Normative Values for Nerve Conduction Study among healthy subjects from Aurangabad, INDIA

Shaikh Shahabuddin[1*], DaimiSayad Badar[1], Khan Md Moizuddin[2], L. B. Sami[3], Solepure A. B.[4]

{[1]Assistant Professor, [4]Professor} Department of Physiology, JIIU's Indian Institute of Medical Science and Research, Aurangabad - Jalna Road, Warudi, Tq. Badnapur, Jalna – 431202, Maharashtra, INDIA.

{[2]Assistant Professor, [3]Professor}Department of Physiology, MGM's Medical College, Aurangabad, Maharashtra, INDIA

[*]Corresponding Address:

dr_shahabshaikh@yahoo.co.uk

Research Article

Abstract: **Aim**: The aim of our study is to establish the normal electrophysiological values of the common nerves in upper and lower limb and to study the influence of age and height on conduction velocity in healthy adult subjects. **Material and Method:** The study was conducted in MGM Medical College, a tertiary care center in city of Aurangabad, India. A total of 90 healthy volunteers, 45 males and 45 females aged 20 years and above were selected after clinical evaluation to exclude systemic or neuromuscular disorders. Anthropometric measurements were done using a standard protocol. Nerve Conduction Study was carried out according to a standardized protocol. Motor NCS included the Median, Peroneal and Tibial nerves. Sensory NCS included the Ulnar, Median, and Sural nerves. **Results:** The NCS data was separately analyzed for males and females. The mean along with standard deviation (SD) for latencies, amplitude and velocities of Sural sensory, Ulnar sensory and Median sensory nerves for males and females is obtained. Similarly the means with SD of the latencies, amplitudes and velocities of the Ulnar motor, Median motor, Peroneal motor and Tibial motor nerves were obtained. Also the NCS parameters at various percentiles were obtained. Linear regression models show the inverse association of Age and Height with NCS parameter in males and females. The model also gave the coefficient by which the NCS parameters change for unit change in Age (Year) or Height (Cm). **Conclusion:** The study will be helpful in establishing normative values of nerve conduction parameters of the commonly tested nerves in the upper and lower limb for our region. The mean nerve conduction parameters for all the nerves were similar with the existing data from different Indian studies. In general Age and Height had inverse relation with NCS parameters.

Keywords*:* NCS, Normal Values, Reference values, Age, Height

Running Title: Normative Values of NCS in Aurangabad, India

Introduction

Nerve conduction studies (NCS) are electrodiagnostic tests which are used to evaluate the ability of the conduction of the motor and the sensory nerves. NCS tests are used in the diagnosis of polyneuropathies, mononeuropathies, radicular lesions, tunnel syndromes and nerve damages caused by trauma and compression. Among the NCS parameters, conduction velocity and latency quantify the speed of nerve impulse propagation and are altered in diseases causing demyelination. Amplitude reflects the number of functioning nerve fibers and is reduced in diseases causing axonal degeneration. [1] Nerve conduction studies are the most objective, accurate, and reliable method for detecting peripheral neuropathy. [2] The importance of Nerve conduction study (NCS) tests in evaluation of peripheral nerve abnormality is being increasingly recognized in India. To identify the abnormality on the basis of NCS, normative data from the local population is needed. Several factors may influence the tests such as temperature, age, height, BMI etc. [3] They have to be taken into consideration while doing nerve conduction study. The purpose of our study is to establish the normal electrophysiological values of the common upper and lower limb nerves and to study the influence of height and age on conduction velocity in healthy adult subjects.

Materials and Methods

The study was conducted in MGM Hospital and Medical College, a tertiary care center in city of Aurangabad, India. The study was approved by the ethical committee of MGM University and informed written consent for the study was taken from all the subjects. For this study we used data obtained from healthy volunteers. Using the sample of convenience a total of 90 participants, 45 males and 45 females, aged 20 years and above were selected. All the selected participants of our study were subjected to detailed clinical evaluation to exclude systemic or neuromuscular disorders. Anthropometric measurements of participants were done while they stood in light clothing without shoes, using a standard protocol. Nerve Conduction Study was carried out on a Neurocare 2000 nerve conduction system by BioTech, India. The study was carried out at a fixed room temperature of 32 ° C. All the tests were done according to a standardized protocol. Filters were set at 2 Hz to 5 kHz and sweep speed was 5 ms per division for motor study and for sensory study, filters were at 2 Hz to 3 kHz and sweep speed was 2 ms per division. Recording

was done at a standard distance of 14 cm in all nerves. Most often the right side was studied, but if focal nerve lesions were present at this side (e.g. trauma), the left side was chosen. Surface electrodes were utilized for recording and stimulation in the motor and sensory nerves. The nerves for study include Sural, Tibial, Peroneal, Median and Ulnar nerve. For motor nerves the following parameters were analyzed: The distal motor latency (DML), compound muscle action potential amplitude (CMAP), motor conduction velocity (MCV). Motor NCS included the Median, Peroneal and Tibial nerve. For sensory nerves, distal sensory latency (DSL), velocity, and Sensory nerve action potential amplitude (SNAP) were recorded. Sensory NCS included the Ulnar, Median, and Sural nerves. All the data obtained was subjected to statistical analysis using Statistical Package for Social Sciences version 17.0 (SPSS Inc., Chicago, IL, USA). Linear regression models were used to demonstrate the association of Age and Height with NCS parameters.

Results

A total of 90 subjects participated in the study. 45 were males and 45 were females. The demographic characteristics are as shown in Table 1. In Males, the mean with standard deviation (SD), of age, height, weight, BMI, systolic and diastolic blood pressure is 42.93 (±10.40) years, 1.73 (0.05) Meters, 73.93 (±11.41) Kg, 24.71 (±3.19) kg/m2, 123.89 (±9.06) mmHg and 75.02 (±7.62) mmHg respectively and in females it is 47.22 (±12.02) years, 1.61 (0.07) Meters, 62.97 (±12.05) Kg, 24.23 (±3.98) kg/m2, 123.11 (±10.31) mmHg, 76.739 (±9.41) mmHg respectively. The NCS data was separately analyzed for males and females. In males the mean latencies of Sural sensory, Ulnar sensory and Median sensory nerves is 2.47(0.57), 2.90 (0.36) and 3.05 (0.55) milliseconds respectively while in females it is 2.55(0.51), 2.91 (0.32) and 3.01 (0.53) milliseconds respectively. Also the means of the amplitude and the velocities of the sensory nerves are as shown in the Tables 2A and 2B. Similarly the means with SD of the Latencies, amplitudes and velocities of the Ulnar motor, Median motor, Peroneal motor and Tibial motor nerves are as shown in the tables. Also the NCS parameters at various percentiles are shown in the above tables. Linear regression models were used to show the association of Age & Height with NCS parameter in males and females. The linear regression model gives the coefficient by which the NCS parameters change for unit change in Age (Year) or Height (Cm) as shown in Table 3A and 3B for sensory and motor nerve parameters respectively. For e.g. in males SSDL will increase by 0.05 ms while SSAM will decrease by 0.40 mV and SSVL will decrease by 0.40 m/sec for every one year increase in the age of the subject. Similarly the coefficients for all the studied parameters are as shown in Table 3A and 3B.

Discussion

NCS reference values are used to define the limits of normal function, with test values outside the range suggesting the presence of some form of neuropathy. For NCS, reference values should be established from the local population because previous studies have shown differences in NCS function related to ethnicity and demographic factors. [4, 5] We have evaluated the nerve conduction parameters of the most commonly tested nerves in healthy adult population in Aurangabad city of central Maharashtra, India to obtain the reference values for our laboratory. These can be used for evaluation of peripheral nerve injury. The overall mean sensory and motor nerve conduction parameters for all the nerves were comparable with earlier studies from different regions in India. [4, 6, 7]Gender difference in the NCS parameters is an established fact hence in our study the male and female data was analyzed separately. Studies have tried to explain the effect of gender on NCS parameters on the basis of gender wise difference in anatomical and physiological factors. [7 - 10] Previous studies have demonstrated that Age & Height affects the NCS and failure to adjust normal nerve conduction values for these factors decreases the diagnostic specificity and sensitivity of the NCS. [10] Linear regression models were used to demonstrate the association of Age and Height with NCS parameters in the healthy controls. These models give the coefficient by which the NCS parameter changes with each unit change in Age & Height. In general there was significant inverse relationship between age and NCS parameters. The coefficient of decrease in NCS parameters with increasing age derived from our linear regression models can be used to obtain age adjusted normative values. Earlier studies have shown that with increasing age there is decrease in nerve conduction velocity and amplitude. [8-10] The reason for this decrease was attributed by various studies to decrease in number of nerve fibers, reduction in fiber diameter, and changes in the fiber membrane. [8-10] Height also showed inverse relationship consistently with all NCS parameters in our study. The coefficient of change in NCS parameters with increasing height derived from our linear regression models for all the parameters is as shown in above table. Similar decrease in nerve conduction function with increasing height has been reported by earlier studies. [11, 12] Decrease in the diameter of the fiber distally may explain the decrease in nerve conduction function as proposed in earlier studies. [10] In summary adjusting normal nerve conduction values for known anatomical or physiological

determinants such as age, height, and sex can increase the diagnostic sensitivity of NCS.

Conclusion

The study will be helpful in establishing normative values of nerve conduction parameters of the commonly tested nerves in the upper and lower limb for our region. The mean nerve conduction parameters for all the nerves were similar with the existing data from different Indian studies. In general Age & Height had inverse relation with NCS parameters.

Table 1: Demographic characteristics of study participants

Variable	Sex	Mean	S.D	Min	Max
Age (Years)	M	42.93	10.40	27	73
	F	47.22	12.02	33	73
Height (Meters)	M	1.73	0.05	1.62	1.83
	F	1.61	0.07	1.46	1.72
Weight (Kg)	M	73.93	11.41	50	95.2
	F	62.97	12.05	43	93.6
BMI	M	24.71	3.19	17.30	30.46
	F	24.23	3.98	17.90	33.59
Systolic Blood Pressure (mmHg)	M	123.89	9.06	108	142
	F	123.11	10.31	108	146
Diastolic Blood Pressure (mmHg)	M	75.02	7.62	60	88
	F	76.73	9.41	58	92

Table 2A: NCS Parameters in Male Participants

Nerve	NCS Parameters	Percentiles			Min	Max	Mean ± SD
		25%	**50%**	**75%**			
Sural Sensory	**SSDL(ms)**	2.2	2.4	2.9	1.2	3.4	02.47 ± 0.57
	SSAM(mV)	13.6	16.5	17.7	9	21.2	15.63 ± 3.47
	SSVL(m/s)	47.5	50	53	44	55	50.02 ± 3.45
Ulnar Motor	**UMDL(ms)**	2.06	2.43	2.8	2	3	02.44 ± 0.36
	UMAM(mV)	10.65	11	12.36	10.23	13.06	11.38 ± 0.87
	UMVL(m/s)	53.65	54.9	57	49.7	63.8	55.58 ± 3.33
Median Motor	**MMDL(ms)**	3	3.7	3.95	2.6	4.2	03.53 ± 0.51
	MMAM(mV)	11.37	11.91	12.21	11.03	12.8	11.82 ± 0.48
	MMVL(m/s)	53.16	53.7	53.98	52.82	55	53.62 ± 0.49
Ulnar Sensory	**USDL(ms)**	2.51	2.88	3.25	2.47	3.45	02.90 ± 0.36
	USAM(mV)	26.28	26.82	27.12	25.94	27.71	26.73 ± 0.48
	USVL(m/s)	56.07	56.61	56.91	55.73	57.5	56.52 ± 0.48
Median Sensory	**MSDL(ms)**	2.76	3.16	3.46	1.86	3.96	03.05 ± 0.55
	MSAM(mV)	31.8	33.5	36.4	27.8	48.9	35.21 ± 5.46
	MSVL(m/s)	54.9	57.8	59	50.3	62.5	56.93 ± 3.47
Peroneal Motor	**PMDL(ms)**	3.76	4.13	4.5	3.7	4.7	04.14 ± 0.36
	PMAM(mV)	4.55	4.9	6.29	4.13	7.5	05.37 ± 0.97
	PMVL(m/s)	41.45	45.3	56.59	36.83	69.9	49.03 ± 9.01
Tibial Motor	**TMDL(ms)**	4.39	4.76	5.13	4.33	5.33	04.77 ± 0.36
	TMAM(mV)	5.77	6.31	6.61	5.43	7.2	06.22 ± 0.48
	TMVL(m/s)	43.3	45.45	47.4	40.4	53.15	45.52 ± 3.04

Units of NCS measurements: **ms:** milliseconds; **mV:** Millivolts; **m/s:** meters per second

Table 2B: NCS Parameters in Female Participants

Nerve	NCS Parameters	Percentiles			Min	Max	Mean ± SD
		25%	50%	75%			
Sural Sensory	SSDL(ms)	2.4	2.7	2.86	1.2	3.6	02.55 ± 0.51
	SSAM(mV)	14.2	15.7	17.3	12	21	15.77 ± 2.23
	SSVL(m/s)	48	52	54	42	56	50.82 ± 3.95
Ulnar Motor	UMDL(ms)	2.08	2.52	2.67	1.98	3.2	02.46 ± 0.32
	UMAM(mV)	10.2	10.78	11.3	9	14.09	11.14 ± 1.28
	UMVL(m/s)	54.3	55.7	57	49.2	62.4	55.87 ± 3.15
Median Motor	MMDL(ms)	2.5	2.7	3.2	1.6	4.5	02.84 ± 0.72
	MMAM(mV)	11.3	11.62	12.18	10.8	13.4	11.76 ± 0.71
	MMVL(m/s)	53.09	53.41	53.97	52.59	55.19	53.57 ± 0.71
Ulnar Sensory	USDL(ms)	2.53	2.97	3.12	2.43	3.65	02.91 ± 0.32
	USAM(mV)	26.21	26.53	27.09	25.71	28.31	26.69 ± 0.71
	USVL(m/s)	56	56.32	56.88	55.5	58.1	56.47 ± 0.71
Median Sensory	MSDL(ms)	2.56	3.06	3.36	2.06	4.06	03.01 ± 0.53
	MSAM(mV)	30.2	34	39.8	25.6	48.9	35.26 ± 6.23
	MSVL(m/s)	52.5	57	58.6	50.3	62.3	56.20 ± 3.38
Peroneal Motor	PMDL(ms)	3.78	4.22	4.37	3.68	4.9	04.16 ± 0.32
	PMAM(mV)	3.8	4.1	4.5	3.46	6.9	04.40 ± 0.86
	PMVL(m/s)	46	49.3	51.5	40.5	71.3	50.38 ± 6.91
Tibial Motor	TMDL(ms)	4.41	4.85	5	4.31	5.53	04.79 ± 0.32
	TMAM(mV)	6.2	6.52	7.08	5.7	8.3	06.68 ± 0.71
	TMVL(m/s)	44.6	46.3	47.2	43	53.8	46.40 ± 2.23

Units of NCS measurements: **ms:** milliseconds; **mV:** Millivolts; **m/s:** meters per second

Table 3A: Linear Regression Model for relation of Age & Height with NCS Parameters of Sensory nerves

NCS		MALES		FEMALES	
		Coef. (95% C.I)	***P***	**Coef. (95% C.I)**	***P***
SSDL	**Age**	0.05 (0.05 – 0.06)	0.00	0.05 (0.04 - 0.06)	0.00
	Height	-0.02(-0.04 - -0.01)	0.01	-0.01 (-0.03 - 0.01)	0.34
	Cons	3.98 (1.12 – 6.82)	0.01	2.17 (-0.83 - 5.17)	0.16
SSAM	**Age**	-0.40 (-0.45 - -0.35)	0.00	-0.21 (-0.25 - -0.17)	0.00
	Height	-0.02 (-0.12 – 0.08)	0.60	0.06 (-0.04 - 0.15)	0.24
	Cons	23.81 (10.89 – 36.74)	0.00	14.21 (-0.38 - 28.80)	0.06
SSVL	**Age**	-0.40 (-0.45 - -0.35)	0.00	-0.34 (-0.41 - -0.27)	0.00
	Height	-0.02 (-0.12 – 0.08)	0.74	0.15 (0.00 - 0.30)	0.05
	Cons	68.65 (51.27 – 86.03)	0.00	39.83 (15.77 - 63.88)	0.00
USDL	**Age**	0.02 (0.02 – 0.03)	0.00	0.02 (0.02 - 0.02)	0.00
	Height	0.00 (-0.01 – 0.00)	0.72	0.01 (0.00 - 0.01)	0.06
	Cons	2.05 (1.16 – 2.95)	0.00	0.90 (-0.13 - 1.93)	0.09
USAM	**Age**	-0.04 (-0.04 - -0.03)	0.00	-0.05 (-0.06 - -0.04)	0.00
	Height	0.00 (0.00 – 0.01)	0.27	-0.01 (-0.02 - 0.00)	0.14
	Cons	27.69 (26.47 – 28.90)	0.00	30.70 (28.57 - 32.82)	0.00
USVL	**Age**	-0.04 (-0.04 - -0.03)	0.00	-0.05 (-0.06 - -0.05)	0.00
	Height	0.01 (0.00 – 0.02)	0.04	0.00 (-0.02 - 0.01)	0.71
	Cons	56.47 (54.88 – 58.06)	0.00	59.19 (56.70 - 61.67)	0.00
MSDL	**Age**	0.04 (0.03 – 0.04)	0.00	0.03 (0.03 - 0.04)	0.00
	Height	-0.01 (-0.02 – 0.00)	0.05	0.01 (0.00 - 0.02)	0.24
	Cons	2.95 (1.49 – 4.40)	0.00	0.29 (-1.69 - 2.27)	0.77
MSAM	**Age**	-0.30 (-0.34 - -0.25)	0.00	-0.41 (-0.47 - -0.35)	0.00
	Height	0.12 (0.03 – 0.04)	0.01	-0.03 (-0.16 - 0.09)	0.59
	Cons	27.59 (12.68 – 42.51)	0.00	60.42 (40.24 - 80.60)	0.00
MSVL	**Age**	-0.24 (-0.27 - -0.21)	0.00	-0.26 (-0.29 - -0.24)	0.00
	Height	0.05 (-0.01 – 0.12)	0.09	-0.03 (-0.08 - 0.02)	0.20
	Cons	57.88 (47.07 – 68.68)	0.00	73.20 (65.40 - 81.00)	0.00

Table 3B: Linear Regression Model for relation of Age & Height with NCS Parameters of Motor nerves

NCS		MALES		FEMALES	
		Coef. (95% C.I)	***P***	**Coef. (95% C.I)**	***P***
UMDL	**Age**	0.02 (0.02 – 0.03)	0.00	0.02 (0.02 - 0.02)	0.00
	Height	0.01 (0.00 – 0.01)	0.02	0.01 (0.00 - 0.01)	0.03
	Cons	0.30 (-0.55 – 1.16)	0.48	0.46 (-0.39 - 1.31)	0.29
UMAM	**Age**	-0.07 (-0.07 - -0.06)	0.00	-0.08 (-0.09 - -0.06)	0.00
	Height	0.01 (0.00 – 0.03)	0.06	0.00 (-0.03 - 0.03)	0.88
	Cons	11.49 (8.95 – 14.04)	0.00	14.67 (9.78 - 19.56)	0.00
UMVL	**Age**	-0.16 (-0.19 - -0.13)	0.00	-0.17 (-0.21 - -0.13)	0.00
	Height	0.11 (0.04 – 0.18)	0.00	0.03 (-0.05 - 0.11)	0.49
	Cons	42.96 (31.24 – 54.69)	0.00	58.53 (45.56 - 71.50)	0.00
MMDL	**Age**	0.03 (0.02 – 0.03)	0.00	0.05 (0.04 - 0.05)	0.00
	Height	0.00 (-0.01 – 0.01)	0.76	0.01 (0.00 - 0.03)	0.17
	Cons	2.64 (1.01 – 4.27)	0.00	-0.92 (-3.24 - 1.41)	0.44
MMAM	**Age**	-0.04 (-0.04 - -0.03)	0.00	-0.05 (-0.06 - -0.05)	0.00
	Height	0.00 (0.00 – 0.01)	0.43	-0.01 (-0.02 - 0.00)	0.13
	Cons	12.95 (11.80 – 14.09)	0.00	15.93 (13.73 - 18.13)	0.00
MMVL	**Age**	-0.04 (-0.05 - -0.04)	0.00	-0.05 (-0.06 - -0.05)	0.00
	Height	0.00 (-0.01 – 0.01)	0.51	-0.01 (-0.03 - 0.00)	0.08
	Cons	54.95 (53.35 – 56.55)	0.00	58.09 (55.85 - 60.33)	0.00
PMDL	**Age**	0.03 (0.02 – 0.03)	0.00	0.02 (0.02 - 0.03)	0.00
	Height	0.00 (0.00 – 0.01)	0.26	0.00 (0.00 - 0.01)	0.16
	Cons	2.46 (1.48 – 3.45)	0.00	2.44 (1.56 - 3.33)	0.00
PMAM	**Age**	-0.06 (-0.07 - -0.05)	0.00	-0.04 (-0.05 - -0.03)	0.00
	Height	0.00 (-0.01 – 0.02)	0.68	-0.02 (-0.04 - 0.00)	0.02
	Cons	7.35 (4.61 – 10.08)	0.00	10.32 (7.17 - 13.47)	0.00
PMVL	**Age**	-0.51 (-0.58 - -0.44)	0.00	-0.36 (-0.42 - -0.30)	0.00
	Height	-0.02 (-0.17 – 0.12)	0.77	-0.08 (-0.21 - 0.05)	0.20
	Cons	75.93 (50.72 – 101.13)	0.00	80.04 (59.59 - 100.50)	0.00
TMDL	**Age**	0.03 (0.02 – 0.03)	0.00	0.02 (0.02 - 0.03)	0.00
	Height	0.00 (0.00 – 0.01)	0.27	0.00 (0.00 - 0.01)	0.10
	Cons	3.11 (2.14 – 4.08)	0.00	2.97 (2.09 - 3.85)	0.00
TMAM	**Age**	-0.04 (-0.04 - -0.03)	0.00	-0.05 (-0.06 - -0.05)	0.00
	Height	0.00 (-0.01 – 0.01)	0.70	0.00 (-0.02 - 0.01)	0.91
	Cons	7.53 (6.42 – 8.65)	0.00	9.11 (6.70 - 11.52)	0.00
TMVL	**Age**	-0.17 (-0.20 - -0.14)	0.00	-0.18 (-0.21 - -0.15)	0.00
	Height	0.08 (0.03 – 0.14)	0.00	0.01 (-0.05 - 0.08)	0.68
	Cons	37.77 (27.79 - 47.75)	0.00	51.03 (40.86 - 61.19)	0.00

References

1. Bruce A. Perkins and Vera Bril. Diabetic neuropathy a review emphasizing diagnostic methods. Clinical neurophysiology. 2003;114 : 1167-75
2. BoultonAJ, Vinik AI, Arezzo JC, Bril V, Feldman EL, Freeman R, Malik RA, Maser RE, SosenkoJM, Ziegler D. Diabetic neuropathies: a statement by the American Diabetes Association. Diabetes Care. 2005; 28:956- 62.
3. Kimura J. Principles and pitfalls of nerve conduction studies. Ann Neurol 1984; 16: 415–428.
4. Mcknight J, Nicholls PG, Loretta D, Desikan K V, Lockwood DNJ, Wilder- EP, et al. Reference values for nerve function assessments among a study population in northern India - III : Sensory and motor nerve conduction.. Neurology Asia. 2010;15 (1):39–54.
5. Wang SH, Robinson LR. Considerations in reference values for nerve conduction studies. Phys Med RehabilClin N Am. 1998; 9(4):907-23i.
6. Kumar BR, Gill HS. Motor nerve conduction velocities amongst healthy subjects. J Assoc Physicians India. 1985; 33: 345–348.
7. Pawar SM, Taksande AB, Singh R. Normative data of upper limb nerve conduction in Central India. Indian journal of physiology and pharmacology[Internet].2011;55(3):241–5.Availablefrom: http://www.ncbi.nlm.nih.gov/pubmed/22471231
8. Robinson LR, Rubner DE, WohlPW, Fujimoto WY, Stolov WC. Influences of height and gender on normal nerve conduction studies. Arch Phys Med Rehabil. 1993; 74: 1134–1138.
9. Hennessey WJ, Falco FJ, BraddomRL. Median and Ulnar nerve conduction studies: Normative data for young adults. Arch Phys Med Rehabil 1994; 75(3): 259–264.
10. Stetson DS, Albers JW, Silverstein BA, Wolfe RA. Effect of age, sex, and anthropometric factors on nerve conduction measures. Muscle & Nerve. 1992; 15: 1095–1104.

11. Falco FJ, Hennessey WJ, Goldberg G, BraddomRL. Standardized nerve conduction studies in the lower limb of the healthy elderly. Am J Phys Med Rehabil 1994;73(3):168–74.

12. Saeed S, M Akram. Impact of anthropmetric measures on sural nerve conduction in healthy subjects. J Ayub Med Coll Abbottabad 2008;20(4): 112-114.

Abbreviations:

Abbreviations	Full Form
CMAP	Compound Motor Action Potential
MMAM	Median Motor Amplitude
MMDL	Median Motor Distal Latency
MMVL	Median Motor Velocity
MSAM	Median Sensory Amplitude
MSDL	Median Sensory Distal Latency
MSVL	Median Sensory Velocity
PMAM	Peroneal Motor Amplitude
PMDL	Peroneal Motor Distal Latency
PMVL	Peroneal Motor Velocity
SNAP	Sural Nerve Action Potential
SSAM	Sural Sensory Amplitude
SSDL	Sural Sensory Distal Latency
SSVL	Sural Sensory Velocity
TMAM	Tibial Motor Amplitude
TMDL	Tibial Motor Distal Latency
TMVL	Tibial Motor Velocity
UMAM	Ulnar Motor Amplitude
UMDL	Ulnar Motor Distal Latency
UMVL	Ulnar Motor Velocity
USAM	Ulnar Sensory Amplitude
USDL	Ulnar Sensory Distal Latency
USVL	Ulnar Sensory Velocity

Corresponding Address:
Dr. Shaikh Shahabuddin
Assistant Professor
Department of Physiology
JIIU's Indian Institute of Medical Science and Research
Aurangabad – Jalna Road, Warudi,
Tq. Badnapur, Jalna – 431202, Maharashtra, INDIA.
E-mail: dr_shahabshaikh@yahoo.co.uk