and females.

**Keywords:** Nerve Conduction, Median Nerve, Ulnar Nerve, Myelin

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## INTRODUCTION

An important technique for the diagnosis and assessment of neuromuscular disorders is the electro diagnostic (EDX) study.[1] Neural conduction studies (NCS) and needle electromyography (EMG) are two of these studies. The electro diagnostic examinations are crucial for localizing lesions and can assist in determining the kind and location of the lesion such as neuropathy, myopathy, neuromuscular junction lesion, or central nervous system problem. They play a vital role in localizing neuropathic diseases.[2]

The source of a nerve lesion can be investigated at multiple levels, including the neuron, nerve, nerve plexus, or nerve root. Conditions such as mononeuropathy (affecting a single nerve), mononeuropathy multiplex (involving several individual nerves), and polyneuropathy (impacting all nerves) warrant further exploration. If needed, additional research can determine the type of fibres involved in neuropathic disorders, whether sensory, motor, or mixed. This investigation can also clarify whether axon loss or demyelination is the underlying cause of the condition.[3] This approach can measure the extent of demyelination or axonal loss, providing insights into the prognosis and severity of the disease, as well as the duration of acute, sub-acute, or chronic neuropathy. It offers valuable information on the distribution of the condition (proximal, bulbar, or generalized), the underlying pathology (such as presynaptic conditions like botulism or postsynaptic conditions like myasthenia gravis), and the aetiology (whether genetic or acquired) related to neuromuscular disorders.[4] The fundamental method for studying nerve conduction involves applying an external electrical pulse that generates a propagated nerve action potential (NAP), which can be recorded at a distal site along the same nerve.[2] It also generates a compound muscular action potential (CMAP), which is the result of a particular muscle fibre activation. Surface electrodes or needle EMG can be used to capture both of these potentials.[5] Nearly half of debility after the age of 65 is attributed to neurological diseases, which are particularly prevalent in old age.[6] Alzheimer's disease and dementia are age-related illnesses. Between 65 and 85 years of age, the incidence of Alzheimer's disease doubles every five years.[7] The structure and function of peripheral nerves are significantly impacted by aging. Because the blood-brain-barrier shields the CNS from external stressors, it is less susceptible than the peripheral nervous system to trauma, damage, and infections. The nerve fibres consist of myelin sheaths and axons. Therefore, these two factors are primarily responsible for the loss in nerve function. Thus, although there may be other contributing factors as well, these two elements are also primarily responsible for the loss of nerve function.[8] Decreases in nerve conduction velocity are caused by changes in the myelin sheath. The amplitude of CMAP or sensory nerve action potential (SNAP) may decrease with age due to a possible decrease in the number of functioning axons. As people age, their non-neural cells may undergo additional alterations, and deficiencies in vitamins $B_{12}$ and E which might cause damage to their nerves.[9] The present study was targeted at finding out the changes in median and ulnar nerve conduction related to demographic parameters.

## METHODOLOGY

The study was conducted at the Institute of Basic Medical Sciences at KMU Peshawar and CMH Abbottabad, with approval from the ASRB and the KMU ethical board. Using STAT (UBA), the sample size was determined with a power of 0.80 and α value of 0.05. Seventy-five people made up the sample size for this cross-sectional study, which was chosen via convenient sampling. Those without a history of upper limb injury, myopathy, or neuropathy, as well as those with normal fasting blood sugar (FBS), urea, creatinine, liver function tests (LFTs) and ESR were included in the study.

The nerve conduction studies were performed on Nihon Kohden Neuropack M1 EP/EMG measuring system MEB-9200/MEB-9300. For motor studies the nerves were studied orthodromically. For sensory studies the nerves were studied antidromically. All electrodes were placed on specific and measured distances from each other according to the standard technique given by AANEM.[10] All the parameters, e.g., demographic parameters, blood parameters, and NCS parameters were entered into Microsoft Excel worksheet. All these parameters were then organized, and coding was done to import them into SPSS-22. The nominal variables were looked for frequencies and percentages, while numerical variables were analyzed for Mean±SD. Different groups were compared with each other using Pearson's correlation for multiple group comparisons, and $p \leq 0.05$ was considered statistically significant.

## RESULTS

A total of 75 people between the ages of 40–70 were recruited for the study after qualifying the inclusion criteria, out of which 32 (42.66%) were females and 43 (57.33%) were males. A decline in all NCS parameters was observed with advancing age (decreased amplitude, increased latency, and decreased NCV significantly in sensory assessments). Height has a negative correlation with sensory and motor latencies. Weight and BMI do not have significant effects on NCS parameters.

The mean age of the subjects was 53.83±8.33 Years, height was 162.67±7.91 Cm, weight was 72.59±11.38 Kg, and BMI was calculated as 27.32±3.68 $Kg/m^2$.

With advancing age, median motor latency increased ($\rho$=0.475) while median motor amplitude decreased ($\rho$=-0.419). Height had effect on median motor latency which increases with increase in height ($\rho$=0.388). Weight is affecting ulnar motor amplitude which is increasing with increasing weight ($\rho$=0.229). Increased BMI increases median motor amplitude ($\rho$=0.298). (Table-1).

With advancing age, median sensory latency increased ($\rho$=0.511), median sensory amplitude decreases ($\rho$=-0.457), ulnar sensory latency increases ($\rho$=0.297) whereas ulnar sensory amplitude decreases ($\rho$=-0.330). Height has a significant effect only on ulnar sensory latency which increases with increasing height ($p$=0.412). However, weight and BMI don't have any significant effect on median and ulnar sensory parameters. (Table-2).

**Table-1: Correlation of motor NCS parameters with various factors**

| Parameter | Median Nerve | | | Ulnar Nerve | | |
|---|---|---|---|---|---|---|
| | Latency | Amplitude | NCV | Latency | Amplitude | NCV |
| **Age** | **0.475*** | **-0.419*** | -0.131 | 0.163 | -0.137 | -0.148 |
| **Height** | **0.388*** | 0.207 | -0.080 | **0.462*** | **0.235*** | -0.078 |
| **Weight** | 0.260 | 0.055 | -0.076 | 0.136 | **0.229*** | 0.008 |
| **BMI** | -0.079 | **0.298*** | -0.022 | -0.197 | 0.109 | 0.052 |

*Correlation is significant at the 0.01 level

**Table-2: Correlation of sensory NCS parameters with various factors**

| Parameter | Median Nerve | | | Ulnar Nerve | | |
|---|---|---|---|---|---|---|
| | Latency | Amplitude | NCV | Latency | Amplitude | NCV |
| **Age** | **0.511*** | **-0.465*** | **-0.457*** | **0.297*** | **-0.330*** | -0.110 |
| **Height** | 0.113 | -0.097 | 0.097 | **0.412*** | -0.154 | -0.215 |
| **Weight** | 0.037 | -0.028 | 0.101 | 0.050 | 0.003 | 0.002 |
| **BMI** | -0.020 | 0.027 | 0.024 | -0.260* | 0.111 | 0.182 |

*Correlation is significant at the 0.01 level

## DISCUSSION

An essential and sensitive method for assessing neuronal diseases is nerve conduction study.[11] In addition to other variables (height, gender, and BMI), age and ethnicity have a significant impact on nerve conduction parameters.[12] As one ages, there is a decrease in NCV, an increase in latency, and a decrease in the amplitude of the action potential; however, there is no specific age at which this decline starts.[13] There is a decrease in the number of nerve fibres, reduced nerve diameter, and change in fibre membrane with aging.[14] The reduced diameter of nerve fibre is either due to a reduction in myelin content or axon loss in nerve fibres.

We observed that as people aged, the amplitude of their CMAP and SNAP decreased. Werner *et al*[15] reported similar results, observing a drop in median and ulnar peak sensory amplitudes throughout the course of a four-year follow-up investigation. Since amplitude is a measure of all the active axons in a nerve fibre, a fall in amplitude with age can be the cause of decline in axon function or number. Hennessey *et al*[16] observed that as people age, the median nerve's CMAP amplitude decreases. They stated that the average drop in sensory amplitude was 10% per decade, but the average decline in motor amplitude was 5% per decade.[16] In our subjects there was an increase in the sensory and motor latency of the ulnar and median nerves as people aged, indicating that nerve impulses are transmitted to the nerve fibres more slowly as people age. Numerous reasons, including changes in the myelin sheath (myelin figures/myelin balloons), the loss of nerve fibres, and a decrease in neurotransmitters, could be the cause of this.[17] After 4 years, the median and ulnar sensory latencies rises from their baseline values.[15] The current study also showed a reduction in median and ulnar nerve conduction velocities with increasing age. Since NCV indicates the degree of myelination of peripheral nerve fibres, the loss of myelinated nerve fibres may be the cause of the decline in NCV with aging.[18] The NCV reduction starts from age 30 to 40.[13,19]

## CONCLUSION

The sensory NCS characteristics (amplitude, latency, and NCV) and motor NCS parameters (amplitude and NCV) of the median and ulnar nerves significantly deteriorate with age. The median nerve showed more pronounced age-related alterations than the ulnar nerve. A larger sample size and continued follow-up with the same research population would have produced more reliable results.

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**Contribution of Authors:**

**MS:** Conception and study design
**RN:** Proof reading
**KS:** Results compilation/data entry
**ASA:** Data collection
**SHH:** Data analysis and interpretation
**SF:** Literature review
**AR:** Data collection


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