

# Electrodiagnostic (EDX) Predictors of Sensory Neuropathy in Primary Hypothyroidism and its Association with Age and Body Mass Index (BMI): A Cross Sectional Study

Sangeeta Jain<sup>1</sup>, Balaji Ghugare<sup>1</sup>, Mukesh Dinkar<sup>2</sup>, Komal Makwana<sup>3</sup>, Ravindra Ninama<sup>4</sup>, Himanshu Chauhan<sup>4</sup>

<sup>1</sup>Associate Professor, GMERS Medical College and Hospital, Gotri Vadodara, Gujarat, <sup>2</sup>Professor & Head, GMERS Medical College and Hospital, Vadnagar, Gujarat, <sup>3</sup>Assistant Professor, <sup>5</sup>Tutor, GMERS Medical College and Hospital, Gotri Vadodara, Gujarat

## Abstract

**Background:** Sensory neuropathy occurs in hypothyroidism often early as compared to motor. Involvement of median and sural nerve is reported earliest in literature. There is controversial electrophysiological data with respect to predictors of neuropathy and its association with age and body mass index.

**Objectives:** Present study was aimed to find out EDX predictors of sensory neuropathy and its association with age and BMI in primary hypothyroidism patients.

**Materials and Method:** Total 28 out of 39 hypothyroid cases referred to clinical neurophysiology laboratory were selected for analysis. These cases satisfied the biochemical and EDX criteria. Percentages of abnormalities in different variables of nerve conduction study were calculated. Also coefficient of correlation between age, BMI and different variables evaluated for association between them if any.

**Results:** Study population was having age range from 23-75 years, 15 female and 13 male. Female preponderance was observed. Correlation between Age, BMI and different variables of NCV were statistically not significant. Sensory conduction velocity was most common abnormality observed (49%), followed by SNAP amplitude (42%) and onset latency (25%).

**Conclusion:** We concluded that age and BMI have no effect on occurrence of neuropathy in primary hypothyroidism. Sensory Conduction velocity was most common predictor of sensory neuropathy in these cases.

**Key Words:** Hypothyroidism, Neuropathy, Nerve conduction study, Onset latency.

## Introduction

Hypothyroidism is caused by the low level of circulating thyroid hormones and raised TSH. It is estimated to affect 3.8–4.6 % of general population, with four times common in women.<sup>[1]</sup> Hypothyroidism

is an endocrine disorder which results in neurological dysfunction. It also affects brain, peripheral nerves and muscular system. The neurologic manifestations, which may be noted incidentally, occur in conjunction with the systemic features of the disease. The symptoms and signs of neurologic dysfunction may be the presenting feature in some patients and can contribute significantly to disability.<sup>[2]</sup>

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### Corresponding Author:

**Dr Balaji W Ghugare**

Associate Professor Physiology, GMERS Medical College Gotri Vadodara 390021,  
email ID: mulbala@gmail.com, mob No: 9427119413.

In adults, the neurological manifestations of clinical hypothyroidism include decreased mental status, bradycardia, hypothermia, poor concentration and short-term memory, peripheral neuropathy, entrapment

neuropathy and myxoedema coma. In some patients with clinical hypothyroidism, the main and presenting manifestation may be the peripheral nerve dysfunction. In overt hypothyroidism, the frequency and severity of neuromuscular disease depends mostly upon the severity and duration of thyroid hormone deficiency.[3] In hypothyroidism, metabolic alteration occurs due to hormonal imbalance which affects the Schwann cell and induces a segmental demyelination. It has been shown electrophysiologically and pathologically that there is primary axonal degeneration.[4] The function and the ability of electrical conduction of the motor and sensory nerves can be evaluated by nerve conduction study. With the steady improvement and the standardization of these methods, nerve conduction studies have become reliable tests in clinical settings. Nerve conduction studies often can define whether the underlying pathophysiology is demyelination or axonal loss and they can differentiate between a primary demyelination and a primary axonal neuropathy.[5] Most of the studies on hypothyroidism and neuropathy evaluated prevalence of neuropathy in primary and overt hypothyroid cases and effect of age, gender, obesity, duration of disease on occurrence of neuropathy. With above background this study was done to find out the effects of age and BMI on sensory nerve conduction study variables in primary hypothyroid patients. We also evaluated the frequent EDX predictors of sensory neuropathy in these patients.

### Material and Method

A cross sectional study was done by analysing the data retrieved from 28 hypothyroid patients that were referred to clinical neurophysiology laboratory at GMERS Medical College Gotri Vadodara. Total 39 cases were referred for electrodiagnostic evaluation during period January 2015 to December 2018. All the Cases were referred from department of Medicine. Out of these 11 patients were excluded as it did not meet our clinical, EDX and biochemical criteria for inclusion. Data in these cases was insufficient. Patients suffering from diabetes mellitus, liver and kidney disease and patients with hypothyroidism secondary to pituitary disease were excluded from the study. 28 cases fulfilled above mentioned inclusion criteria and hence their data selected for analysis.

RMS EMG Portable Aleron machine was used for nerve conduction study at clinical neurophysiology laboratory, Department of Physiology. All the patients underwent Sensory nerve conduction study that included

the determination of onset latency, sensory nerve action potential (SNAP) amplitude and conduction velocity of median, ulnar nerves bilaterally.

### Procedure in brief

Sensory nerve conduction study (antidromic) involved stimulation of sensory nerves proximally and recording SNAPs with electrodes placed distally over the dermatomic distribution. Sensory nerve conduction velocity was calculated by dividing the distance between active electrode and cathode of stimulator by onset latency. Sensory nerve action potential amplitude was taken from peak to base. Ground electrode was placed between stimulating and recording electrodes.

Antidromic study was done using ring electrode. Ring electrode was placed on index finger for Median nerve on little finger for ulnar nerve. In all cases cathode and anode were 3 cm apart. For upper and lower limbs, duration was 100  $\mu$ s, sweep speed 2 ms/D and filter was between 20Hz to 3 KHz.

### Data storage and Statistical analysis

Data was stored in Microsoft excel sheet. Graph Pad prism software was used for data analysis. Correlation coefficient was obtained to see the effect of age and BMI on different nerve conduction study variables in hypothyroid cases. Demographic profile was obtained for the study population. Frequency of abnormalities in sensory nerve conduction study variables was obtained. Further, correlation coefficient to evaluate the effect of age and BMI on different variables was measured.

### Results

Total 28 cases data was selected for analysis. Out of that 15 were female and 13 were male. Table number 1 shows demographic and anthropometric profile of participants.

**Table No. 1: Demographic profile of participants in study (n=28, 15 female, 13 male)**

Parameters	Mean $\pm$ SD	Range (Minimum-Maximum)
Age (Years)	50.12 $\pm$ 13.5	23-75
Weight (Kg)	60.41 $\pm$ 11.35	45-88
Height (Cm)	158.2 $\pm$ 5.62	150-168
BMI (Kg/M <sup>2</sup> )	24.23 $\pm$ 4.89	17.6-34.2

(Note: SD- standard Deviation, Kg- Kilograms, Cm-centimetres, BMI- Body mass index, M<sup>2</sup>- Square meter)

Table number 2 shows frequency of abnormalities observed in sensory nerve conduction study parameters. Total 112 nerves (56 median and ulnar each) were

assessed for observation of abnormalities. Nerve conduction velocity abnormalities were most common and onset latency variable was least affected. Absent SNAP, Present but reduced amplitude and CV and Prolonged OL were noted as abnormalities in variables.

**Table No.2: Distribution of abnormalities in different sensory nerve conduction study variables in study population (n=112)**

NCV Variables	Right side		Left side		Total (%)
	Median	Ulnar	Median	Ulnar	
OL	6	05	09	08	28 (25%)
SNAP Amplitude	14	07	15	12	48 (42.85%)
CV	17	08	17	13	55 (49.10%)

(Note: NCV- Nerve conduction velocity, OL- Onset latency, SNAP- sensory nerve action potential)

Table number 3 shows whether BMI and age had any association with Neuropathy in hypothyroid patients or not? Table shows that there was no statistically significant association observed between age, BMI and different NCV variables (r value was <0.5 for all variables). Although a negative trend with respect to age, BMI and SNAP amplitude was observed, it was not statistically significant.

**Table No. 3: Association of age and BMI with sensory nerve conduction study variables in study population.**

NCV variables Age		Onset latency		Amplitude		Conduction velocity	
		BMI	Age	BMI	Age	BMI	
Right side	Median	-0.14	-0.16	0.021	-0.31	0.30	0.16
	Ulnar	0.008	-0.08	-0.13	0.05	0.07	0.20
Left side	Median	0.137	-0.15	-0.36	0.05	0.04	0.19
	Ulnar	0.4	0.04	-0.23	0.15	-0.03	0.27

(Note- NCV- Nerve conduction study, BMI- Body mass index, all numerical values represent ‘r’ values)

### Discussion

Present study enlightens our existing knowledge about frequently abnormal sensory NCV variables in hypothyroid patients and also about trends in abnormality of these variables with respect to age and BMI.

We analysed 112 sensory median and ulnar nerves bilaterally to find out most common predictor of neuropathy in hypothyroids. Conduction velocity was most frequently occurring abnormality (49.10%) followed by SNAP amplitude abnormality (42.85%). Onset latency abnormalities remained least common predictors of neuropathy in hypothyroid cases (only

25%).

Our observations are coinciding with the previous studies that concluded median and sural nerve demyelinating sensory polyneuropathy are common in hypothyroidism. Reduction in amplitude in 60% cases for median and sural sensory nerves and slowing of conduction velocity in 71% for these nerves was noted. In most of these studies early sensory involvement affecting prolonged latencies, reduced amplitude and CV have been observed.<sup>[6, 7, 8]</sup>

Neurological dysfunction associated with disorders of thyroid gland could be the result of hormonal imbalance or immune mechanism accompanying thyroid disease. Metabolic alteration in hypothyroidism affects Schwann cells leading to segmental demyelination which is reflected as a decrease in conduction velocity.<sup>[9]</sup>

Present study also highlighted about effect of age and BMI on different NCV variables in hypothyroid cases. Although there was no statistically significant correlation observed between age, and BMI with different variables; a negative association of advancing age and neuropathy in hypothyroidism was attributed to persistent reduction in SNAP amplitude. S Karne et al reported that there was independent correlation of advanced age and female gender with development of neuropathy among primary hypothyroid cases. They also observed that obesity was also one of the risk factor for neuropathy although we could not find any such association between BMI and EDX variables of Neuropathy.<sup>[10]</sup>

### Conclusion

We concluded that age and BMI have no effect on occurrence of neuropathy in primary hypothyroidism. Sensory Conduction velocity was most common predictor of sensory neuropathy in these cases. Onset latency of SNAP was least abnormal among different EDX variables. Smaller sample size remains major drawback of study to extrapolate findings in general population.

**Ethical Clearance:** Institutional Ethics committee was informed and permission to publish neurophysiology laboratory data from institute/department head was duly obtained.

**Conflict of Interest:** None declared

**Sources of Support:** Nil.

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