ISSN 2310-4090

International Journal of Scientific Footprints Open Access

Low Back Pain and Work-Related Risk Factors among Drivers of Pondicherry

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Keywords:
Epidemiology; low back pain; occupational risk factor; taxi drivers; disability questionnaire

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Funding Information:
No funding information provided.

Received:
6 December 2013; Accepted: 26 December 2013.

International Journal of Scientific Footprints 2013; 1(2): 7–16

Abstract

Several international scientific investigators proved that long-term whole-body vibration from engines and vehicles is an important mechanical stress factor contributing to early and accelerated degenerative spine diseases, leading to back pain and prolapsed discs. Poor body posture, inadequate seat support and fatigue of back muscles have been described as co-factors in the pathogenesis of musculoskeletal disorders of the spine in operators/drivers. A survey of drivers was conducted to determine the actual situation of drivers' low back pain (LBP). The survey was carried out in September- October, 2013, the target drivers were asked to complete a questionnaire which contains questions regarding physique of drivers, demographic features, working conditions, office environment, health conditions, the presence of low back pain, the level of low back pain based on Visual Analogue Scale and Roland-Morris Disability Questionnaire score. As a result, the total number of valid responses was 667 and the response rate was 74 percent, and the 1-week prevalence of LBP was 22.9 percent of respondents. Regarding 158 subjects with LBP, Visual Analogue Scale (VAS) averaged 4.1. There was a positive weak correlation between VAS and Roland-Morris Disability Questionnaire score (R=0.41). And Logistic regression analysis was performed to examine the relationship between LBP and occupational factors, the results suggested following items as risk factors; such as history of LBP, suffering from fatigue, diseases other than LBP and smoking habit.

Introduction

In a systematical review of the available scientific evidence on the causes of low back pain and the effectiveness of interventions to prevent it, Frank *et al.*, (1996) mention two terms that are usually used to describe the phenomenon of low back pain. Low back pain is any back pain between the ribs and top of the leg, from any cause. Work-related low back pain, is any back pain originating in the context of work and considered clinically to have been probably caused, at least in part, or exacerbated by the claimant's job. However in practice it is often impossible to distinguish back pain "caused" by work from pain of uncertain origin that makes the patient's work impossible to carry out.

Origin of Low Back Disorders

Low back disorders include spinal disc problems such as hernias and spondylolisthesis, muscle and soft tissue injuries. In addition to the normal degenerative aging process, epidemiological studies reveal that poor ergonomic factors in the workplace contribute to low back disorders in a healthy back or accelerate existing changes in an already damaged back. Poor ergonomic work factors increase the load or strain on the back. This may arise from many situations, for example lifting, twisting, bending, awkward movements, stretching, and static postures. Tasks include physical work, manual handling and vehicle driving (where whole body vibration is known

to be another contributing factor).

Although spinal disc related problems maybe detectable by x-rays or bone scans, other abnormalities, such as muscular and other soft-tissue injuries, can often not be detected in this way. In fact, 95% of low back disorders are termed "non-specific". Evidence suggests that the common approach suggested below can be taken to prevent and reduce all types of work-related low back disorders.

Low back pain is a one of the most common symptoms throughout the general population, and there have been many discussions of occupational low back pain in particular. There are many reports and monographs regarding low back pain among seated workers, standing workers, truck drivers and those performing heavy labor and so on (Roland and Morris, 1983; Bovenzi and Zandini, 1992; Netterstrom and Juel, 1989; Piazzi et.al, 1991; Miyamoto et.al, 2000; Boshuzen et.al, 1990; Chen et.al, 2005; Anderson and Raanaas, 2000; Funakoshi et.al, 2003). Various studies have found positive associations between exposure to whole-body vibration and development of low back pain (LBP) among occupational drivers including truck, bus, car, auto and tempoo drivers with some reporting on the effects of shock loading to the spine (Boshuizen et.al, 1992; Lines, and Stayner, 2000; Schwarze, et.al, 1998; Rehn, et.al, 2002).

Low back pain of vehicle drivers are mainly caused by long hours of driving in a restricted posture, car vibration or shocks from roads, and mental stress associated with driving. However, these possible causes have not been identified as risk factors concerting mechanisms underlying low back pain. In this study, a questionnaire survey was conducted among drivers truck, bus, car, auto and tempoo drivers of Pondicherry to determine the actual situation of drivers' low back pain from the perspective of their working conditions.

Materials and Methods

Government, or private Company-employed or self-employed drivers were selected for the present study. The survey was carried out in September-October, 2013with cooperation from Government organization or private transport companies and a self-employed drivers' association; the target drivers were asked to complete a questionnaire concerning low back pain. Questionnaires using a fill-in form were distributed to many transport companies and self-employed driver's association.

Imported Questions included in the questionnaire are demographic features (age, gender and marital status), physique of drivers, the length of time as a driver or the length of service; working conditions such as working hours and the frequency of night shifts; average mileage, seat condition, space for the driver, whole-body vibration and car weight; office environment such as human relationships or the existence of a place to rest; and daily life outside work. The questionnaire also included questions regarding: health conditions such as diseases other than low back pain; history of treatment and sick-leave due to low back pain and; the presence of low back pain in the past one week. also defined the incidence rate of subjects who experienced LBP (low back pain) in the past one week as the prevalence of the LBP; the level of low back pain based on Visual Analogue Scale (the levels of LBP/VAS) and; Roland-Morris Disability Questionnaire score to assess physical disability due to low back pain (the disability level of ADL/RMDQ score)(Roland and Morris, 1983)).

The questionnaire results were used to conduct the following statistical analyses: the prevalence of LBP and the correlation between the levels of LBP and the disability level of ADL (activities of daily living): the relationship between the LBP incidence and occupational factors. For the latter analyses, researcher compared the subjects with LBP from those without LBP by χ -square test for categorical data. Furthermore, to identify LBP-related occupational factors, researcher used multiple logistic regression and obtained estimates of the prevalence odds ratio (POR).

The responses from respondents with a history of diseases causing low back pain were excluded at the time of analysis in order to focus simply on the low back pain that was associated with work as drivers. All these statistical analyses were carried out by SPSS 14.0 statistical software, and significance was accepted at the 5 % level.

Need for research and consensus

There is support in the literature for the ergonomics approach, contained in the "Manual Handling Directive", as the basis for employers to take action. To assist its application the report suggests that the main focus of future research should be on how the ergonomics approach can be used most effectively in practice. Such research may include:

- Satisfactorily evaluated studies of "holistic" intervention strategies (for example: application of ergonomics; ergonomics integrated with rehabilitation and health surveillance)

- Studies to develop and evaluate practical risk assessment methods for use in the workplace
- Studies of the effect of combinations of factors and their practical assessment

Although it is proposed that the main focus of future research be on strategies to prevent injury in the work place, a number of areas concerning laboratory analysis of the problem are suggested (for example: exposure measurement techniques; joint movement measurement methods and studies to further understand the biochemical and biomechanical properties of the vertebra, disc and ligaments).

Results

Table 1 Distribution of Subject according to Work conditions and the characteristics (N=667)

Work conditions and the characteristics	Mean±SD	Min	Max
Age (years)	49.5±9.6	21	78
Height (cm)	169.8±5.8	149.8	188.7
Weight (kg)	67.8±9.2	43	93
BMI (kg/m^2)	23.70±2.9	19.11	26.27
The length of service (years)	13.5±4.5	0.0	39.0
Daily working hours	11.8±3.4	1.0	24.0
Monthly mileage (Km)	14125±115.5	250.6	880.4
Prevalence of LBP (N (%))	158 (23.7)	56 (8.4)	261 (39.2)

The total number of valid responses was 667 and the percentage of participation was 74 percent. The fundamental attributes of the investigated subjects are presented in Table 1. The average age of respondents was 49.5 years old and the average length of service was 13.5 years. The prevalence of LBP was 23.7 percent of respondents.

Regarding 158 subjects with LBP, the level of LBP/VAS averaged 4.1. The response rate of each item in Roland-Morris Disability Questionnaire score (RMDQ) is presented in Table 2. High positive responses were found in the following questions; I change position frequently to try to get my back comfortable; I avoid heavy jobs around the house because of my back; Because of my back, I lie down to rest more often; and the RMDQ score averaged 3.5. There was a positive weak correlation between the level of LBP and the RMDQ score, and the correlation coefficient was 0.41.

Table 2 The response rates among respondents with LBP by Roland-Morris Disability Questionnaire (n=190)

S.No.	Questionnaire	%
1	I stay at home most of the time because of my back.	11.3
2	I change position frequently to try and get my back comfortable.	69.2
3	I walk more slowly than usual because of my back.	12.7
4	Because of my back I am not doing any of the jobs that I usually do around the house.	3.6
5	Because of my back, I use a handrail to get upstairs.	5.9
6	Because of my back, I lie down to rest more often.	41.6
7	Because of my back, I have to hold on to something to get out of an easy chair	6.3
8	Because of my back, I try to get other people to do things for me.	0.9
9	I get dressed more slowly than usual because of my back.	3.5

10	I only stand for short periods of time because of my back.	22.6
11	Because of my back, I try not to bend or kneel down.	22.6
12	I find it difficult to get out of a chair because of my back.	4.1
13	My back is painful almost all the time.	20.4
14	I find it difficult to turn over in bed because of my back.	5.9
15	My appetite is not very good because of my back pain.	1.8
16	I have trouble putting on my socks (or stockings) because of the pain in my back.	10.9
17	I only walk short distances because of my back.	16.7
18	I sleep less well on my back.	13.1
19	Because of my back pain, I get dressed with help from someone else.	0.5
20	I sit down for most of the day because of my back.	11.3
21	I avoid heavy jobs around the house because of my back.	48.0
22	Because of my back pain, I am more irritable and bad tempered with people than usual.	5.4
23	Because of my back, I go upstairs more slowly than usual.	14.9
24	I stay in bed most of the time because of my back.	4.1

Comparison between the subjects with LBP (LBP group) and without LBP (without LBP group)

Table 3 The comparison between the groups with and without LBP tested by χ -square test

S.No	Characteristics	Odd Ratio	95%C.I.	p
1	I had a history of low back pain before working as a driver	5.15	3.66–7.17	<0.001
2	I seldom feel energetic	2.67	1.97–3.84	<0.001
3	I suffer from diseases other than low back pain	2.56	1.89–3.51	<0.001
4	not have enough time to relax at home	2.52	1.90–3.51	<0.001
5	not sleep well	2.20	1.60–3.00	<0.001
6	narrow space for drivers	1.91	1.37–2.66	<0.001
7	strong vehicle vibration	1.86	1.36–2.60	<0.001
8	Smoking	1.78	1.27–2.43	<0.001
9	mental stress with customers	1.76	1.32–2.36	<0.001
10	Too long working time	1.73	1.26–2.31	<0.001
11	My work is not challenging	0.58	0.40–0.75	<0.001
12	Lack of physical exercise	0.60	0.40–0.93	0.015
13	I feel a heavy burden of responsibility in my work	1.34	1.02–1.18	0.051
14	Married	0.85	0.60–1.13	0.350

Concerning items in the questionnaire showing significant differences between the groups with and without LBP by χ -square test, the highest odds ratio was 5.15 for the question; "I had a history of low back pain before working as a driver"; the next highest odds ratio was 2.67 on the question "I seldom feel energetic"; and the next was 2.56 for questions: "I suffer from diseases other than low back pain" and 2.52 for question "I do not have enough time to relax at home", 2.20 for "I do not sleep well", 1.91 for "narrow space for drivers", and "feel strong car vibration" had an odds ratio of 1.86 (Table 3).

Table 4 The comparison between the groups with and without LBP

S. No.	Work conditions and the characteristics	LBP group Mean±SD	without LBP group Mean±SD
1	age	50.2±8.3	50.7±9.4
2	height	168.6±6.0	167.2±5.8
3	weight	67.0±9.8	65.9±8.8
4	BMI	23.5±2.9	23.5±2.5
5	the length of service	12.5±8.9	13.7±11.5
6	monthly working day	19.1±3.8	18.9±3.9
7	monthly average mileage (Km)	16210±251	12540±158
8	frequency of night shifts	12.1±6.6	11.3±6.4

However, there were no differences between variables from those either with or without LBP concerning following questions such as age, gender, height, weight and BMI, the length of service, daily working hours, monthly mileage and frequency of night-shift work (Table 4).

An effort is made to summarize the relationship between low back disorders and the risk factors (Table 5). The classification system of Bernard et al. (1997) and the classification of Hoogendoorn et al. (2000) was used to characterize the strength of evidence for work-relatedness, examining the contribution of each physical risk factor to low back disorders The evidence for a relationship is classified into one of the following categories:

- Strong evidence of work-relatedness (+++): provided by generally consistent findings in multiple high quality studies.
- Evidence (++): provided by generally consistent findings in one high quality study and one or more low quality studies, or in multiple low quality studies
- Insufficient evidence (+/0): only one study available or inconsistent findings in multiple studies

Table 5 The work relatedness of low back disorders: overview of the risk factors.

Category of risk factor	Risk factor	Evidence
Physical factors	Heavy manual labor	+++
	Awkward postures	+/0
	Whole-body-vibration	+
	Heavy manual labour	+++
	Awkward postures	+/0
	Whole-body-vibration	+
Psychosocial/ work organizational factors	Job content	+/0
	Job control	+++
	Job dissatisfaction	+/0
	Job content	+++
	Job control	+++

Individual factors	Age	+/0
	Socio economic status	+++
	Smoking	++
	Medical history	+++
	Gender	+/0
	Anthropometry	+/0
	Physical activity	+/0

Table 6 The result of the multiple logistic regression analysis and the prevalence odds ratio (POR)

S.No	Characteristics	Exp (B)	95%C.I.	significance probability
1	I have a history of LBP before working as a driver	4.93	3.30–7.36	<0.01
2	I suffer from fatigue	3.32	2.06–5.35	<0.01
3	I have diseases other than low back pain	1.63	1.07–2.46	0.02
4	I have a habit of smoking	1.63	1.06–2.51	0.02
5	I often feel sleeplessness	1.50	0.97–2.36	0.07
6	I take regular exercise	1.11	0.64–1.98	0.66
7	Driving seat is too narrow	1.11	0.70–1.77	0.61
8	Working hours are too long	1.05	0.68–1.61	0.72
9	I feel burdensome on my responsibility	0.95	0.62–1.46	0.87
10	I feel vibration in the driving seat	0.97	0.62–1.54	0.94

Cox and Snell R^2=0.202 P<0.001.

Logistic regression analysis using the existence or nonexistence of low back pain as a dependent variable was performed. Table 6 shows that responses to four items were significant: 1) I had a history of low back pain before working as a driver, 2) I suffer from fatigue, 3) I have diseases other than low back pain, and 4) I have a habit of smoking.

Risk Factors

Many review articles have been published investigating the risk factors of low back disorders on the physical, psychosocial and personal domains. These factors may interact in different ways to cause low back disorders. In one situation the psychosocial risk factor may be the main contributor, whereas in other cases it may be the physical risk factors that are the primary causes. Thus, in every situation the risk factors would interact in a different manner to reach a critical tolerance level unacceptable to the person, and resulting in reporting of low back pain. The comparison of the different studies is not always easy, due to different definitions of risk factors or categories of risk factors. Especially in the non-biomechanical domain, as the terms such as psychological, psychosocial, psychic, individual and personal are often used with overlapping meanings.

Hagberg et al. (1995) have discussed the meaning of work organizational and psychosocial work: "Psychosocial factors at work are the subjective aspects as perceived by workers and the managers. They often have the same names as the work organization factors, but are different in that they carry 'emotional value for the worker. Thus, the nature of the supervision can have positive or negative psychosocial effects (emotional stress), while the work organization aspects are just descriptive of how the supervision is accomplished and do not carry emotional value. Psychosocial factors are the individual subjective perceptions of the work organization factors." With individual factors, factors related to the subject but outside the work organizational context are stressed. It should be mentioned that a combination of possible risk factors might increase the development or occurrence of low back disorders.

Vingard et al. (2000) reported that a combination of high physical and psychosocial load increased the care seeking for low back pain in working men and women. Below is a brief discussion of some of the most important risk factors of the different domains, based on several review studies that use thorough selection criteria to identify relevant articles (e.g. Riihimäki, 1991; Hales and Bernard, 1996; Bernard et al., 1997; Burdorf and Sorock, 1997; Ferguson

and Marras, 1997; Frank et al., 1996a and 1996b; Bongers et al., 2000; Hoogendoorn et al., 2000). Emphasis is laid on risk factors related to the working environment, although some information on personal risk factors is provided.

Discussion

Many researchers have already reported the high risk for LBP and various spinal disorders among professional drivers of vehicles, such as bus, truck, tractor and so on (Bovenzi and Zandini, 1992; Netterstrom and Juel, 1989; Piazzi et.al, 1991; Miyamoto et.al, 2000; Boshuzen et.al, 1990). It is thought that specific factors related to vehicle driving and work environments might influence the occurrence of LBP. Though there have been only several reports regarding drivers, a significantly elevated 1-yr prevalence of LBP (51%) was reported in taxi drivers (Chen et.al, 2005), and rate of 59% for men and 66% for women were reported in Norway (Anderson and Raanaas, 2000). In investigations of Japanese taxi drivers; the 1-yr prevalence of LBP was 45.8%, which was slightly lower than the values reported from other countries (Funakoshi et.al, 2003). In the present study, the 1-wk prevalence of LBP, which was 22.9%, and adopted the prevalence of LBP during the previous week in this study because the period of 1 year was considered too long for subjects to remember accurately, and RMDQ also asks about the previous one week.

Regarding LBP-related occupational factors, multiple logistic regression analysis using all question items as evaluate variables was performed in stepwise method and researcher obtained estimates of the prevalence odds ratio. It was suggested that certain factors were related to low back pain. As factors related to work details, narrow space for drivers and whole-body vibration were suggested.

The relatively confined space within taxicabs or auto, tempo may put drivers at great risk for LBP, as biomechanical studies have shown that driving activities within automobiles can impose postural strain on lumbar spines (Harrison et.al, 1999).

However, various studies have already reported that whole-body vibration might be one of the causes of low back pain among various types of occupational drivers. In 1982, Wilder et.al, identified that 3 frequencies cause the spine to resonate and that the greatest transmissibility of vibratory input occurs at the first resonant frequency of 5 Hz (Chen et.al, 2004). Bovenzi reported that bus driving is associated with an increased risk for low back problems that may be due to both whole-body vibration exposure and prolonged sitting in a constrained posture, and the average vertical whole-body vibration magnitude measured on the seat pan of buses was 0.4 m/s2 (Bovenzi and Zandini, 1992). Chen has recently documented that urban drivers are regularly exposed to lower levels of whole-body vibration (with a mean vertical vibration 0.31 m/s2) (Chen et.al, 2004).

Harrison reported a thesis proposing the optimal seat to reduce the prevalence of LBP, which would be seat with shock absorbers to dampen whole-body vibration of frequencies in the 1 to 20 Hz range, with a seat back, seat bottom, lumbar support, arm rests and head restraint that are adjustable to the individual needs of drivers (Harrison et.al, 2000). Based on the findings of this research, there is certain work environment factors suggested to be related to LBP, such as prolonged driving time and mental stress and so on. Regarding the length of working time, Chen reported that drivers have OR of 1.79 for 1-yr prevalence of LBP when driving more than 4 hours a day (Chen et.al, 2005). Pietri *et.al*, reported that drivers have OR of 2.0 for LBP when driving more than 20 hours a week (Pietri et.al, 1992). Porter and Gyi also found that driving more than 20 hours a week for work was associated with a high frequency of low back problems and related sickness absence (Porter and Gyi, 2002). In this study, almost all drivers drove more than 40 hours a week.

It was suggested that mental stress might be related to LBP based on the significantly different response rates between respondents with or without LBP for the items: “I feel mental stress from customers”; “My work is not challenging.” Chen reported that mental factors were significantly associated with higher LBP prevalence, especially for drivers who felt moderate-to-severe job stress, the crude POR was 2.19 (CI 1.57–3.04), and who reported a high degree of job dissatisfaction, the crude POR was 1.48 (CI 1.11–1.96) (Chen et.al, 2005). Funakoshi pointed out the relation between work stress and low back pain in his research on taxi drivers, for drivers who work long hours, the age adjusted odds ratio was 2.19 (CI 0.98–5.16) (Funakoshi et.al, 2003). Bongers (1993) reviewed the relationship between psychosocial work factors and musculoskeletal disease, and concluded that monotonous work, high perceived work load, time pressure, low control on the job and lack of social support by colleagues are related to or positively associated with musculoskeletal disease including LBP.

Based on the results of this survey some other points were suggested to be related with LBP; prior health conditions such as having a history of LBP before working as a driver or suffering from diseases other than LBP; poor life style

issues such as fatigue, insomnia, lack of time to relax at home, habitual smoking or lack of physical exercise. Therefore possible measures for the prevention of low back pain are thought to include: counseling for psychological problems; implementation of medical examinations and guidance for consulting medical institutions; promotion of a better lifestyle; improvement of vehicle structures, such as the improvement of seat comfort and the absorption of vibration; check for low back pain through medical examination prior to working as a driver, guidance for drivers with a previous history of low back pain, the provision of medical examination and necessary guidance for those who have already started working as drivers.

Strategies and effectiveness of prevention

Strategies to prevent low back disorders include both workplace based and health care based interventions. Increasingly there is recognition that an integrated approach including both types of intervention is needed to really tackle the problem effectively. Prevention, training, health surveillance, rehabilitation etc. should all be approached together. In the workplace there is growing support for the effectiveness of ergonomic interventions. Ergonomics interventions are based on a "holistic" or systems approach that considers the effect of the equipment, the work environment and the work organization as well as the worker. The full participation of workers in the ergonomics approach is important for its effectiveness.

A summary of the main prevention strategies is given below:

Strategies to prevent low back disorders in the workplace

- Reduction of physical demands
- Improvements in work organization
- Education/training (as part of an integrated approach)
- Medical treatment and rehabilitation (as part of an integrated approach)
- Cognitive and behavioral strategies (for example coping strategies)

Study of several international organization revealed that long-term whole-body vibration from engines and vehicles is an important mechanical stress factor contributing early and accelerated degenerative spine diseases, leading to back pain and prolapsed discs. Poor body posture, inadequate seat support and fatigue of back muscles have been described as co-factors in the pathogenesis of musculoskeletal disorders of the spine in operators/drivers (Hulshof, 1998; Johanning, 2000). Two principal pathological mechanisms of vertebral damage due to whole-body-vibration have been suggested. Firstly, induction of micro fractures at the endplates, with callus formation during healing and the altered disc dimension under the load, may reduce the rate of nutrient diffusion. Secondly, vibration-induced mechanical overload, causing continuous compression and stretching of the spinal structures, may result in tissue fatigue. Spinal muscle fatigue can increase the effect (Johanning, 2000). High prevalence of low back disorders has been consistently reported among vibration-exposed occupational groups, i.e. tractor drivers, truckers and bus drivers, crane or earth moving equipment operators and helicopter pilots (Hulshof, 1998). Also among operators of rail vehicles with relatively low vertical but high lateral vibration, the prevalence is high. The highest levels of vertical vibration were found in off-road vehicles and forklifts (Johanning, 2000).

Conclusions

A research on different vehicle drivers of Pondicherry was conducted to determine the actual situation of drivers' low back pain, and the 1- week prevalence of LBP was 23.9 percent of respondents. For the prevention of low back pain, the following measures might be suggested: improvement of seat comfort, treatment for coexisting diseases other than low back pain, psychological counseling, guidance for a better lifestyle, a check for previous history of low back pain prior to working as a driver, and appropriate guidance.

Acknowledgements

Author is thankful to present subject and their families for their cooperation. I am especially grateful for the assistance and encouragement of Prof. A. K. Kapoor and Prof. Satwanti Kapoor, Department of Anthropology, Delhi University and Prof. A. Chellaperumal, and all the other member of the Department of Anthropology, Pondicherry University.

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