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Pre - Mapping of Health Related Risk Factors in Auto Rickshaw Drivers of Navi-Mumbai and Analysis of Posture using OWAS (Ovako Work Assessment System)

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Abstract

Auto rickshaw drivers have a lifestyle that is not conductive to good health. Work Related Musculoskeletal disorders (WRMSDs) are the most prevalent work-related disorders and injuries and leading cause of disability. The main cause is inappropriate posture, manual material handling, repetitive movements, body vibrations, exposure to pollutants, and organisational problems. This study aims to identify the health-related risk factors and analysis of posture of auto rickshaw drivers. A sample of 140 Autorickshaw drivers at areas of Navi-Mumbai were surveyed using a pre-mapping assessment tool provided by EPM (Ergonomic of posture and movement) and analysing the different postures gained by Autorickshaw drivers was assessed using OWAS (Ovako work Assessment System).In the present study it is found that automatic ignition has been found to be significantly associated with musculoskeletal pain, spine and lower limb awkward posture with moderate risks. OWAS evaluates the posture of the back and found out that majority of the drivers fell under severe risks with bent and twisted postures. A Pearson's chi square test was performed to determine the association between two categorical variables. The risk factor which is most likely adopted by auto rickshaw drivers is the forward bent and twisted sitting posture.

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Keywords

Auto rickshaw drivers, Health related risk factor, WRMSDS (Work Related Musculoskeletal Disorders), EPM (Ergonomic of posture and movement), OWAS (Ovako Work Assessment System).

Introduction

In India auto-rickshaw are the main mode of public transport. These auto-rickshaws are a cheap and easily available source of public transport in most of the cities. As for any other professional drivers; drivers of these autorickshaws are exposed to many kinds of risk due to their profession. The majorities of the drivers remain unaware of the health effects of noise and polluted air this is the main causes of the occupational hazards of auto and other drivers. Auto drivers have a lifestyle that is not conducive to good health. In addition to their exposure to noise and air pollution the job does not provide the same opportunities for social contact as many other jobs, and shift work, unsocial hours etc can disrupt both home life and social activity. Sitting in the driving position exerts considerable forces on the spine and can cause a number of problems with the musculoskeletal system in particular back pains, headaches, stress, and general stiffness. The driving posture can cause problem to the digestive system.[1]

The environment in which drivers spend majority of their time is polluted, noisy and dangerous. Drivers are exposed to harmful environment like pollutant gases, continuous noise and the entire body vibrations as well

harmful lifestyle like irregularity of meals, bad posture while driving and stressful occupational conditions due to their working conditions. Ergonomic can be defined simply as the study of work. More specifically, ergonomics is the science of designing the job to fit the worker, rather than physically forcing the worker's body to fit the job. [2]Work Related Musculoskeletal Disorders are the most prevalent work-related disorders and injuries and leading cause of disability. The main cause of "WRMSDs" are inappropriate body postures, manual material handling, repetitive movements, body vibrations. [3]

Auto- rickshaw drivers faced common risk factors like Smoking, Obesity, Hypertension (Blood Pressure), Alcohol and drug abuse, Stress, fatigue, Sleep apnea, Poor eating habits, and Physical Inactivity and also some of the Occupational Health Diseases like Blood Pressure, Back Pain, Cardiovascular Diseases, Headache, Stomach pain, Musculoskeletal Disorders and also Psychological distress.[1]

A lot of study has been conducted worldwide on the prevalence of various risk factors or posture assessment among truck, bus and taxi drivers but no study is ever done in auto-rickshaw drivers of India. So this study was conducted with objectives of finding how the health related problems in Auto-rickshaw drivers and also the risk factors that may cause musculoskeletal disorders. To find out the awkward posture while driving an Autorickshaw using OWAS (Ovako work Assessment System) and levels of action category which gives guidelines as to whether the postures are harmful or not and do they need immediate changes or not.

Job Analysis

They have to work for 9-10 hours in a day in an environment of excessive exposure to organic dust (Roadside Dusts); Chemicals (Petrol, CNG).

Task Analysis

Their work compromises:-

Repeating the Same motion like when the foot are active [i.e when they are actively being used – the right foot on the gas (accelerator) pedal, the left on the brake, and in stick shift also on the clutch], they cannot be used to support and stabilize the lower body as it normally happens when they are placed on the floor during normal sitting in chair.

Driving rickshaw in awkward position or unsupported position like bending and twisting that stretch physical limits, can compress nerves and irritate tendons.

Driving as a task also involves excessive vibrations which decrease blood flow, damage nerves, and contribute to muscle fatigue also there is an involvement of Whole Body Vibration and it can affect skeletal muscle and causes low back pain.

Working in extreme temperature like too hot or too cold.

Working more than 8 hours/ day.

Job Demands

Their job demands include an sedentary Lifestyle and Unhygienic environment of workplace which leads to a great amount of Postural impairments and Pulmonary and Respiratory problems respectively. Thus purpose of the present research was to find the awkward posture and workplace environment risk factors that could cause low back pain, shooting pain or Numbness in upper legs or whole body vibrations which lead to back disability (discomfort) along with work related musculoskeletal disorders. It occurs when the physical capabilities of worker do not match the physical requirement of job.

Materials and Methods

It was a cross-sectional study and the data has been collected by direct method from Auto Rickshaw Drivers. 140 Autorickshaw Drivers of Navi Mumbai with auto rickshaws of manual and automatic ignition were included in this study. Each subject were explained about the use of this study. The Consent form and the Information Sheet was been taken in Hindi / Marathi (written) and it has an understandable language and involve sufficient information to make an informed decision for participants whether to take part in research or not and also the information shall be kept confidential. Prior to the Commencement of data collection the subjects were asked to fill the Consent Form. The demographic details like Age, Gender, Height, Weight, BMI was documented. A sample of 140 Auto-rickshaw drivers was been surveyed for the potential risk for Work Related Musculoskeletal disorders (WRMSDs) and hazards of work environment using a Pre-Mapping Assessment tool. Pre-mapping done using EPM Questionnaire. The risk assessment done according to the classification of colour marking obtained on assessment. Levels of Risk Factors according to first level of pre-

mapping was as follows: [Table 1] Levels of risk factors are calculated as per the responses of the drivers and were denoted by the colour coding in the software.

Work related hazards were used to assess the Qualitative risks of Biomechanical overload of Manual Handling, pollutant, and repetitive Movements, twisting movements and long hours of working in awkward position.

OWAS is a postural assessment method that is conducted by encoded postures [Fig. 1]. This method often evaluates the posture of the Back (4 Postures), Arms (3 postures), legs (7 postures), and displaced load in the form of 3 items. Each posture of the OWAS is determined by the four digit code in which the numbers indicates the posture of the back, the arms, legs and the load needed [Table 2] and then according to that it shows the amount of MSK risk level and priority of ergonomic intervention and modification.

Each OWAS posture code then will be analysed by using the individual OWAS classified posture combination to get the action category for each work phases. The classification for individual posture combination indicating the level of risk injury for the musculoskeletal system. If the risk for musculoskeletal disorder is high, then the action category indicated the need and urgency for corrective actions.

The action categories for each individual postures are presented in *Figure 2* and explanation about OWAS action categories for prevention shows at *Table 3*. Prolong time spending in one particular posture may cause musculoskeletal injury. Therefore, the next analysis is identifying the OWAS action category by calculate the total time spent in different postures for each body part for one complete work task.

Results and Discussion

Navi-Mumbai is an urban conglomerate which has come up in last 30 years where Autorickshaws constitute major means of private transport, unlike neighbouring metro cities of Mumbai where taxis are the main mode of private transport. This study was conducted with an aim to identify the health-related risk factors in Autorickshaw drivers of Navi Mumbai and assessment of posture using OWAS (Ovako Work Assessment System).

Ergonomic of Posture and Movement (EPM) assessed factors like Biomechanical overload of upper limb in repetitive tasks, Pushing and pulling, awkward posture of spine and lower limb. Physical factors like lighting, UV radiations, Noise, Micro-climate issues, equipment / tools, Vibrations, machinery, chemical and biological factors like pollutants etc. Organisational factors like shift work, work rate or duration of work were also assessed based on the responses of the subjects on the EPM risk pre-mapping tool.

Biomechanical overload assessment showed that all the Autorickshaw drivers were at moderate risk of overloading their upper limb in repetitive task whereas biomechanical overloading due to manual pushing and pulling activities have no significant risk in Autorickshaw drivers. When assessed for Biomechanical overload for spine and lower limb awkward posture, 9% fell in mild risk category, 58% fell in Moderate risks category, 33% fell in severe risks category; i.e postures having a very harmful effect on musculoskeletal system for which corrective actions should be done as soon as possible. A study among Autorickshaw drivers in Vashi, Navi-Mumbai reported that musculoskeletal pain was the major complaint in 95 (59.74%); Majority 50.3% had a lower back pain followed by knee pain 22.6% [4]A study among urban taxi drivers in Ghana reported a prevalence of musculoskeletal disorders as 70.5% with low back pain in 34.3% and knee pain in 10.0%.[5] In a study at Guntur city low back pain was the main complaint in 63.66% followed by knee pain in 52.33% of the Autorickshaw drivers.[6]

According to EPM Category of Risk Factor, questions for identification of inside lighting problems as for all the other sections of pre-mapping form. It involved generalised and localised lighting both at the work station. The results showed that 49 drivers were at severe risks, 30 at moderate risks, 18 at mild risks whereas remaining 43 drivers reported that they were comfortable and thus showed a low-level risk in green colour coding. Questions for identifying problems related to UV Radiations or Climate factors, 65% ARD reported that it affect them for a significant part of the year and thus it shows a mild risk for the drivers. Questions for identifying problems related to noise i.e whether the task involves verbal communication with other people at workplace and does it bother to the ARD. It showed that it was a distracting factor for ARD and that it has moderate risk at their workplace while driving. TirtharajSen reported in his study conducted on noise exposures from Autorickshaws suggested that noise exposure and noise induced hearing loss can interfere with the safety of driver daily life. [7].A study Questions

for identifying problems relating to the microclimate i.e does it feel hot or does it feel cold with description of the duration: only in summer, winter or all year long. The ARD complained of heat all year long as they work out doors and are at moderate risks for the same. Questions for identifying problems relating to equipment / tools showed that the rickshaws overheat easily due to open environment, some rickshaws are of manual ignition so they are reported as technologically backward and they need excessive attention while some are adequate and in good condition of maintenance. Kirkorowics J *et al.*, (2013). In their study among three-wheeler drivers found that the most frequent health complaint was musculoskeletal pain. This was most likely linked to occupation. The survey indicated that the primary cause of musculoskeletal pain (which included LBP, shoulder and knee pains) was due to vibration and staying in the same position for hours.[11] However in this study questions for identifying problems relating to vibrations, 61% reported that it does not affect the ARD while driving and however the result was not significant in this study. Whole body vibration and posture adopted in driving like sitting in driving position over a long period of time exert considerable forces on spine and can cause back pain, neck problems, pulled muscles and general stiffness. Questions for identifying problems relating to pollutants (chemical risk, biological risk) and other specific risk factors which helped to detect the presence and quantity of any pollutants. Out of 140 ARD 110 reported that they are exposed to roadside dusts, and chemicals like CNG and so they are under severe risks for the same. A study done by Satheeshbabu Kollambalath found that 85% of the drivers has been suffering badly from the issues like Cardiovascular diseases and undergo severe health issue due to prevalence regular traffic congestion under which toxic automobile exhaustion like CO2 and carbon monoxide are close to noise bound to do the duty.[8] Questions for identifying organisational problems i.e Shift type and duration and forced working rate are the main factors that can potentially cause organisational problems. 82% ARD reported that they have several day shifts and their work rate exceed more than 8 hours per shift and are under severe risk.

According to **Table 7**, the results of this study indicated that 58% of Autorickshaw drivers have spine and lower limb awkward posture with 77% of automatic ignition type of vehicle. Therefore, automatic ignition has been found to be significantly associated with musculoskeletal pain, spine and lower limb awkward posture with moderate risks. The descriptive analysis showed that except vehicle type none of the independent variable were risk factor for awkward posture.

OWAS (Ovako Work Assessment System) is a postural assessment method that is conducted by encoded postures. The result from OWAS analysis was used to identify the awkward postures. From OWAS action category table we can identify which body segments bring discomfort to the driver. Besides the level of Action-Category it also gives a guideline to the observer whether the working postures are in harmful or not and whether it needs to be change immediately or not. According to **Table 8;**OWAS evaluates the posture of the back and found out that 65(46.4%) drivers fell under severe risks with bent and twisted postures. 100% drivers have no risks for arms and legs as arms are always below the shoulder level while driving and legs are in sitting position while doing task so no involvement or no such risks are seen for arms and legs. It is found that 64 (46%) drivers fall under Action Category 4 and are at severe risks, whereas 47 (34%) fell under moderate risks and 25 (18%) fell under mild risks and remaining found to be normal. The drivers who fall in category 4 while driving rickshaw i.e awkward posture having a very harmful effect on the musculoskeletal system and corrective actions for improvement required immediately. Previous literature indicates that working posture in which the individual is mostly bending or rotating, is in flexion or lateral bending, is twisting and or is in an awkward posture, doing the same activity continuously, eventually is a cause of muscle fatigue. [9.10]Sedentary work like driving causes LBP, where driver's hip at an angle of 90^0 or less produces continuous pressure over lumbar discs which may lead to degeneration of the lumbar spine.
Autorickshaw drivers are susceptible to various health related problems and there is a need of monitoring on an ongoing basis. ARD work in extreme awkward postures at their workplace which makes vulnerable to health hazards. The risk factor for awkward postures in ARD is the forward bent and twisted sitting posture which is frequently adopted by ARD while driving. The findings of this study indicate the obvious need of ergonomic considerations while designing the vehicle and provide ergonomic evaluation for ARD while driving.

Table.1 EPM (Ergonomic of Posture and Movement) Pre Mapping Colour Coding.

GREEN	0-10%	Acceptable; no further actions are required.
YELLOW	11-50%	Neither acceptable nor critical – risk assessment will have to be carried out using the analytical methods.
RED	51- 99%	Neither acceptable nor Critical- risk assessment will have to be carried out using the analytical methods.
PURPLE	100%	Critical Code.

Table.2 Ovako Work Assessment System Posture Code Definition

Body Parts	OWAS Code	Description of position
Back	1	Back Straight
	2	Back Bent
	3	Back Twisted
	4	Back Bent and Twisted
Arm	1	Both arms below the shoulder level
	2	One arm at or above the shoulder level.
	3	Both arms at or above the shoulder level
Leg	1	Sitting
	2	Standing on both straight legs
	3	Standing on one straight legs
	4	Standing or squatting on both feet, knees bent
	5	Standing or squatting on one foot, knee bent
	6	Kneeling on one or both knee
	7	Walking or moving
Load Handle	1	Load < 10kg
	2	10 < Load < 20kg
	3	Load > 20kg

OWAS: Ovako work assessment system

Table.3 The Ovako Work Assessment System Action Categories for Prevention

ACTION CATEGORY	**EXPLANATION**
1	Normal and natural postures with no harmful effect on the musculoskeletal system – No actions required
2	Postures with some harmful effect on the musculoskeletal system – Corrective actions required in the near future.
3	Postures have a harmful effect on the musculoskeletal system – Corrective actions should be done as soon as possible.
4	The load caused by these postures has a very harmful effect on the musculoskeletal system – Corrective actions for improvement required immediately.

Resource: (Karwowski and Marras, 2003)

Table.4 Relationship of Risk Factor of Spine and Lower Limb Posture and the Type of Ignition of Autorickshaw Drivers of Navi-Mumbai.

			AI	MI	TOTAL
SPINE AND LL POSTURE	**MILD RISK**	**Count**	11	1	12
		% within Spine LL Posture	91.7%	8.3%	100.0%
		% within Vehicle Type	10.2%	3.1%	8.6%
		Residual	1.7	-1.7	
	MODERATE RISK	**Count**	67	14	81
		% within Spine LL Posture	82.7%	17.3%	100.0%
		% within Vehicle Type	62.0%	43.8%	57.9%
		Residual	4.5	-4.5	
	SEVERE RISK	**Count**	30	17	47
		% within Spine LL Posture	63.8%	36.2%	100.0%
		% within Vehicle Type	27.8%	53.1%	33.6%
		Residual	-6.3	6.3	
TOTAL		**Count**	108	32	140
		% within Spine LL Posture	77.1%	22.9%	100.0%
		% within Vehicle Type	100.0%	100.0%	100.0%

LL= Lower Limb; AI = Automatic Ignition; MI = Manual Ignitions

Table.5 Test of Correlation of Risk Factor With Ignition using Chi Square Test.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.587	2	.023
Likelihood Ratio	7.537	2	.023
Linear-by-Linear Association	7.172	1	.007
N of Valid Cases	140		

Fig.1 Sitting Postures of Auto Rickshaw Drivers of Navi-Mumbai

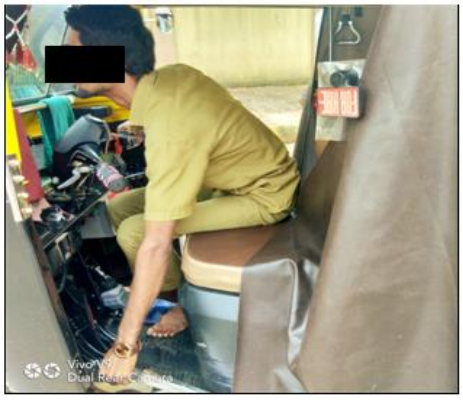

Table.6 Posture of the Back, Arm, Leg and Load Handle

		Frequency	Percent
BACK	**Normal**	12	8.6
	Mild Risk	19	13.6
	moderate risk	44	31.4
	Severe risks	65	46.4
	Total	140	100.0
		Frequency	**Percent**
ARM AND LEG	**Normal**	140	100.0
		Frequency	**Percent**
LOAD HANDLE	**Normal**	77	55.0
	Mild risk	51	36.4
	Moderate risk	12	8.6
	Total	140	100.0

Fig.2 Action Category for Each Individual Ovako Work Assessment System Classified Posture Combination, based on the Grades Allocated from Table Below

Back	Arms	1			2			3			4			5			6			7			Legs
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	Load Handled
1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	2	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	3	1	1	1	1	1	1	1	1	1	2	2	3	2	2	3	1	1	1	1	1	2	
2	1	2	2	3	2	2	3	2	2	3	3	3	3	3	3	3	2	2	2	2	3	3	
	2	2	2	3	2	2	3	2	3	3	3	4	4	3	4	4	3	3	4	2	3	4	
	3	3	3	4	2	2	3	3	3	3	3	4	4	4	4	4	4	4	4	2	3	4	
3	1	1	1	1	1	1	1	1	1	2	3	3	3	4	4	4	1	1	1	1	1	1	
	2	2	2	3	1	1	1	1	1	2	4	4	4	4	4	4	3	3	3	1	1	1	
	3	2	2	3	1	1	1	2	3	3	4	4	4	4	4	4	4	4	4	1	1	1	
4	1	2	3	3	2	2	3	2	2	3	4	4	4	4	4	4	4	4	4	2	3	4	
	2	3	3	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	
	3	4	4	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	

Recommendation

According to the present study, the findings show that the ARD have two main factors that lead to poor posture.

Hours of slumped sitting with bending awkwardly, slouching in seats, twisting awkwardly without taking breaks.

They neglect pain and continue working in awkward positions.

The vibration of the vehicle.

Prevention for this could be:

They need to be taught the importance of sitting on a comfortable position with proper seats. The seat should have a proper back rest to support the thoracic and lumbar spine.

They need to realise the importance of maintaining a proper erect posture and avoiding a slouched posture. Stretching and range of motion exercise can be implemented to prevent tightness, spasm and hence pain. Hot water fermentation is advised. They also need to practise the stretching exercises in the rest pause which they take.

They should actively practise holding themselves in good posture during sitting and check their position regularly to ensure they have not resumed slouching. Maintain regular exercise can help the ARD to assist in preventing a posture related injury by giving your body a break from the continuous stress of sitting in one position.

ARD should be advised to take multiple breaks with longer duration during their working hours.

Sit erect and avoid twisting and bending forward, choose a seat with good back support. Social marketing to educate drivers on healthier sitting postures.

Postural Modification, Strengthening, Mobility, stretching exercises can be taught to them. It is necessary to communicate our findings and these recommendations to the Auto rickshaw drivers themselves for early prevention and intervention for low back pain.

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