CHAPTER 7

CONCLUSIONS

7.1 RESEARCH FINDINGS

To predict the statistical significance of the independent variables on the dependent variable, this study has utilized various methods including Pearson’s correlation technique, Simple Regression, Multiple Regression, Two-sample t-test and one way ANOVA tests. The study critically examined LBD prevalence level issues among vehicle drivers from their perspectives. All the nine potential environmental ergonomic risk factors were regarded as significant to predict the LBD prevalence level. The hypothesized positive relationships of these independent variables, with the LBD prevalence were found.

The LBD causing potential environmental ergonomic risk factors considered in this study are Intensity of Whole body vibration, Posture, Road Condition, Seat Condition, Discomfort, Drive Duration, Break Duration, Psychosocial Work Aspect and Psychosocial Personal Aspect.

The result of multiple regression analysis shows that the nine potential environmental ergonomic variables jointly predict the dependent variable LBD prevalence level. The result of step-wise regression analysis identified the most significant predictors of LBD prevalence level, which are Intensity of Whole body vibration, Posture, Road Condition, Seat Condition, Break Duration and Psychosocial Work Aspect. Through simple linear
regression, it is established that LBD prevalence level is a significant predictor of Prevention of Activities and Medical Intervention due to LBD prevalence.

The two sample t-test was used to test the significant difference in the perception of LBD variables between drivers and University staff members who did not drive vehicles at work (Control group). The result proves that drivers perceive higher level of intensity of whole body vibration, constrained posture, higher discomfort, higher work stressors and lower colleague and supervisor support when compared to University staff members (Control group). It implies that vehicle drivers are experiencing higher level of intensity of whole body vibration, higher discomfort and adopting awkward posture due to their occupational condition. Further, work nature of the professional drivers leads to higher work stressors, which confounds the lower social support from supervisor and colleagues in addition to their individual nature.

The smoking drivers perceive higher level of awkward posture, discomfort, LBD prevalence and prevention of activities and lower level of good relationship with colleagues and supervisor than non-smoking drivers. It is understood that when drivers give up the habit of smoking, they can adopt non-constrained posture, they can perceive lower level of discomfort, LBD prevalence, prevention of activities and maintain good relationship with supervisor and colleagues.

While testing whether Pan/Tobacco chewers and non-Pan/Tobacco chewers perceive the level of LBD variables the same, a two sample t-test has been employed and the result reveals that variables LBD prevalence and prevention of activities shows significant difference among Pan/Tobacco chewers and non-Pan/Tobacco chewers.
The independent two sample t-test result confirms that the vehicle drivers with drinking alcoholic beverages habit perceive higher level of intensity of WBV, awkward posture, worst road condition and seat condition, higher discomfort, longer drive duration, higher work stressor, lower support from supervisor and colleagues, and higher level of LBD prevalence.

The result of t-test proves that the drivers, who are not doing exercise regularly perceive higher level of intensity of whole body vibration, discomfort, mild constrained posture, bad road condition, longer break duration, higher work stressor, LBD prevalence, prevention of activities and medical intervention.

This reveals that when drivers practice exercise regularly, the influence of potential environmental ergonomic risk factors can be reduced, which leads to lower level of LBD prevalence and their consequences such as prevention of activities and medical intervention.

The two sample t-test was used to test the significant difference in the perception of LBD variables between drivers without back pain in previous job and drivers with back pain in previous job. The result proves that Drivers who had back pain in previous job perceive higher level of intensity of WBV, discomfort, constrained posture, worst road condition and seat condition, shorter drive duration, longer break duration and higher work stressor, and lower social support, higher LBD prevalence, prevention of activities and medical intervention.
perceive higher LBD prevalence level when compared to the other vehicle drivers.

For testing the perception of LBD level among vehicle drivers of various age groups, one way ANOVA has been employed and result shows that the road condition is found significant. The Post-hoc test corroborates that the vehicle drivers of age group above 50 years and 46-50 years perceive worst road condition when compared to remaining age groups.

In order to test whether the vehicle drivers with different qualifications, perceive the same level of LBD prevalence, one way ANOVA has been conducted and the result classifies that the perception of drivers with different educational qualifications are significantly different regarding the road condition and drive duration. The Post-hoc test substantiates that the illiterates perceive worst road condition and degree holders perceive longer drive duration than others.

Through analysis of variance test, it is found that there is a significant effect on posture, road condition, discomfort and psychosocial work aspect variables among different income groups. The perception differs significantly between low income and high income groups.

On conducting one way ANOVA for testing the perception level of LBD among vehicle drivers of different body mass indices, the result shows that the LBD prevalence level variables road condition, seat condition, discomfort and drive duration are found significantly different between body mass indices. The Tukey’s test for road condition has confirmed that the perception differs significantly between under weight group and others.

In order to test whether the vehicle drivers with different seat suspension perceive the same level of LBD prevalence, one way ANOVA has
been conducted and the result clarifies that the perception of mechanical, air
and no seat suspension users are significantly different regarding the variable
LBD prevalence. The Post-hoc test proves that vehicle drivers with air seat
suspension perceive lower LBD prevalence than others.

7.2 CONTRIBUTIONS OF THE RESEARCH

This research has developed a LBD potential risk factor model to
test the prevalence of LBD among drivers. The instrument framed in this
study is an easy assessment of the LBD symptoms among drivers. The study
has established the relationship between the environmental ergonomic
potential risk factors and prevalence of LBD among the vehicle drivers. The
study has established the relationship between the prevalence of LBD,
prevention of activities and medical intervention for LBD prevalence. The
study has brought out various insights of environmental ergonomic problems
leading to the prevalence of LBD, which will help the drivers to overcome the
LBD related issues. Thus, the present research has contribution to the
literature on the environmental ergonomic field.

7.3 RECOMMENDATIONS

The findings of the study examined the relationships between the
prevalence of self-reported lower back disorders attributed to work and
Intensity of Whole body vibration, Posture, Road Condition, Seat Condition,
Discomfort, Drive Duration, Break Duration, Psychosocial Work Aspect and
Psychosocial Personal Aspect in a general population of vehicle drivers. The
study has brought to limelight, while designing a preventive intervention
program aiming at reducing the occurrence of Lower back Disorders (LBD)
symptoms in the vehicle drivers environment should address the above
mentioned nine factors.
The environmental ergonomic recommendations for the management from the results of this study are as follows.

- The survey has elucidated that variables Intensity of WBV, Discomfort and Psychosocial Work Aspect plays a discriminating factor between vehicle drivers and University staff members (Control group- who did not drive vehicles at work). Hence, management has to understand the urgent need to take steps towards reducing the intensity of WBV, Discomfort and work stressors, since the vehicle drivers suffer a lot compared to control group.

- The management has to focus on technical prophylactic modifications in tractors and single Decker buses to reduce the intensity of WBV, discomfort and to improve seat condition. Further, improve the road conditions and reduce the continuous drive duration to the maximum of three hours and reduce the work stress and increase the break duration to maximum of twenty minutes between three hours of continuous drive duration in order to reduce the LBD prevalence level. Since the tractor and single Decker bus drivers suffer a lot compared to Lorry drivers.

- The Management/Government should invest more money on development and maintenance of roads with sufficient strength and smooth riding surface to improve health condition of illiterate drivers and drivers in the age group of 46-50 years and above 50 years.

- Management can concentrate on reduction in continuous drive duration to a maximum three hours in order to satisfy the wide
range of its employees who have completed school education upto 12\textsuperscript{th} standard, Diploma & ITI and Degree holders.

- The management has to take steps to improve the existing work environment regarding the Road Condition and Discomfort in order to satisfy the wide range of income group of employees.

- The management can implement air seat suspensions to all vehicle types as an initiative towards reducing the LBD prevalence level, since the drivers without seat suspension and drivers using mechanical suspension suffer a lot compared to air seat suspension users.

The environmental ergonomic recommendations for an individual vehicle drivers based on the results of this study are as follows.

- The study has perused that University staff members (Control group) alter their working posture in a better way and maintain good interpersonal relationships between supervisor and colleagues when compared to drivers. It is advised as common that the vehicle drivers has to concentrate on their body posture while driving and develop interpersonal skill to maintain good relationships between supervisors and colleagues to abate LBD.

- The vehicle drivers are instructed to abandon the habit of smoking, Pan/Tobacco chewing and drinking alcoholic beverages and practice exercise regularly since it influence the reduction of LBD prevalence level.
The drivers with persistence of back pain in previous job itself have to take care of their health, since they are enduring due to health problems relating to LBD.

The Tractor and single Decker bus drivers have to show attention regarding their work posture and interpersonal relationships.

The high income group of vehicle drivers are admonished to change their working posture to overcome LBD problem. The low income group of drivers are recommended to learn skills to manage the work stressors.

It is exhorted that vehicle drivers should concentrate on their body height and weight in order to keep their body mass index as normal weight. Worst road condition and higher level of Discomfort is perceived by underweight category of vehicle drivers. Hence, the underweight category of vehicle drivers have high chance of LBD prevalence.

7.4 PREVENTATIVE MEASURES TO REDUCE POTENTIAL ENVIRONMENTAL ERGONOMIC RISK FACTORS OF VEHICLE DRIVERS

Different element of prevention can be distinguished: technical prevention aimed at elimination or reduction of physical risk factors, organizational changes in the work, personal protection for psychological risk factors and medical prevention. In most cases, only a combination of preventive actions will lead to a successful reduction in lower back disorder prevalence among vehicle drivers.
As personal protective equipment against potential environmental ergonomic risk factors is not available, information, knowledge, and tools enabling employees to cope with risk factors and early effects are fundamental in the maintenance of health and safety in workplace.

Engineering solutions to minimize the effects of potential environmental ergonomic risk factors:

- Intensity of WBV, Discomfort, Road condition and Seat condition are grouped into two areas;

  1. Reduction of vibration at source by improvement of the quality of terrain, careful selection of vehicle or machine, correct loading, proper maintenance etc.

  2. Reduction of vibration transmission by incorporating suspension systems (tyres, vehicle suspensions, suspension cab and seat) between the operator and the source of vibration. The possible positions of vehicle suspension system is shown in Figure 7.1.

![Figure 7.1 Possible positions of vehicle suspension systems](image)
Posture

1. Reduce the need for awkward postures by improving cab visibility and relocating machine controls.

2. Improve the driver’s posture by providing a seat with the correct profile and adjustments, which is compatible with driver anthropometrical dimension, cab internal dimension driver tasks and the dynamic environment.

Drive duration

Limitation of vibration exposure duration.

Break duration

Provision for regular breaks during continuous drive duration.

Psychosocial Work Aspect

Organizational changes in work which includes manageable workloads and increased worker autonomy.

Psychosocial Personal Aspect

Behavioral changes in individuals which could result in supportive work environment.

These preventive measures should result in a concomitant reduction in the development of lower back disorders.
7.5 LIMITATIONS OF THE STUDY

Limitation of the study concerns the use of a single source data (i.e.) a questionnaire survey. Therefore, the problem of common method variance is a possibility. Validity and reliability are closely related. Researchers often use a rifle target to illustrate the relationship between these two properties of a measuring instrument. Reliability is a function of consistency of the shots, while validity is a function of shots being arranged around the bull’s eye. Thus, an instrument that is valid is always reliable; an instrument that is not reliable is never valid (Raymond Mark 1996). Because we cannot have validity without reliability. In social science study, it is necessary for the researcher to make tradeoffs between explanatory power and scope of a research project. Although this study attempts to reasonably infer the causal relationships from the treatment to dependent variables, the ambiguity about the direction of causal influence are still regarded as potential threats to internal validity.

Use of questionnaires which rely on symptoms reporting can over estimate the magnitude of the problem as presence of lower back disorders. The presence of symptoms alone may therefore be unstable predictor of musculoskeletal disorders of spine system in a working population. However medical examination is essential to establish a clinical diagnosis. The questionnaire responses are collected only from vehicle drivers of Tamil Nadu.

7.6 SCOPE FOR FUTURE RESEARCH

This study investigated both LBD potential environmental ergonomic risk factors responsible for LBD prevalence among vehicle drivers and also this study has confirmed the positive relationship between the LBD prevalence level, prevention of activities and medical intervention. For future
research, several research areas can be derived from this study. A generalized model can also be developed in order to suit any group of vehicle drivers to test the prevalence of LBD. The responses can be collected from the drivers of all over India and results made can infer the perception of vehicle drivers of whole India. This work can also be extended to two wheeler riders by the future researchers.

The influence of individual factors such as, sleeping hours, rest period between the driving slots, leisure time activities and duration on LBD prevalence can be studied as further research. Neck-shoulder problems must be treated as equally contributing, as LBD in decreasing the quality of work life of the drivers. Hence neck and shoulder pain can also be included in the future study.

Intensity of whole body vibration measurements can be measured using Tri-axial seat pad accelerometer at the driver/seat interface. The questionnaire can be used in multicentre studies and data collected and analyzed in a data base. Follow-ups should be undertaken yearly over a ten years period or more.

Further examination of those who report LBP, neck and shoulder pain will include measurement of range of motion and muscle function (Clinical examination). Muscle function measurement should include the flexion-relaxation phenomenon, strength, endurance and response to sudden loads using electromyography.