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Original Article

Physiology Section

Potential Risk of Developing Peripheral Neuropathy in Heavy Motor Vehicle Driving: A Cross-sectional Study

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ABSTRACT

Introduction: There is a growing concern regarding increasing road traffic accidents due to overburdened drivers, which also affect their general health. Drivers maintain the extreme position of arm, forearm, and legs which during distant journeys may put increased constraint on nerves passing in forearm and legs in addition to the vibrations transmission i.e., Hand Arm Vibration Syndrome (HAVS) and Foot Transmitted Vibration (FTV).

Aim: To find out if chronic repeated movements at wrist and foot along with vibration transmitted from steering wheel and pedals influence the nerve conduction parameters and to find out which nerves are more prone to neurological conduction defects.

Materials and Methods: A cross-sectional study was conducted over a period of two years in Neurophysiology Lab, Department of Physiology, JN Medical College, Aligarh Muslim University, Aligarh, Uttar Pradesh, India. Mean peak sensory and motor latency, mean motor and sensory Nerve Conduction Velocity (NCV), Sensory Nerve Action Potential (SNAP) and Compound Muscle Action Potential (CMAP) of median, ulnar and common peroneal nerve in Professional Heavy Vehicle Drivers (PHVD) was compared with non-drivers using Medicaid System's (Electromyography) EMG/ (Nerve Conduction Velocity) NCV equipment with Neuroperfect Software. Student's unpaired t-test was used to assess the significance of difference in nerve conduction study findings.

Results: Heavy vehicle drivers showed slow Sensory Nerve Conduction Velocity (SNCV) (drivers: 51.40±3.30, non-drivers: 53.66±3.60 in right hand p-value 0.0001) and (drivers: 52.51±3.78, non-drivers: 53.87±3.61 in left hand p-value=0.0145) and increase in sensory latency (drivers: 3.71±0.72, non-drivers: 2.89±0.56 in right hand p-value<0.0001 and drivers: 3.4±0.81 non-drivers: 2.76±0.70 in left hand p-value <0.0001) of median nerve. Ulnar nerve sensory latency was prolonged (drivers: 2.98±0.52, non-drivers: 2.76±0.42 in right hand p-value 0.0021 and drivers: 2.97±0.42, non-drivers: 2.80±0.65 in left hand p-value 0.0386) and sural nerve sensory latency was prolonged (drivers: 3.05±0.55, non-drivers: 2.78±0.54 in right leg p-value=0.0011 and drivers: 2.92±0.45, non-drivers: 2.69±0.40 in left leg p-value 0.0004).

There was no significant difference in Motor Nerve Conduction Velocity (MNCV), motor latency, SNAP and CMAP of median, ulnar and common peroneal nerve among heavy vehicle drivers in comparison to non-drivers.

Conclusion: We conclude that pressure and vibrations transmitted at hand and foot along with repeated movements at forearm wrist and pedals leads to more neurological conduction defects in median nerve than in ulnar and sural nerve. Flexibility in delivery time, incorporating judicious breaks in duty, better ergonomics design may help in improving work conditions of drivers.

Keywords: Carpal tunnel syndrome, Heavy vehicle drivers, Nerve conduction study, Truck drivers, Vibration

INTRODUCTION

According to a report published in 2018, about 151,417 deaths occurred in road traffic accidents [1]. Difficult driving conditions arising because of time constraint, long shifts, distant travels, and bad weather which increases the risky driving by heavy vehicle drivers leading to road accidents [2,3]. PHVDs are more prone to lifestyle disorders like diabetes and obesity [4]. Neurologic impairment like cognitive impairment, inability to balance, motor control and vision impairment adds to the morbidity and mortality in drivers [2,3]. Majority of the drivers with peripheral neuropathy involved in accident attribute their peripheral neuropathy as the cause of accident [5]. Repetitive or sustained flexion of the wrist or contraction of the muscles whose tendons pass through the carpal tunnel, especially when doing forceful work has been found to cause inflammation of tendons which can alter the space or pressure within the carpal tunnel, thus compressing the median nerve [6,7]. There is increased risk of Carpal Tunnel Syndrome (CTS) among drivers on long journeys and truck drivers [8,9]. Vibration transmitted from steering wheel and pedals called Hand Transmitted Vibration (HTV) and FTV [10] may lead to finger blanching [11], CTS [7] and white feet syndrome [9] in drivers.

Since professional drivers are responsible for driving commercial vehicles, they are viable for economic growth and completing the chain of production to the consumption. For a developing country and fast growing economy like India, the research on occupational hazard of driving on the nerve conduction in professional drivers is scanty. Singh D et al., in their study on median neuropathy among various professionals found 47% subjects with peripheral neuropathy. However, among them they found tailors to be maximally affected and drivers were moderately affected [12]. Afsar S et al., in their study on Turkish taxi drivers found peripheral neuropathy amongst 82.5% drivers [13].

The purpose of this study was to find early the neurological component of occupational health hazard of driving like peripheral neuropathies which is noticed at a late stage when considerable amount of nerve damage has occurred. This research is expected to contribute for improved and early preventive measures, better work schedules and improvements in ergonomics of truck designing.

MATERIALS AND METHODS

The present study was a cross-sectional study in which 180 subjects (90 subjects were PHVDs and 90 were non-drivers) were included and study was completed over a span of two years from November 2014 to December 2016. The study was approved by the College Human Institutional Ethical Committee (JNMCH dop: 11/14). The NCS, to estimate the motor and sensory NCV, was performed in the Neurophysiology Laboratory in the Department of Physiology, JN Medical College. For differentiating between cases and controls, subjects were grouped as controls (non-drivers) if they don't hold a valid motor driving license. They were largely medical college office staff not holding valid light/heavy motor vehicle license for more than five years.

Participants who were continuously in the profession of driving heavy vehicles like trucks at least for the last five years were considered to be PHVDs [14-17]. PHVDs with intercity/interstate booking for more than 20 days every month for last six months in booking register were included in the study. They were chosen by simple randomised sampling from the transport offices located in the city.

A total of 210 professional drivers were interviewed telephonically or face-to-face and asked to participate in the study. A total of 180 drivers were ready to participate in the study and 30 drivers refused to participate citing busy schedule, apprehension or not interested in study. Selection of the eligible participant was done after taking history.

Inclusion Criteria

Control

- Willingness (informed consent).
- Age ≥30 years.
- Normal and healthy adults male.
- Do not hold valid light/heavy motor vehicle license.

Case

- Age ≥30 years.
- Willingness (informed consent).
- Adult males in profession of truck driving at least for last consecutive five years.
- Driving trucks intercity/interstate.
- Truck driving for more than 20 days every month at least for last six months.

Exclusion Criteria

- Diabetes mellitus.
- Renal failure.
- Neuropathies associated with toxic agents e.g., metal or drugs.
- Neuropathies associated with malnutrition, alcoholic hepatitis or medication.
- Skin lesion or swelling that would interfere with nerve conduction study.
- Previous trauma to the study site.
- Hormone replacement therapy.
- Other serious illness (for example, cardiac failure or HIV infection), a family history of peripheral neuropathy.
- Subjects having any sign or symptom of sensory or motor peripheral neuropathy based on interview and clinical examination.

After screening of 180 drivers on the basis of predefined inclusion and exclusion criteria 130 drivers were shortlisted in the PHVD category. All the shortlisted participants were asked to undergo neurological clinical examination and nerve conduction study in the neurophysiology lab. Twenty eight drivers were further excluded as they were found unsuitable after clinical examination or they opted out due to apprehensions about the test, not any more interested in the study, or non-availability of dates, 12 drivers did not turn up on their scheduled date. Due to the busy schedule of the drivers and no financial support only nerve conduction study was done. A total of 180 subjects (90 cases and 90 controls) participated in the study. They were explained about the purpose and procedure of the study and written informed consent in compliance with requirements of the Helsinki Declaration taken. No monetary benefits were offered and the participation was purely voluntary.

Nerve Conduction Study

Participants (drivers and non-drivers) were explained about nerve conduction study and it's the non-invasive procedure to conduct the test. The equipment used for nerve conduction study was Medicaid System's EMG/NCV equipment with neuroperfect software.

Nerve conduction studies were performed on both the right and left side of every participant. Supramaximal stimulation was applied to obtain reliable and reproducible evoked responses in both motor and sensory nerve conduction studies. Sensory and motor latencies amplitudes and conduction velocities of the median, ulnar and common peroneal nerve were recorded [18,19].

STATISTICAL ANALYSIS

For data analysis and interpretation Statistical Package for the Social Sciences (SPSS) version 20 was used and values were expressed in mean and standard deviation. Student's unpaired t-test was used to assess the significance of difference in NCS findings between the mean values of median, ulnar, common peroneal nerve. The p-value <0.001 was considered as significant.

RESULTS

The mean age of the non-drivers was 42.4±7.5 and their BMI was 25.3±3.8. Mean age of heavy vehicle drivers was 40.2±8.30 and their BMI was 26.2±2.9 (p-value >0.05) [Table/Fig-1]. Since all the drivers were male participants we included only male non-drivers for comparison. All the participants were right hand dominant.

S. No.	Age	Non-drivers	Professional heavy vehicle drivers
1	Mean age±SD	42.4±7.5	40.20±8.30
2	31-40 year	48	53
3	41-50 years	37	34
4	>50 years	5	3
5	BMI (kg/mg_2)	25.3±3.8	26.2±2.9

[Table/Fig-1]: Demographic distribution of cases and controls.

Nerve conduction parameters of median nerve in drivers and non-drivers: In drivers there was a significant slowing in the SNCV of median nerve of both right and left side as compared to the healthy controls (non-drivers). Mean peak sensory latency was significantly prolonged in drivers in comparison to non-drivers for median nerve in right and left hand [Table/Fig-2].

Nerve conduction parameters of ulnar nerve in drivers and non-drivers: Peak sensory latencies shows significant difference in right and left hand amongst drivers but no significant difference in non-drivers [Table/Fig-3].

Nerve conduction parameters of common peroneal nerve in drivers and non-drivers: Sensory latency was significantly prolonged in drivers in comparison to non-drivers for sural nerve in right and left limb [Table/Fig-4].

Comparison of median nerve conduction parameters in right and left hand: In median nerve there was significant difference in peak sensory latencies of right and left hand in drivers but the peak sensory latencies does not show significant difference in right and left hand of non-drivers [Table/Fig-5].

S. No.	Nerve conduction study	Right/Left hand	Median nerve conduction parameters		p-value
			Non-drivers (n=90)	Professional heavy motor vehicle drivers (n=90)	
1	Mean Peak Sensory Latency	Right hand	2.89±0.56	3.71±0.72	**<0.0001**
		Left hand	2.76±0.70	3.4±0.81	**<0.0001**
2	Mean Motor Latency	Right hand	3.45±0.51	3.59±0.67	0.1165
		Left hand	3.42±0.69	3.59±0.77	0.1206
3	Mean MNCV (Motor Nerve Conduction Velocity)	Right hand	53.14±4.36	52.55±5.04	0.4021
		Left hand	51.13±3.80	52.17±3.90	0.0717
4	Mean SNCV (Sensory Nerve Conduction Velocity)	Right hand	53.66±3.60	51.40±3.30	**0.0001**
		Left hand	53.87±3.61	52.51±3.78	**0.0145**
5	Mean SNAP (Sensory Nerve Action Potential in microvolt)	Right leg	39.12±11.7	38.22±12.2	0.6141
		Left leg	40.73±12.4	40.34±10.8	0.8222
6	CMAP (Compound Muscle Action Potential)	Right leg	5.67±0.98	5.42±1.18	0.1238
		Left leg	5.54±0.80	5.40±1.42	0.4162

[Table/Fig-2]: Nerve conduction parameters of median nerve.
Student's unpaired t-test was used

S. No.	Nerve conduction study	Right/Left hand	Ulnar nerve conduction parameters		p-value
			Non drivers (n=90)	Professional heavy vehicle drivers (n=90)	
1	Mean Peak Sensory Latency	Right hand	2.76±0.42	2.98±0.52	**0.0021**
		Left hand	2.80±0.65	2.97±0.42	**0.0386**
2	Mean Motor Latency	Right hand	3.06±0.44	2.95±0.52	0.1273
		Left hand	3.23±0.60	3.13±0.65	0.2850
3	Mean MNCV (Motor Nerve Conduction Velocity)	Right hand	54.67±3.50	53.92±3.30	0.1409
		Left hand	54.77±3.42	53.9±2.89	0.0669
4	Mean SNCV (Sensory Nerve Conduction Velocity)	Right hand	54.34±4.80	53.78±3.80	0.3867
		Left hand	55.72±4.60	54.48±3.90	0.0527
5	Mean SNAP (Sensory Nerve Action Potential) in microvolt	Right leg	35.4±10.6	34.2±11.2	0.4613
		Left leg	34.2±9.8	33.8±10.7	0.7940
6	CMAP (Compound Muscle Action Potential)	Right leg	6.5±1.3	6.2±1.6	0.1692
		Left leg	6.8±1.5	6.6±1.48	0.3691

[Table/Fig-3]: Nerve conduction parameters of ulnar nerve.
Student's unpaired t-test was used

S. No.	Nerve conduction study	Right/Left lower limb	Common peroneal nerve conduction parameters		p-value
			Non-drivers (n=90)	Professional heavy vehicle drivers (n=90)	
1	Mean Peak Sensory Latency	Right leg	2.78±0.54	3.05±0.55	**0.0011**
		Left leg	2.69±0.40	2.92±0.45	**0.0004**
2	Mean Motor Latency	Right leg	4.55±0.71	4.77±0.81	0.0557
		Left leg	4.50±0.69	4.67±0.86	0.1453
3	Mean MNCV (Motor Nerve Conduction Velocity)	Right leg	50.20±4.49	49.45±5.03	0.2927
		Left leg	49.92±5.11	49.47±5.15	0.5570
4	Mean SNCV (Sensory Nerve Conduction Velocity)	Right leg	48.95±4.39	48.06±2.48	0.0958
		Left leg	48.47±3.56	47.71±2.98	0.1222
5	Mean SNAP (Sensory Nerve Action Potential) in microvolt	Right leg	4.48±0.80	4.71±1.30	0.1546
		Left leg	4.27±1.33	4.65±1.27	0.0515
6	CMAP (Compound Muscle Action Potential)	Right leg	4.94±1.83	4.89±1.80	0.8536
		Left leg	4.88±1.67	4.78±1.74	0.6945

[Table/Fig-4]: Nerve conduction parameters of common peroneal nerve.
Student's unpaired t-test was used

Comparison of ulnar nerve conduction parameters in right and left hand: In ulnar nerve there was no significant difference in the nerve conduction study parameters of right and left hand in drivers and non-drivers [Table/Fig-6].

Comparison of common peroneal nerve conduction study in right and left leg: In common peroneal nerve there was no significant difference in the nerve conduction study parameters of right and left common peroneal nerve in drivers and non-drivers [Table/Fig-7].

DISCUSSION

Nerve conduction studies are considered to be the most sensitive, reliable, and non-invasive method to test the condition of nerves. Exposure to vibration, mechanical pressure, repeated movements at the wrist may have been associated with an increased risk of developing CTS [20,21]. The individual variation in risk factors, varying workplace exposure and duration of forceful exertion has a greater risk of CTS than anthropometry [2]. On exposure to vibration, structural signs seen are demyelination of the nerve fiber (indicating

S. No.	Nerve conduction parameters	Right hand	Left hand	p-value
1	Mean peak Sensory Latency in Non-drivers (n=90)	2.89±0.56	2.76±0.70	0.1706
	Mean peak Sensory Latency in professional Heavy Vehicle Drivers (n=90)	3.71±0.72	3.4±0.81	**0.0073**
2	Mean Motor Latency in Non-drivers (n=90)	3.45±0.51	3.42±0.69	0.9721
	Mean Motor Latency in professional Heavy Vehicle Drivers (n=90)	3.59±0.67	3.59±0.77	0.8679
3	Mean MNCV (Motor Nerve Conduction Velocity) in Non-drivers (n=90)	53.14±4.36	51.13±3.80	0.7286
	Mean MNCV (Motor Nerve Conduction Velocity) in professional Heavy Vehicle Drivers (n=90)	52.55±5.04	52.17±3.90	0.9525
4	Mean SNCV (Sensory Nerve Conduction Velocity) in Non-drivers (n=90)	53.66±3.60	53.87±3.61	0.9645
	Mean SNCV (Sensory Nerve Conduction Velocity) in professional Heavy Vehicle Drivers (n=90)	51.40±3.30	52.51±3.78	0.8252
5	Mean SNAP (Sensory Nerve Action Potential) in microvolt in Non-drivers (n=90)	39.12±11.70	40.73±12.40	0.3715
	Mean SNAP (Sensory Nerve Action Potential) in microvolt in professional Heavy Vehicle Drivers (n=90)	38.22±12.20	40.34±10.8	0.2187
6	CMAP (Compound Muscle Action Potential) in Non-drivers (n=90)	5.67±0.98	5.54±0.80	0.3309
	CMAP (Compound Muscle Action Potential) in professional Heavy Vehicle Drivers (n=90)	5.42±1.18	5.40±1.42	0.9183

[Table/Fig-5]: Comparison of nerve conduction parameters in right and left median nerve.
Student's unpaired t-test was used

S. No.	Nerve conduction parameters	Right hand	Left hand	p-value
1	Mean peak Sensory Latency in Non-drivers (n=90)	2.76±0.42	2.80±0.65	0.9588
	Mean peak Sensory Latency in professional Heavy Vehicle Drivers (n=90)	2.98±0.52	2.97±0.42	0.9881
2	Mean Motor Latency in Non-drivers (n=90)	3.06±0.44	3.23±0.60	0.8195
	Mean Motor Latency in professional Heavy Vehicle Drivers (n=90)	2.95±0.52	3.13±0.65	0.8290
3	Mean MNCV (Motor Nerve Conduction Velocity) in Non-drivers (n=90)	54.67±3.50	54.77±3.42	0.8465
	Mean MNCV (Motor Nerve Conduction Velocity) in professional Heavy Vehicle Drivers (n=90)	53.92±3.30	53.90±2.89	0.9655
4	Mean SNCV (Sensory Nerve Conduction Velocity) in Non-drivers (n=90)	54.34±4.80	55.72±4.60	0.0505
	Mean SNCV (Sensory Nerve Conduction Velocity) in professional Heavy Vehicle Drivers (n=90)	53.78±3.80	54.48±3.90	0.2242
5	Mean SNAP (Sensory Nerve Action Potential) in microvolt Non-drivers (n=90)	35.4±10.60	34.2±9.8	0.4313
	Mean SNAP (Sensory Nerve Action Potential) in microvolt in professional Heavy Vehicle Drivers (n=90)	34.20±11.20	33.80±10.70	0.8068
6	CMAP (Compound Muscle Action Potential) in Non-drivers (n=90)	6.5±1.30	6.8±1.50	0.1534
	CMAP (Compound Muscle Action Potential) in professional Heavy Vehicle Drivers (n=90)	6.20±1.6	6.6±1.48	0.0834

[Table/Fig-6]: Comparison of nerve conduction parameters in right and left ulnar nerve.
Student's unpaired t-test was used

S. No.	Nerve conduction parameters	Right leg	Left leg	p-value
1	Mean peak Sensory Latency in Non-drivers (n=90)	2.78±0.54	2.69±0.40	0.8936
	Mean peak Sensory Latency in professional Heavy Vehicle Drivers (n=90)	3.05±0.55	2.92±0.45	0.8551
2	Mean Motor Latency in Non-drivers (n=90)	4.55±0.71	4.50±0.69	0.6324
	Mean Motor Latency in professional Heavy Vehicle Drivers (n=90)	4.77±0.81	4.67±0.86	0.4230
3	Mean MNCV (Motor Nerve Conduction Velocity) in Non-drivers (n=90)	50.20±4.49	49.92±5.11	0.9672
	Mean MNCV (Motor Nerve Conduction Velocity) in professional Heavy Vehicle Drivers (n=90)	49.45±5.03	49.47±5.15	0.9978
4	Mean SNCV (Sensory Nerve Conduction Velocity) in Non-drivers (n=90)	48.95±4.39	48.47±3.56	0.4215
	Mean SNCV (Sensory Nerve Conduction Velocity) in professional Heavy Vehicle Drivers (n=90)	48.06±2.48	47.71±2.98	0.3929
5	Mean SNAP (Sensory Nerve Action Potential) in microvolt in Non-drivers (n=90)	4.48±0.80	4.27±1.33	0.2009
	Mean SNAP (Sensory Nerve Action Potential) in microvolt in professional Heavy Vehicle Drivers (n=90)	4.71±1.30	4.65±1.27	0.7545
6	CMAP (Compound Muscle Action Potential) in Non-drivers (n=90)	4.94±1.83	4.88±1.67	0.8185
	CMAP (Compound Muscle Action Potential) in professional Heavy Vehicle Drivers (n=90)	4.89±1.80	4.78±1.74	0.6773

[Table/Fig-7]: Comparison of nerve conduction parameters in right and left common peroneal nerve.
Student's unpaired t-test was used

that the schwann cells are soon affected by the vibration exposure), and these abnormal changes are more pronounced than the loss of axons [22]. Signs of proliferation of non-neuronal cells such as schwann cells after vibration exposure have been detected [23]. Due to repeated nerve compression and traction the peripheral nerves while passing through anatomical compartment become too tight leading to disorders of the intraneural microcirculation, lesions in the myelin sheath and the axon [24]. There is also the accumulation of inflammatory proteins, cytokines which are released leading to a vicious circle [25].

Forearm of the truck drivers while driving, rest over steering wheel which may further increase the pressure on nerves leading to peripheral neuropathy. Changes in median nerve in the CTS are likely to be even more severe and further trauma may be added to the nerve from repetitive motions and strenuous manual work as the nerve lies closer to the vibrating source [26-28].

In the present study nerve conduction study on PHVDs and non-drivers was conducted and it was found that long-haul professional drivers, driving heavy vehicles showed conduction slowing and increased latency in the median nerve of both right (steering wheel using) hand and left (gear changing) hand in comparison to non-drivers. There was significant slowing of SNCV of median nerve in both hands, sensory latency was also significantly prolonged in PHVD in comparison to non-drivers for median nerve in right and left hand. Present study findings were similar to the findings of Singh D et al., who in their nerve conduction study on various professionals found significant number of drivers with CTS [13].

Amatya M and Khanal B in their study on taxi drivers concluded median and ulnar involvement in taxi drivers who were regularly driving for last six months [9]. In present study, on ulnar nerve only sensory latency was found to be significantly prolonged which could be due to the different driving posture of taxi drivers, as taxi drivers frequently rest their right hand over the window while driving [11].

In the present study it was found that 44% of drivers and 18% of non-drivers were having asymptomatic median nerve neuropathy in comparison to Turkish drivers who found no significant difference in median nerve conduction parameters, as Turkish drivers while left side driving used to rest their left hand on window. In Indian truck drivers right side driving could be the cause that they drive by dominant (right) hand and so they don't rest their right hand over window [12].

There was no significant slowing of motor nerve conduction studies, it may be due to the reason that sensory conduction loss occurs earlier and subjects who have developed clinical peripheral neuropathies while driving over many years were excluded based on exclusion criteria, so in present study subjects were asymptomatic for peripheral neuropathies [28]. MNCV and SNCV of ulnar nerve does not show significant difference in the nerve conduction studies. Sensory nerve conduction study of sural nerve showed significant slowing of the sensory latency in both legs. Jensen A et al., in their study amongst various type of vehicle drivers found higher incidence of CTS amongst long haul truck drivers. They concluded type of vehicle and different working conditions cause different health effects [8].

Sensory peripheral neuropathies may lead to impaired judgement of applying proper pressure over pedals for braking and accelerating. Early detection of peripheral neuropathies could prevent this impending danger and would make driving safer [22]. Though there are few studies available in this field to date, it is clear that long duration pressure with repeated movements at wrist while changing gears may lead to increased pressure on the median nerve at the carpal tunnel and sural nerve whereas ulnar nerve is less prone. Though the quality of evidence in the available literature is relatively low, it still contains numerous valuable observations and suggestions for all professionals working in this field. There is a need for further research, even in the form of preliminary or pilot studies, to assess the scope of this study in other countries. Researchers should also attempt to assess the impact of NCV on female drivers, and between age group of 18-29 years, those in remote or rural areas. In addition, because of the limited sample size, these findings may not represent the entire population. Therefore, a larger sample size might be needed so that information regarding effective therapeutic strategies can be widely disseminated among those working in this field. It is proposed that a long term cohort study should be conducted to determine progression and development of peripheral neuropathy in heavy motor vehicle drivers.

Limitation(s)

Cross-sectional design was the limitation of present study, as it cannot provide strong evidence for causality. Thus, further research should use a longitudinal design. Due to the financial constraints, busy schedule of drivers and lack of resources we are unable to do quantitative sensory testing of heavy vehicle drivers.

CONCLUSION(S)

Ulnar nerve and common peroneal nerve in truck drivers is relatively less affected by pressure induced peripheral neuropathy, vibration transmitted injury and injury due to repetitive movements at hands. In the Indian context, the present study is a unique, well-designed quantitative, observational study to target the occupational hazards of heavy motor vehicle driving on peripheral nerves; it will serve as guide for neurophysiologist and other healthcare workers, which can help in improving neurological health in drivers.

REFERENCES

[1] Ministry of Road Transport and Highways. Road Accidents in India; 2018 morth.nic.in/sites/default/files/Road_Accidednt.pdf 4-5.
[2] Burt S, Deddens JA, Crombie K, Jin Y, Wurzelbacher S, Ramsey J. A prospective study of carpal tunnel syndrome: Workplace and individual risk factors. Occup Environ Med. 2013;70(8):568-64.
[3] Gómez V, Cendales B, Useche S, Bocarejo JP. Relationships of working conditions, health problems and vehicle accidents in Bus Rapid Transit (BRT) drivers. Am J Ind Med. 2018;61(4):336-43.
[4] Dahl S, Kaerlev L, Jensen A, Tüchsen F, Hannerz H, Nielsen PS, et al. Hospitalization for lifestyle related diseases in long haul drivers compared with other truck drivers and the working population at large. Work. 2009;33(3):345-53.
[5] Cho SC, Katzberg HD, Rama A, Kim BJ, Roh H, Park J, et al. Driving with polyneuropathy. Muscle Nerve. 2010;41(3):324-28.
[6] Palmer KT, Harris EC, Coggon D. Carpal tunnel syndrome and its relation to occupation: A systematic literature review. Occup Med (Lond). 2007;57(1):57-66.
[7] Zakaria D, Robertson J, MacDermid J, Hartford K, Koval J. Work-related cumulative trauma disorders of the upper extremity: Navigating the epidemiologic literature. Am J Ind Med. 2002;42(3):258-69.
[8] Jensen A, Kaerlev L, Tüchsen F, Hannerz H, Dahl S, Nielsen PS, et al. Locomotor diseases among male long-haul truck drivers and other professional drivers. Int Arch Occup Environ Health. 2008;81(7):821-27.
[9] Amatya M, Khanal B. Median and ulnar nerve functions in taxi/microbus drivers and helpers in Kathmandu. Journal of Kathmandu Medical College. 2020;8(3):151-55.
[10] Eger T, Thompson A, Leduc M, Krajnak K, Goggins K, Godwin A, et al. Vibration induced white-feet: Overview and field study of vibration exposure and reported symptoms in workers. Work. 2014;47(1):101-10.
[11] Goglia V, Grbac I. Whole-body vibration transmitted to the frame saw operator. Applied Ergonomics. 2005;36(1):43-48.
[12] Singh D, Singh GK, Srivastava S. Carpal tunnel syndrome among occupational workers in India. Proceedings of the Human Factors and Ergonomics Society Annual Meeting. 2013;57(1):883-86.
[13] Afsar S,Cetin N, Ayas S, Mumcu GA, Karatas M. Ulnar nerve conduction abnormalities in turkish taxi drivers. Arch Rheumatol. 2014;29(2):110-17.
[14] Solecki L. Assessment of annual exposure of private farmers to whole body mechanical vibration on selected family farms of plant production profile. Ann Agric Environ Med. 2010;17(2):243-50.
[15] Solecki L. Preliminary recognition of whole body vibration risk in private farmers' working environment. Ann Agric Environ Med. 2007;14(2):299-94.
[16] Boshuizen HC, Bongers PM, Hulshof CT. Self-reported back pain in fork-lift truck and freight-container tractor drivers exposed to whole-body vibration. Spine. 1992;17(1):59-65.
[17] Kumar A, Varghese M, Mohan D, Mahajan P, Gulati P, Kale S. Effect of whole-body vibration on the low back. A study of tractor-driving farmers in north India. Spine (Phila Pa 1976). 1999;24(23):2506-15.
[18] Buschbacher RM, Prahlow ND. Manual of nerve conduction studies. 2nd ed. New York: Demos Medical Publishing; 2006.

[19] Mishra U, Kalita J. Clinical Neurophysiology. 2nd ed. Elsevier India; 2006. ISBN: 9788131203040.

[20] Lund CB, Mikkelsen S, Thygesen LC, Hansson GÅ, Thomsen JF. Movements of the wrist and the risk of carpal tunnel syndrome: A nationwide cohort study using objective exposure measurements. Occup Environ Med. 2019;76(8):519-16.

[21] Riccò M, Signorelli C. Personal and occupational risk factors for carpal tunnel syndrome in meat processing industry workers in Northern Italy. Med Pr. 2017;68(2):199-99.

[22] Ho ST, Yu HS. Ultrastructural changes of the peripheral nerve induced by vibration: An experimental study. Br J Ind Med. 1989;46(3):157-54.

[23] Chang KY, Ho ST, Yu HS. Vibration induced neurophysiological and electron microscopical changes in rat peripheral nerves. Occup Environ Med. 1994;51(2):130-35.

[24] Alfonso C, Jann S, Massa R, Torreggiani A. Diagnosis, treatment and follow-up of the carpal tunnel syndrome: A review. Neurol Sci. 2010;31(3):243-42.

[25] Gold R, Stoll G, Kieseier B, Hartung H, Toyka K. Experimental autoimmune neuritis. In: Dyck PJ, Thomas PK, editors. Peripheral neuropathy. 4th ed. Amsterdam (NL): Elsevier; 2005. pp. 1391-02.

[26] Pelmear PL, Taylor W. Carpal tunnel syndrome and hand-arm vibration syndrome: A diagnostic enigma. Arch Neurol. 1994;51(4):416-20.

[27] Takeuchi T, Futatsuka M, Imanishi H, Yamada S. Pathological changes observed in the finger biopsy of patients with vibration-induced white finger. Scand J Work Environ Health. 1986;12(4 Spec No):280-83.

[28] Wang L. Electrodiagnosis of carpal tunnel syndrome. Phys Med Rehabil Clin N Am. 2013;24(1):67-77.

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