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Incidence Of Work-related Musculoskeletal Pain Due To Vibration In Bus Drivers – A Survey Study

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Abstract: **Context**: Professional bus drivers form a major occupational group in transportation sector who are at high risk of developing back pain and neck pain from prolonged sitting and vehicular vibration. From various studies, it was revealed that these are the highest rates of musculoskeletal disorders in bus drivers. An adequate knowledge of ergonomically designing of driver's seat can prevent a lot of discomfort and maximize productivity.

Aims: The aim of this study was to find out the percentage of work-related musculoskeletal pain due to vibration among BEST bus drivers by using a Whole-body Vibration Health Surveillance Questionnaire.

Methods and Material: The present cross-sectional study was conducted at Wadala and Sewri bus depot on 210 bus drivers. Data was collected by interview method using Whole-body vibration health surveillance questionnaire.

Statistical analysis : Descriptive statistical data analysis was done using Statistical Package for Social Science software.

Results: It was found that 85.7 % of participants reported musculoskeletal pain and 14.3% had no pain. It was seen that 41.4% had vertical vibration discomfort, whereas 34.3% had no vibration discomfort. It was found that painful area was highest in low back(35.7%), shoulder(20%) and neck(12.9%) followed by knee(11%), upper back(3.8%), ankle/feet(1%), elbow(1%) and wrist/hand(0.5%).

Conclusions: The study conducted that work-related musculoskeletal pain due to vibration among bus drivers is found to be high and hence it can be reduced by designing the driver's seat ergonomically. Thus, low back pain, shoulder pain and neck pain are the most common sites of pain reported among bus drivers.

Index Terms : Work-related musculoskeletal disorders, bus drivers, whole body vibration

I. INTRODUCTION

Literature states that bus drivers are prone to develop musculoskeletal injuries due to nature of job.[1] The term work-related musculoskeletal disorders (WRMSDs) are defined as impairments of the musculoskeletal system caused or aggravated primarily by work itself or by the environment in which work is performed. Bus drivers are at high risk of developing back pain and neck pain from prolonged sitting and vehicular vibration. [2] Higher rates of WRMSDs are reported in driving occupation, as per a health and safety executive (HSE) report, 2015 from the UK. Another recent finding published by US Bureau of Labor Statistics

in 2017 indicates that bus drivers are one of the top three occupations prone to have musculoskeletal disorders with highest incidence rate.[1]

Several factors have been identified as being important occupational stressors contributing to the onset and development of back trouble but the two main ones are postural stress and long-term exposure to whole body vibration (WBV). [3] There are many questionnaires which are used for evaluation of musculoskeletal disorder.[4] Rapid work pace, repetitive motion patterns, insufficient recovery, heavy lifting and non-neutral body postures and whole-body vibration (WBV) are risk factors that can contribute to the onset and development of low back disorders. WBV can increase muscle forces and muscle fatigue, decrease the disc height in the lumbar spine, elevate spinal load and fatigue-induced micro-fractures have been reported in in vitro lumbar vertebral endplates from transient impulsive WBV exposures, which may be led to subsequent disc degeneration. [5]

Whole body vibration is the frequency transfer to the whole body while seated in a moving vehicle. The higher a person's exposure to whole body vibration (WBV), the poorer is their performance due to exposure to lower back pain (LBP) symptoms preventing them from focusing to their highest level. [6] The aims of health surveillance with respect to whole-body vibration are to assess health status and diagnose vibration-induced disorders at an early stage, to inform the workers on the potential risk associated with vibration exposure, to give preventive advice to employees.

Biodynamic and physiological experiments have shown that seated WBV exposure can affect the spine by mechanical overloading and excessive muscular fatigue supporting the epidemiological findings, supporting the possible causal role of WBV in the development of back trouble. Several data show that in particular the combination of prolonged sitting and exposure to WBV may increase the risk of spinal damage. [6] It is suggested that periodic medical examination should be made available at least every two years to all Vibration Injury Network Appendix W1A to Final Report Biomed 2 project no. BMH4-CT98-3251 7 workers who are exposed to WBV. [6]

An adequate knowledge of ergonomically designing of driver's seat can prevent a lot of discomfort and maximize productivity. Hence, it is important to find out percentage of WRMSDs due to vibration among bus drivers.

II. METHODOLOGY

Study design was a cross-sectional study using convenience type of sampling. This study was conducted at Mumbai region
(Wadala and Sewri) bus depot. The sample size was 210 bus drivers.

Inclusion criteria
a. Subjects working as professional bus drivers for at least 1 year.
b. Subjects of 25-45 years of age.

Exclusion criteria
a. Incomplete responses.
b. Non-consent to participation.
c. Any participant with accidents or trauma, those with a congenital deformity, serious neurological condition, limb injuries
prior to the starting the job.

Instrumentation:
1) Consent form.
2) Information sheet.
3) Data collection sheet.
4) Whole-body vibration health surveillance questionnaire.

III. PROCEDURE

The ethical clearance was obtained from the Institutional Ethics Committee of TMV's Lokmanya Tilak College of Physiotherapy, Kharghar and from the Wadala bus depot for the study. One on one interview was done. Information was gathered by visiting bus depots in Mumbai region (Wadala and Sewri) during their break time. The purpose and the procedure of the study was clearly explained to the participants and informed consent was taken.

General characteristics of the participants working as bus drivers was obtained and later the Whole-body vibration health surveillance questionnaire was administered to the participants. Participants marked the answer of the questions present in questionnaire. The questionnaires collected was screened and converted into computer-based spreadsheets to exclude any incomplete questionnaire or participants who did not meet the inclusion criteria. Interpretation and results were analyzed accordingly using SPSS software.

IV. DATA ANALYSIS AND RESULTS

Descriptive statistical data analysis is done using Statistical Package for Social Science (SPSS) software. The mean age of bus drivers in our study was 37.3 years (Standard Deviation [SD] : 4.84 years).

1) Pain Profile : In fig 1.1, it can be seen that 85.7 % of participants reported musculoskeletal pain and 14.3% had no pain

Table1.1 : Representing descriptive statistics on musculoskeletal pain prevalence

Valid Pain	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	180	85.7	85.7	85.7
No	30	14.3	14.3	100.0
Total	210	100.0	100.0	

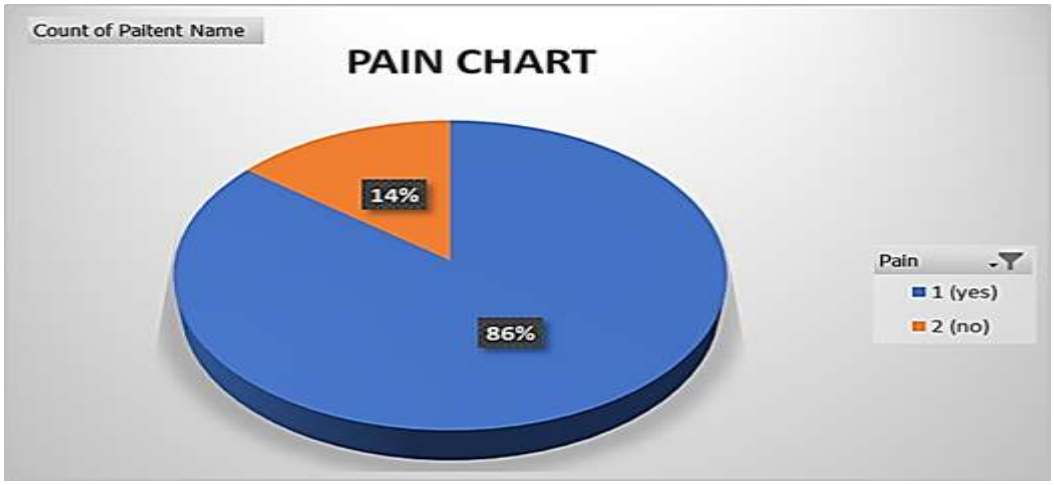

Figure 1.1 : A pie chart representing percentage of musculoskeletal pain in bus drivers

2) Classification based on area of pain : In figure 2.1, it can be observed that painful area caused by vibration is highest in low back(35.7%), shoulder(20%) and neck(12.9%) followed by knee(11%), upper back(3.8%), ankle/feet(1%), elbow(1%) and wrist/hand(0.5%).

Table 2.1 : Representing descriptive statistics on area of musculoskeletal pain

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Low back	75	35.7	35.7	35.7
Neck	27	12.9	12.9	48.6
Shoulder	42	20.0	20.0	68.6
Elbow	2	1.0	1.0	69.5
Wrist/Hand	1	0.5	0.5	70.0
Upper back	8	3.8	3.8	73.8
Knee	23	11.0	11.0	84.8
Ankle/feet	2	1.0	1.0	85.7
No pain	30	14.3	14.3	100.0

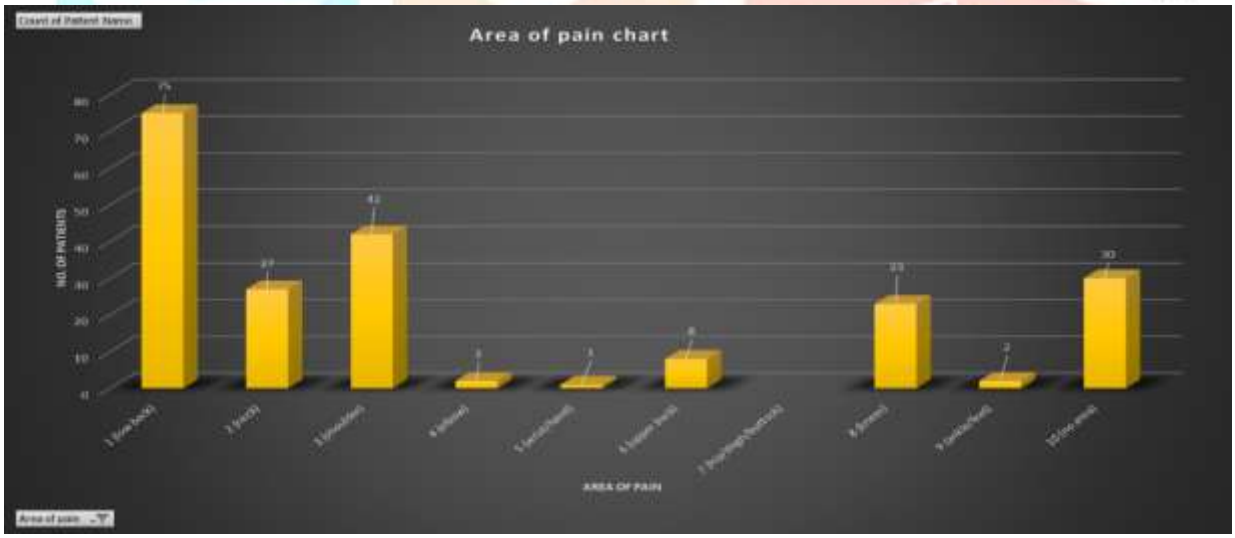

Figure 2.1 : A histogram representing classification based on area of pain

3) Classification based on vibrational discomfort : In figure 3, it can be observed that vertical vibration discomfort(41.4%) is more than fore/aft(11.9%) and side-to-side(12.4%) whereas 34.3% have no vibration discomfort complaints

Table 3.1 : Representing descriptive statistics on vibrational discomfort

Valid	Frequency	Percent	Valid Percent	Cumulative percent
Vertical	87	41.4	41.4	41.4
Fore-aft	25	11.9	11.9	53.3
Side to side	26	12.4	12.4	65.7

No discomfort	72	34.3	34.3	100.0
Total	210	100.0	100.0	

Figure 3.1 : A histogram representing classification based on vibrational discomfort

4) Classification based on posture adopted during driving: In fig 4. It can be observed that bent forward posture (30%) and lean against the back rest (70%) were the most preferred posture while driving bus.

Table 4.1 : Representing descriptive statistics on posture adopted during driving

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Bent forward	63	30.0	30.0	30.0
Lean against the back rest	147	70.0	70.0	100.0
Total	210	100.0	100.0	

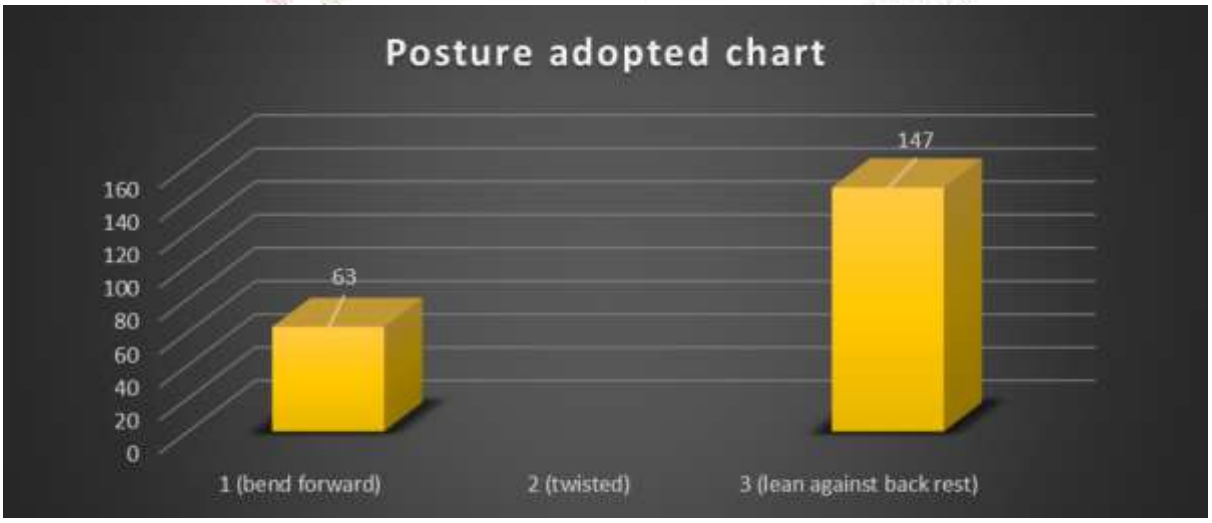

Figure 4.1 : A histogram representing classification based on posture adopted during driving

V. DISCUSSION

The aim of the study was to find out the incidence of work-related musculoskeletal pain due to vibration in BEST bus drivers using the Whole-body Vibration Health Surveillance Questionnaire in Wadala, Dadar and Sewri.

In the present study, the participants were in the age group of 25 to 45 years. The majority of bus drivers reported that they had experienced WRMSDs at some time. Out of the total sample of 210 male bus drivers in Wadala, Dadar and Sewri 180 reported that they had WRMSDs. The prevalence of WRMSDs among bus drivers was 85.7%. Various studies show that there are higher prevalence rates of these disorders in bus drivers. Anderson et al found the prevalence to be 80.5% in bus drivers. Also, Ojo et al found similar results that 77% of the bus drivers in Nigeria reported that they had experienced WRMSDs at some time.[7]

The higher prevalence among bus drivers in the present study suggests that they are exuberantly predisposed to WRMSDs. Various risk factors contribute in the development of such kind of disorders. These include individual risk factors, work related physical risk factors as well as work related psychosocial and occupational risk factors. The number of hours spent in driving per week and years of work experience contributes significantly to pain intensity.[4] This result is in accordance with that of Porter et al and Pietri et al, that increased time of driving was a major risk factor in development of musculoskeletal pain among drivers.[8] Vibration exposure in the seat is higher as compared with the floor for the bus. [9]

In present study, the prevalence of low back pain was highest among the bus drivers that is 35.7%, then shoulder pain 20%, neck pain 12.9%, knee pain 11%, upper back 3.8%, ankle/feet 1%, elbow 1% and wrist/hand 0.5%. Thus, low back pain, shoulder pain and neck pain are the most prevalent WRMSDs amongst bus drivers. Bent forward (30%) and lean against the back rest (70%) were the most preferred posture while driving bus among participants of age 25-45 years. Poor posture which is maintained for prolonged period of time can lead to MSP among individuals. Higher prevalence of low back pain can be due to prolonged sitting which not only induces greater loading on intervertebral disc by increasing intradiscal pressures but also because of continuous low load vibration which causes greater creep in the soft tissues.[4] Pope et al suggested that axial loading of spine for prolonged period leads to fatigue of back muscles and increased compression of discs which there by increases the risk of sustaining serious injuries to the spine.[9] The reason could be that when frequency and duration of prolonged posture leading to loading exceeds the ability of muscle and tendon to adapt, inflammation occurs which is followed by degeneration, micro tears, and scar formation.[4]

Lewis CA et al suggested that significant negative effects of whole-body vibration are present on joint tissues. In this research examination of the knee joints after just four weeks of daily exposure to whole-body vibration revealed focal damage to the articular cartilage resembling osteoarthritis, as well as damage to the spine resembling disc degeneration. 5 This results in high prevalence of low back pain and knee pain among bus drivers due to vibration exposure. However, the advantage of the present study is that it gives a clue on the prevalence of WRMSDs in bus drivers with a broad population surveyed.

FUTURE SCOPE : Further studies can be carried out by assessing how seat and vehicle characteristics affect and influence WBV exposure. The findings can be used to support the future study related to factors impacting musculoskeletal problems in bus drivers.

VI. CONCLUSION

The study conducted that WRMS pain due to vibration among bus drivers is found to be as high as 85.7% and hence it can be reduced by designing the driver's seat ergonomically. Thus, low back pain, shoulder pain and neck pain are the most common sites of pain reported among bus drivers.

Therefore, present study results strongly indicate the need for education awareness on ergonomic advice and other precautions for prevention of WRMSDs in bus drivers should be made mandatory in order to decrease the risk of WRMSDs which may help in improving their quality of life.

VII. LIMITATIONS

Drivers were not willing to disclose their problems as to continue in the job they need a fitness. So, the information may not be reliable. While the current study presented the incidence of WRMSP among bus drivers, the risk factor associated with MSP were not studied which could be a limitation in study. The study only measured musculoskeletal symptom i.e. pain and vibration discomfort but did not include other aspect such as psychological health and job satisfaction. All the data is self - reported, therefore the data could be subjected to method bias. Lastly, it's a survey study so the effect and cause of pain are not well defined so results of study are somewhat limited

VIII. ACKNOWLEDGMENT

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