

## NORMAL UPPER LIMB SENSORY NERVE CONDUCTION PARAMETERS IN NORTHERN KERALA POPULATION

Ahammed Naseem V H<sup>1</sup>, Ashraf Usman<sup>2</sup>, Fasma K A<sup>1</sup>, Mahroosa C<sup>1</sup>, Geethu Das B. K<sup>1</sup>, Jija Jose M<sup>1</sup>, Harikrishnan R<sup>1</sup>

<sup>1</sup>Department of Physiology, Government Medical College, Kozhikode, Kerala, India

<sup>2</sup>Department Cardiovascular and Thoracic Surgery, Government Medical College, Thrissur, Kerala, India

Received : 08/12/2023  
Received in revised form : 16/02/2024  
Accepted : 02/03/2024

**Keywords:**

Nerve conduction, sensory conduction, sensory amplitude, distal latency, and normative data.

Corresponding Author:

**Dr. Geethu Das B. K**

Email: geethuarun1471@gmail.com

DOI: 10.47009/jamp.2024.6.2.55

Source of Support: Nil,

Conflict of Interest: None declared

*Int J Acad Med Pharm*  
2024; 6 (2); 260-263



### Abstract

**Background:** Nerve conduction study (NCS) is a widely used electrodiagnostic procedure to assess the peripheral nerve function in neurophysiology labs. The types of NCS, motor and sensory, should be performed sequentially rather than simultaneously whenever the same mixed nerve is assessed. Since the factors which may affect NCS like age, height, weight, ambient temperature varies greatly among different geographical locations, each neurophysiology laboratory needs to have normative data which is specific for a population. **Materials and Methods:** This cross-sectional observational study was conducted at Neurophysiology lab, Government Medical College Kozhikode after getting permission from institutional ethics committee. 250 normal subjects participated in the study which included equal number of male and females. Sensory amplitude and sensory distal latency of median and ulnar nerve were derived. **Result:** Median sensory amplitude and distal latency obtained in the present study were 13.96 (2.1)  $\mu$ V and 2.85 (0.16) ms respectively. Ulnar sensory amplitude and distal latency obtained in the present study were 6.70 (0.89)  $\mu$ V and 2.80 (0.16) ms respectively. **Conclusion:** Normative value for median and ulnar sensory latency and amplitude were derived from the present study. This can be used as reference data for accurate diagnosis sensory conduction abnormalities in the study population.

## INTRODUCTION

Nerve conduction study is a widely used electrodiagnostic procedure to assess the peripheral nerve function in neurophysiology labs for diagnostic and for research purposes. The conduction of impulse through the peripheral nerve on stimulation with a surface electrode placed at various sites along the peripheral nerve will be studied by recording the response from another site on the nerve or from a muscle which is innervated by the nerve. Thus, the sensory and motor nerve function will be assessed. In clinical practice NCS is used to diagnose various peripheral nervous system diseases affecting nerve roots, peripheral nerves, neuromuscular junction or muscle. Interpretation of NCS data will help to differentiate between demyelination and axonal degeneration. Also, helps to establish an early diagnosis as it is a very sensitive test to detect slowing of conduction.<sup>[1]</sup> Basic NCSs are non-invasive and of relatively low risk, as nerve stimulation and recording are carried out on the surface of the skin.<sup>[2]</sup> NCS are done by stimulating motor or sensory nerves electrically at 2

or more different sites and recording from either the muscle innervated, for motor nerves; or from another site on stimulated nerve trunk for sensory nerves.<sup>[3]</sup>

NCS consists of

- Motor nerve conduction study
- Sensory nerve conduction study
- Late responses (F- wave and H reflex)
- Repetitive nerve stimulation

Routine NCSs are composed of motor and sensory nerve responses. By conducting mixed NCS we can simultaneously assess both motor and sensory components; which is used in the evaluation of specific diseases such as carpal tunnel syndrome (CTS). Repetitive nerve stimulation (RNS) is an electrophysiological study that evaluates the integrity of the neuromuscular junction, usually done to confirm a neuromuscular junction disorder and to pinpoint which element of signal transmission is abnormal.<sup>[4]</sup> The sensory conduction can be measured orthodromically or antidromically. In orthodromic conduction, a distal portion of the nerve, e.g, digital nerve is stimulated and sensory nerve action potential (SNAP) is recorded at a

proximal point along the nerve. In antidromic sensory nerve conduction, the nerve is stimulated at a proximal point and nerve action potential is recorded distally.<sup>[5]</sup>

Physiological factors like age, temperature, height can influence the outcome of nerve conduction studies. Also, Technical factors like stimulating system and recording system will also affect the outcome. Age will definitely affect nerve conduction. In infants and children, it will be of low value. It is about half of adult value in neonates. Age will definitely affect nerve conduction; showing a low value in infants and children and near to adult value by three to five years of age only. After sixty years it starts to decline and by 1.5 percentages per decade. This decline may be due to loss of larger neurons with ageing.<sup>[6]</sup>

The reference data of nerve conduction vary from one population to another. So, every electrophysiological laboratory needs to establish the normal values for its population to identify abnormal subjects. No such values of sensory nerve conduction are available for the Northern Kerala population. The aim of this study is to establish normal values of sensory nerve conduction in Northern Kerala population.

## MATERIALS AND METHODS

After getting approval from Institutional ethical committee, this cross-sectional study was conducted in the Neurophysiology laboratory of Calicut medical college, in northern Kerala population for a duration of one year. 250 normal subjects of 18-50 years from north Kerala were recruited for the study; with informed consent. Study group consisted of equal number of males and females.

### Inclusion Criteria

Normal healthy adults of age 18 to 50 years

### Exclusion Criteria

Individuals with history of systemic or neuromuscular diseases were excluded from the study.

Sensory nerve conduction studies were carried out by stimulating sensory nerves electrically at two or more sites and recording from yet another site on the stimulated nerve trunk. Sensory Amplitude is the height of the Sensory Nerve Action Potential (SNAP) obtained during nerve conduction studies measured from baseline to peak; in microvolts. Sensory Distal Latency is the time it takes following distal stimulation of the nerve to the appearance of sensory nerve action potential. It is measured in milliseconds.

The electrodiagnostic equipment consists of:

- A computer with software for NCS
- Active, reference & ground electrodes
- A stimulator

Detailed history was taken and clinical examination was done to rule out any systemic or neuromuscular diseases. Subjects were acclimatized to standard room temperature (27°C +/-20°C) for 10 minutes.

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### Electrode Placements and Stimulation of Individual Nerves:

**Median Nerve:** Sensory Conduction Study (Antidromic)

- ✓ Active electrode: Over the proximal interphalangeal joint on the second finger.
- ✓ Reference electrode: Over the distal interphalangeal joint.
- ✓ Ground electrode: On the dorsum of the hand between active electrode and the stimulator.
- ❖ Stimulation: 3 cm proximal to distal wrist crease between tendons of flexor carpi radialis and Palmaris longus.

### Ulnar Nerve:

Sensory Conduction Study (Antidromic)

- ✓ Active electrode: On the 5<sup>th</sup> digit over proximal interphalangeal joint.
- ✓ Reference electrode: On the 5<sup>th</sup> digit over the distal interphalangeal joint.
- ✓ Ground electrode: On the dorsum of the hand between active electrode and the stimulator.

Stimulation: 3 cm proximal to distal wrist crease just medial to the Flexor carpi ulnaris tendon.

### Calculations and Analysis:

Average values of nerve conduction parameters were calculated.

## RESULTS

**Table 1: Normal values - sensory conduction study**

Nerves	Amplitude (µV)		DL (ms)	
	Mean	SD	Mean	SD
Median	13.96	2.1	2.85	0.16

Ulnar	6.7	0.89	2.8	0.16
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**Table 2: Normal values - sensory conduction study (Gender-wise)**

Nerves	Parameters	Male Mean (SD)	Female Mean (SD)
Median	Amplitude ( $\mu\text{V}$ )	12.63 (1.71)	15.3 (1.55)
	DL (ms)	2.93 (0.16)	2.78 (0.12)
Ulnar	Amplitude ( $\mu\text{V}$ )	6.11 (0.71)	7.3 (0.6)
	DL (ms)	2.87 (0.16)	2.72 (0.13)

## DISCUSSION

Nerve conduction studies (NCS) are an essential part in the evaluation of the peripheral nervous system. The types of NCS- motor, sensory and mixed, because of different technical aspects in performing each of these, should be performed sequentially rather than simultaneously whenever the same mixed nerve is assessed.<sup>[7]</sup> Nerve conduction studies (NCSs) have become a simple and reliable test of peripheral nerve function.<sup>[8]</sup> With adequate standardization, the method now provides a means of not only objectively identifying the lesion but also precisely localizing the site of maximal involvement.<sup>[9]</sup>

Since the factors which may affect NCS like age, height, weight, ambient temperature vary greatly among different geographical locations, each neurophysiology laboratory needs to have normative data which is specific for a particular population.<sup>[10]</sup> No such values are available for the Northern Kerala population. So, the main aim of this study was to make a normative data for nerve conduction of commonly tested nerves of upper limb for the Northern Kerala region. Our electrophysiology laboratory is using values derived in a study done in Sanjay Gandhi Postgraduate institute of Medical Sciences, Uttar Pradesh which is published in the book 'Clinical Neurophysiology' by U.K. Misra and J. Kalita. The study lasted for one year and examined 250 normal subjects of age 18-50 years and the normative value for sensory conduction parameters were derived. Median sensory amplitude and distal latency obtained in the present study were 13.96 (2.1)  $\mu\text{V}$  and 2.85 (0.16) ms respectively [Table 1]. The value of sensory amplitude obtained is higher than that of Misra and Kalita, which is 8.91 (4.48)  $\mu\text{V}$ . The Western value by Kimura has a wider range, 38.5 (15.6)  $\mu\text{V}$ . The sensory distal latency obtained is similar to that of Kimura, which is 2.84 (0.34) ms.

In a study conducted by Manjinder Singh et al., Normative Data for Median Nerve Conduction in Healthy Young Adults from Punjab, India, the average value of median sensory latency in males was 2.86  $\pm$  0.56 ms and in females it was 2.4  $\pm$  0.33 ms.<sup>[10]</sup>

Ulnar sensory amplitude and distal latency obtained in the present study were 6.70 (0.89)  $\mu\text{V}$  and 2.80 (0.16) ms respectively [Table 1]. The value of sensory amplitude obtained was more than that of Misra and Kalita which is 5.54 (2.37)  $\mu\text{V}$ . The Western value by Kimura has a wider range, 35.0

(14.7)  $\mu\text{V}$ . The sensory distal latency obtained is similar to that of Misra and Kalita which is 2.83 (0.40) ms. In a study done by Lukman Femi Owolabi et al., to find out Normative Data for Ulnar Nerve Conduction and the Influence of Gender and Height on Ulnar Nerve Conduction Velocity in Healthy Nigerians the mean sensory latency of the ulnar nerve was 2.97  $\pm$  0.62 with 2.5 and 97.5 percentile of 2.00 and 4.52 respectively. The mean sensory amplitude of the ulnar nerve was 35.56  $\pm$  9.97 with 2.5 and 97.5 percentile of 15.9 and 57.7 respectively. The same study also found out that height significantly affects sensory conduction parameters.<sup>[11]</sup>

Gender-wise reference values were also derived for sensory conduction parameters [Table 2]. Median nerve sensory amplitude and distal latency were 12.63 (1.71)  $\mu\text{V}$  and 2.93 (0.16) ms respectively in males, and 15.3 (1.55)  $\mu\text{V}$  and 2.78 (0.12) ms respectively in females. Ulnar nerve sensory amplitude and distal latency were 6.11 (0.71)  $\mu\text{V}$  and 2.87 (0.16) ms respectively in males, and 7.3 (0.6)  $\mu\text{V}$  and 2.72 (0.13) ms respectively in females. According to a study done by K. Al-Salmi, gender has got a significant influence on distal latencies and conduction velocities of peripheral nerves in normal adults.<sup>[12]</sup>

The difference in values obtained between different studies may be due to technical factors like difference in room temperature, and physiological factors like difference in average height and age of the population studied. This emphasizes the necessity of normative electro diagnostic data for every lab.

## CONCLUSION

Normative value for median and ulnar sensory latency and amplitude were derived from the present study. There may be geographical differences in the values of nerve conduction parameters because the factors which influence nerve conduction like height, weight, temperature may vary from region to region. The present study also showed that gender significantly affects sensory latency and amplitude, males having prolonged latency and decreased amplitude. This difference can be attributed to the difference in height of males and females.

## REFERENCES

1. Agarwal P, Gaur AK. Effect of obesity on median nerve conduction at carpal tunnel level in Indian women. *Natl J Physiol Pharm Pharmacol.* 1970 Jan 1;5(1):21-21.

2. Tavee J. Chapter 14 - Nerve conduction studies: Basic concepts. In: Levin KH, Chauvel P, editors. Handbook of Clinical Neurology [Internet]. Elsevier; 2019[cited 2023 Nov 28]. p. 217–24. (Clinical Neurophysiology: Basis and Technical Aspects; vol. 160). Available from: <https://www.sciencedirect.com/science/article/pii/B978044464032100014X>
3. Department of Physiology, GMC Srinagar, Wadoo OK. Normative Data for Upper Limb Nerve Conduction Study in North India. J Med Sci Clin Res [Internet]. 2018 Jun 7 [cited 2024 Feb 26];6(6). Available from: <http://jmscr.igmpublication.org/v6-i6/26%20jmscr.pdf>
4. Datta N, Hoke A. Repetitive Nerve Stimulation. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 [cited 2024 Feb 24]. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK594249/>
5. Misra UK, Kalita J. Clinical Neurophysiology: Nerve Conduction, Electromyography, Evoked Potentials. Elsevier Health Sciences; 2019. 453 p.
6. Pal GK, Pal P. Textbook of Practical Physiology. Orient Blackswan; 2001. 548 p.
7. Wilbourn AJ. Nerve conduction studies. Types, components, abnormalities, and value in localization. Neurol Clin. 2002 May;20(2):305–38, v.
8. Kimura J. Electrodiagnosis in Diseases of Nerve and Muscle: Principles and Practice. Oxford University Press; 2013. 1177 p.
9. Kimura J. Principles and pitfalls of nerve conduction studies. Ann Neurol. 1984 Oct;16(4):415–29.
10. Singh M, Gupta S, Singh KD, Kumar A. Normative Data for Median Nerve Conduction in Healthy Young Adults from Punjab, India. J Neurosci Rural Pract. 2017 Aug;8(Suppl 1):S83–8.
11. Owolabi LF, Jibo AM, Ibrahim A, Owolabi SD, Gwaram BA, Onwuegbuzie G. Normative Data for Ulnar Nerve Conduction and the Influence of Gender and Height on Ulnar Nerve Conduction Velocity in Healthy Nigerians. Ann Afr Med. 2022;21(1):43–8.
12. Al-Salmi K. Gender has a significant effect on normal nerve conduction values. J Neurol Sci. 2019 Oct 15;405:68