ORIGINAL RESEARCH

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THE PREVALENCE OF MUSCULOSKELETAL DISORDERS AND THEIR ASSOCIATION WITH RISK FACTORS IN AUTO RICKSHAW DRIVERS - A SURVEY IN GUNTUR CITY

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ABSTRACT

Background and Purpose: Musculoskeletal disorders represent largest category of work related illness in India. Variety of internal and external factors leads to postural stress in vehicle drivers that affects the functioning of musculoskeletal system. Vibration, studied extensively among various risk factors causing musculoskeletal disorders. Hence, the current study focused on various risk factors.

Objectives: To know the prevalence of musculoskeletal disorders and their association with possible risk factors in auto rickshaw drivers.

Investigation Tools: Nordic musculoskeletal questionnaire (NMSQ), inch tape, vibrometer.

Methodology: NMSQ has been used to document prevalence of musculoskeletal disorders in 300 subjects. vibrometer and inch tape were used to measure risk factors like driver's seat vibration and workspace envelope (shoulder to handle distance, lower cabin space). Associations with risk factors were analyzed by logistic regression.

Results: Work experience and working hours per week showed a significant positive association with knee problems (p=0.009, p=0.006 respectively).Shoulder to handle distance on right side showed significant negative association with knee problems (p=0.013).Driver's seat vibration showed strong significant positive association with low backache (p=0.000).No variable showed significant association with neck troubles. Working experience and lower cabin space are significantly associated with ankle problems (p=0.012, p=0.045 respectively).Age, work experience and shoulder to handle distance on left side showed significant positive association with general musculoskeletal troubles (p=0.029, p= 0.005, p=0.045 respectively).

Conclusion: Lower back, knee, neck and ankle troubles are more prevalent in auto rickshaw drivers. Increasing age, work experience, maximum working hours per week, increased left shoulder to handle distance and greater driver's seat vibrations are increasing the risk of musculoskeletal disorders. Restricted lower cabin space and reduced shoulder to handle distance on right side also increased the risk of musculoskeletal disorders.

Keywords: Auto rickshaw drivers, Musculoskeletal disorders, Workspace envelope, Nordic musculoskeletal questionnaire.

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INTRODUCTION

Auto rickshaws are the major means of public transport in southern India[1]. Guntur an urban city of Andhra Pradesh around ten thousand people have settled down as auto rickshaw drivers. City is highly populated with most of the roads poorly maintained. Most of the auto-rickshaw drivers are accustomed to accommodating passengers in front cabin due to poor traffic surveillance in the city. They allow the passengers to sit to their left side since the construction of these auto-rickshaws does not permit them to accommodate the passengers to their right. There is extensive literature quoting the fact that motor vehicle drivers (light and heavy vehicle drivers) are vulnerable to work related musculoskeletal disorders [2, 3] due to various factors like postural stress, exposure to vibrations and so on. Professional drivers have a higher prevalence of occupational disorders than other groups[4.] Since their occupation involves postural stress, specifically twisting, bending which increase risk of diseases of lower back besides exposure to vehicle vibrations[5] particularly when working in confined areas.

The complex multi axis transitional and rotational components of vibration generate a variety of inputs to various body parts [6, 7]. Researchers reported existence of positive relationship between discomfort, injury, risk of low back pain and duration of exposure to whole body vibration [8,910]. Mechanical energy transmission of vibrations is dependent on body position and muscle contractions. With subjects in sitting position, resonance of vibrations occurs at shoulders and to little extent at head regions with about 5 Hz frequencies. There are clear illustrations by literature in regard to the greater risk of incidence of low back pain at an earlier age in subjects exposed to vibrations[11], apart from which evident spinal radiographic changes were also noted down.[12,13,14] Vibrations pave way for degenerative disc changes by interrupting the disc nutrition(Sanders 1981 and 1985).

Besides vibrations, in most of the work situations individuals perform their activity within a specified 3D space of fixed location, which is sometimes referred to as “work space envelope” which preferably should be circumscribed by the functional arm reach of the operator, and most of the things they need to handle should be arranged within the envelope. During driving, feet are active so they cannot support and stabilize the lower body as it happens during normal sitting in a chair. The operation of foot controls like brakes and accelerator with accommodation of passengers in the front cabin changes the alignment of lower extremities. If the driver does not accommodate any passenger in the front cabin the lower cabin space and alignment of feet would be optimal, incase if he accommodates one passenger the space available for manipulating brake and accelerator decreases to half of the optimal space and if he accommodates two passengers it decreases approximately to two thirds of the optimal space. This reduction would result in change in the alignment of the feet and knee joints. When it comes to upper extremities with only the driver in the front cabin the shoulder to handle distance would be same for both upper limbs. With accommodation of passengers, the shoulder to handle distance will be changed for right and left upper limb leading to mal alignment of the shoulders, elbow, and wrist joints.

Construction of the auto-rickshaws with a relatively smaller driver’s cabin and accommodation of passengers in driver’s cabin results in postural stress to maintain balance and stability. Besides, duration of work and driver’s seat vibrations is also contributing to the occurrence of work related musculoskeletal disorders in auto rickshaw drivers. Existing literature makes it clear the occurrence of work related musculoskeletal disorders in drivers. Literature to establish the association of possible risk

factors is not sufficient at present. Hence, the current study made an attempt to find out the prevalence of work related musculoskeletal disorders, and their association with possible risk factors among the auto-rickshaw drivers of Guntur city.

METHODS

A blinded assessor recruited 300 male auto rickshaw drivers who were having valid driving license and registration number, in a period of three months. The study used a cross sectional design. Cluster sampling technique was used to accumulating the study population. The subjects who are having more than one year experience as auto rickshaw drivers were included for the current study and informed consent was taken before starting the study procedure. Subjects who were having congenital deformities and any other deformities of traumatic origin were excluded from the study. Nordic musculoskeletal questionnaire (NMSQ) was used as an assessment tool. NMSQ is used in epidemiological studies to compare problems of low back, neck, shoulder and general complaints.[15,16] The questionnaire notifies whether the respondents have had any musculoskeletal trouble in the last in 12 months and the last 7 days which has prevented their normal activity. Prior to administration, the questionnaire has been translated in to local language with the help of experts to avoid possible translation errors. The data representing musculoskeletal troubles of last 12 months was considered for statistical analysis in the study. Based on the literature, risk factors were identified and a risk factor assessment form was prepared. The risk factors included were age, years of driving, working hours per week, seat vibrations, driver's cabin space (lower cabin space; shoulder to handle distance).

Seat vibrations were measured using Vibrometer an education application available in the android market (version 1.4.3). This application uses phone sensors to measure vibrations. Driver's workspace envelop has been measured in two ways, the shoulder to handle distance and lower cabin space. Shoulder to handle distance on both sides and lower cabin space were measured by using an inch tape. If the driver is habituated accommodating passengers in his cabin then the assessor made the driver to assume similar position and measured the shoulder to handle distance from center of handle to the acromion process of shoulder on both sides. The prevalence of musculoskeletal problems of each body part were documented and represented by a pie diagram. The relationship between risk factors and occurrence of musculoskeletal problems were examined by Logistic regression by using SPSS software trial version 22.0.0.

RESULTS AND DISCUSSION:

In this study pie diagram (fig: 1) has been used to represent the prevalence of musculoskeletal disorders in various body parts. This showed a high percentage of lower back, knee, neck and ankle troubles. In a total sample of 300 drivers 63.66% reported LBA, 58.66% reported knee troubles, 52.33% reported neck troubles and 46.33% reported ankle troubles (table:1).

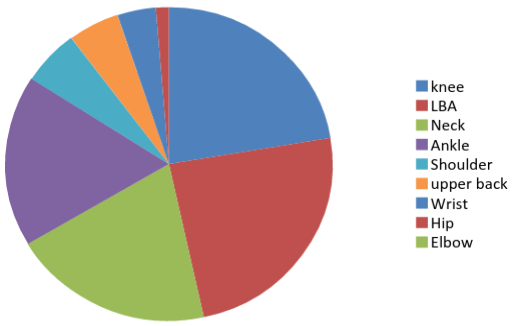

Fig: 1: prevalence of musculoskeletal troubles

Sl. No	Trouble	Yes	percentage
1	Neck	157	52.33%
2	Shoulder	45	15%
3	Elbow	0	0%
4	Wrist	30	10%
5	Upper back	40	13.33%
6	Lower back	191	63.66%
7	Hip	10	3.33%
8	Knee	176	58.66%
9	Ankle	139	46.33%

Table 1: percentages of subjects reported yes on NMSQ

Knee Troubles:

Work-experience and working hours per week, showed a significant positive association with the occurrence of knee problems (p=0.009, p=0.006 respectively). Shoulder to handle distance on right side showed significant negative association with knee problems (p=0.013)(table: 2). As the subject tends to work more hours in a week and as he continues to be in the same occupation for longer time the risk of getting knee troubles will be increased because lower extremities are always active while driving and are kept in fixed postures for considerably longer durations[17].The tendency of leaning towards right side will decrease the shoulder to handle distance on right side as this distance decreases the prevalence of knee troubles increases. This can be possibly attributed to the increased stress on the lower extremities in an attempt to maintain the dynamic balance[18].

Risk Factors	*Beta*	S.E.	Wald	df	Sig.	Exp(B)
Age	.001	.020	.001	1	.974	1.001
Experience	.095	.036	6.925	1	.009	1.099
Hours per week	.025	.009	7.467	1	.006	1.026
Seat vibrations	-.087	.139	.390	1	.532	.917
Lower cabin space	-.019	.046	.167	1	.683	.981
Shoulder to handle distance (Rt)	-.198	.080	6.139	1	.013	.820
Shoulder to handle distance (Lt)	.069	.085	.657	1	.418	1.071
Constant	1.137	2.762	.170	1	.681	3.118

Table 2: Association of risk factors with knee troubles analyzed with logistic regression.

Lower back troubles:

Driver's seat vibration is having strong significant positive association with the occurrence of low backache (p=0.000) (table 3).Other variables are not associated with the prevalence of low backache. The vibration acting on the musculoskeletal system of the body causes the degeneration of the inter-vertebral disc while the long periods of sitting being aggravated by vibration exposure causes nutrients needed for the growth and repair to be diffused outwards[19, 20]. This causes irreparable damage at a cellular level and wear. Muscle fatigue occurs as the muscles react to the vibration energy in an attempt of maintain balance, protecting and supporting the spinal column. Apart from that performing hand and foot controls in improper seating posture which leads to continuous bending, twisting, leaning, and stretching will place a load on lower back, because

of that, bone is subjected to mechanical fatigue, like all other materials[21]. Maintaining fixed posture in sitting for longer time without being able to change the posture causes low back pain among drivers[22].

Risk factors	Beta	S.E.	Wald	df	Sig.	Exp(B)
Age	.006	.022	.082	1	.775	1.006
Experience	.032	.037	.748	1	.387	1.032
Hours per week	.009	.010	.936	1	.333	1.009
Seat vibration	1.060	.183	33.678	1	.000	2.885
Lower cabin space	.008	.049	.026	1	.872	1.008
Shoulder to handle distance (Rt)	.070	.082	.720	1	.396	1.072
Shoulder to handle distance (Lt)	.058	.092	.396	1	.529	1.060
Constant	-9.377	3.049	9.456	1	.002	.000

Table 3: Association of risk factors with lower back troubles analyzed with logistic regression.

Neck troubles:

No risk factor is showing significant association with the prevalence of neck trouble (table 4). These results may be attributed to the low intensity vibrations recorded in the current study (4 to 10 Hz). Literature emphasizes the risk of neck pains when the vehicle vibrations are at 20 to 30 Hz particularly of vertical vibrations23. However, vertical vibrations were recorded but are not used for statistical analysis.

Risk Factors	Beta	S. E.	Wald	df	Sig.	Exp. (B)
Age	-.019	.019	1.007	1	.316	.981
Experience	.049	.033	2.270	1	.132	1.050
Hours per week	.012	.009	2.030	1	.154	1.012
Seat vibrations	.099	.131	.566	1	.452	1.104
Lower cabin space	.008	.043	.031	1	.859	1.008
Shoulder to handle distance (Rt)	-.054	.074	.533	1	.465	.947
Shoulder to handle distance (Lt)	-.009	.080	.014	1	.906	.991
Constant	.157	2.614	.004	1	.952	1.170

Table 4: Association of risk factors with neck troubles analyzed with logistic regression.

Ankle:

Working experience and lower cabin space are significantly associated with ankle problems (p=0.012, p=0.045 respectively) (table 5). The association between work experience and ankle problems is positively related but association between lower cabin space and ankle problems is negatively related. Repetitive occupational movements while manipulating foot controls in a congested lower cabin space may possibly lead to wear and tear effect contributing to the risk of ankle troubles.

Risk factors	Beta	S.E.	Wald	df	Sig.	Exp(B)
Age	-.011	.020	.291	1	.590	.990
Experience	.084	.033	6.304	1	.012	1.088
Hours per week	.000	.009	.001	1	.972	1.000
Seat vibration	.009	.133	.005	1	.944	1.009
Lower cabin space	-.089	.044	4.014	1	.045	.915
Shoulder to handle distance (Rt)	.019	.075	.062	1	.804	1.019
Shoulder to handle distance (Lt)	-.125	.083	2.241	1	.134	.883
Constant	3.267	2.684	1.482	1	.223	26.230

Table 5: Association of risk factors with ankle troubles analyzed with logistic regression.

General Musculoskeletal Troubles:

Age, work experience and shoulder to handle distance on left side were showing significant positive association with occurrence of general musculoskeletal troubles (p=0.029,p=0.005,p=0.045 respectively) (table 6). The shoulder to handle distance which is increased on left side, decreased on right side and reduction in lower cabin space which were resultants of poor posture adopted during working hours since many years may possibly place the musculature on abnormal loading which can increase the risk of musculoskeletal troubles in general. Usually individuals are more prone for musculoskeletal disorders with advancing age, the present study cannot assure the risk because of aging in causing musculoskeletal troubles in auto rickshaw drivers due to wide range of age in sample selected.

Some factors which may possibly influence the occurrence of musculoskeletal troubles like smoking [24, 25, 26], personal habits, psychological factors[27], regular exercises, proper nutrition, frequent servicing of vehicle and the condition of roads which they shuttle regularly are not included in this study. Reliability of android application, used to measure vibration quantitatively is also questionable. Besides, the drivers were instructed to start the engine and then seat vibrations were recorded in a static position rather than measuring during driving. Measuring workspace envelope varies from vehicle to vehicle. The authors considered shoulder to handle distance and lower cabin space to represent workspace envelop because of less availability of standardized ways to measure it in three seat auto rickshaws

Risk factors	Beta	S.E.	Wald	df	Sig.	Exp(B)
Age	.050	.023	4.770	1	.029	1.052
Experience	.119	.043	7.809	1	.005	1.127
Hours per week	.013	.010	1.727	1	.189	1.013
Seat vibration	-.028	.154	.033	1	.855	.972
Lower cabin space	-.049	.051	.953	1	.329	.952
Shoulder to handle distance (Rt)	-.023	.089	.067	1	.796	.977
Shoulder to handle distance (Lt)	.191	.095	4.004	1	.045	1.210
Constant	-5.627	3.076	3.346	1	.067	.004

Table 6: Association of risk factors with general musculoskeletal troubles analyzed with logistic regression.

CONCLUSION

Most of the auto rickshaw drivers are experiencing musculoskeletal disorders of lower back, knee, neck, and ankle. The prevalence of musculoskeletal disorders is in association with risk factors. Work experience, maximum working hours per week, and less shoulder to handle distance are associated with knee troubles. Driver's seat on right side vibration is associated with lower back troubles; working experience and lower cabin space are associated with ankle troubles. These findings indicate the obvious need of ergonomic considerations while designing the vehicle and providing ergonomic education for terrain vehicle drivers. Further research is required to establish all the possible risk factors contributing to work related musculoskeletal disorders in drivers.

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