Interventions to Reduce Musculoskeletal Disorders among Motor Vehicle Workers: A Review

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ABSTRACT

Background: Musculoskeletal disorders (MSDs) are one of the most common work-related health problems affecting workers across all employment sectors. It causes problems in several economic activity sectors in industrialized countries. Objective: The purpose of this study was to identify which specific types of interventions were effective to reduce musculoskeletal disorders among motor vehicle workers. Results: Among of these studies, two of them were conducted in Netherlands and the other two also were conducted in the United State. The other five remaining articles were conducted in Japan, Finland, Italy, China and United Kingdom. All of them were intervention studies but only one of this was systematic review. In general, of the 9 included studies, 7 of the reviews showed positive effect from the implemented interventions done at their workplace. The 2 reviews presented that the interventions was not effective towards their workers. Conclusion: Overall, among several types of intervention used to reduce MSD, there is the most common type of intervention that usually applied towards motor vehicle workers which is administrative control intervention. However, this type of intervention is not effective as engineering control intervention which is provide more positive effects.

INTRODUCTION

Musculoskeletal disorders (MSDs) are one of the most common work-related health problems affecting workers across all employment sectors. It causes problems in several economic activity sectors in industrialized countries. For example, in the United States, current data shows that MSDs represent 40% of compensated injuries and cost between $45 and $54 billion per year [9, 23]. Work-related injuries and occupational diseases have become an increasing concern among employees, employers, and governments because of big impacts on workers’ health and productivity. A survey in the United States found that more than one million workers with MSD missed time from their jobs at a cost of more than $50 billion a year [22, 41].

Results from a Household Survey (SWI95) estimated that 1.2 million men and women in 1995 believed themselves to be suffering from musculoskeletal symptoms caused or made worse by work [14]. MSDs most commonly affected lower back, neck, shoulder and upper back, with prevalence rates of 28.0%, 24.0%, 18.6% and 15.5% [41]. Among workers suffering from MSDs, about 50% reported pain or discomfort with less than one month duration [41].

Work-related musculoskeletal disorders, especially low back pain (LBP), cause substantial economic losses to individuals as well as to the community. Professional drivers have been found to be at high risk for developing LBP due to prolonged sitting and vehicle vibration. Among the different types of work-related musculoskeletal disorders that could potentially be associated with professional driving, LBP has been reported the most extensively [2]. Population surveys conducted in the USA and Canada have both found that back pain frequency among drivers is 1.6–2.0 times the reference prevalence. Similar observations on the high frequency of LBP and spinal disorders associated with driving have also been reported in developed countries, for machine drivers, forklift truck drivers, bus drivers, agricultural tractor drivers, truck drivers, police officers and other professional drivers [7].

Prior reviews have examined the effectiveness of interventions for reducing or preventing musculoskeletal disorders, but the prior reviews differ from this current review in many ways. Several focused on clinically-
based interventions not specific to the workplace. Others included a wide range of disciplines on work-relatedness of MSD and therefore not specific to motor vehicle workers. This systematic review used a structured methodology for evaluating the literature and synthesizing evidence regarding interventions to reduce musculoskeletal disorders focused on motor vehicle workers. Further, this study also seeks to identify which specific types of interventions are effective.

**Methodology:**

**Identification of publications:**

A list of articles between 2000-2014 related to intervention or prevention of musculoskeletal disorders among motor vehicle workers was compiled using a series of keywords with 5 databases (PubMed, Science Direct, Google Scholar, ELCOSH and OSH-ROM). The keywords were ergonomic*, intervention*, prevention*, musculo*, control*, motor vehicle* and workers*. Then, the bibliography of already published literature reviews on the effectiveness of the intervention was examined and the relevant titles were retained. Thus, 437 publications related to an intervention on musculoskeletal disorders were identified. The abstracts of these 437 publications were read. 62 publications were accepted since they did discuss the intervention.

**Selection of publications:**

The final selection articles were done using the following criteria:

- The articles published between years 2000 until 2014 were only selected. Articles published before year 2000 were not considered.
- The articles had to be published in English. Articles published in books or book chapters as well as research reports were not considered.
- The interventions had to be aimed at the prevention or reduction of musculoskeletal disorders among motor vehicle workers.
- Changes resulting from the intervention had to involve the work performed. Changes not directly related to the work were not considered.

Thus, in the end there were a total of 9 usable articles that met all of the selection criteria.

**Analysis strategies for selected publications:**

A detailed analysis grid was used to extract 3 major categories of information from the selected articles:

- **Population:** first step was to define the populations in the work situation studied.
- **Intervention:** second step was to determine the type of intervention used.
- **Result:** last step was to assess the results from these studies.

All these information were presented through tables which included data in raw form (Table 1).

![Fig. 1: Flowchart of systematic review process.](image)

**Results:**

Nine review articles between 2000-2014 related to intervention or reduction of musculoskeletal disorders among motor vehicle workers were identified. Among of these studies, two of them were conducted in Netherlands [15,36] and the other two also were conducted in the United State [4,21]. Nevertheless, the other five remaining articles were conducted in Japan, Finland, Italy, China and United Kingdom.

Eight of these reviews were identified as intervention studies [4,13,15,19,31,36,38,40]. Only one of this was systematic review [21]. The population of these studies included drivers and forklift workers. Seven reviews focused on drivers such as car drivers, bus drivers and truck drivers [4,13,19,21,36,38,40] while 2 of the reviews had focused on forklift workers [15,31].

An attempt was made to categorize the studies as related to types of intervention used. Five of the reviews had used administrative control intervention [4,13,15,36,38] while 2 reviews had used engineering control
intervention [19,21] and only 1 of the review had used personal protective equipment (PPE) intervention [40] to reduce MSD. There was only one studies conducted by Shinozaki [31] had implemented two types of intervention which were administrative control and engineering control.

A summary of the intervention effects is presented in (Table 1). Overall, seven of the reviews showed positive effect from the implemented interventions done at their workplace [4,13,15,21,31,38,40]. The 2 reviews presented that the interventions was not effective towards their workers [19, 36]. Among of these 2 reviews, one of them was used administrative control interventions while the other one review was used engineering control intervention.

There was little evidence to suggest that lumbar supports are not effective. Engineering control compared to administrative control is effective in reducing the prevalence of low back pain (LBP) among forklift workers. Lyons [21] found that ergonomic control have been recommended in order to reduce low back pain and injury among professional drivers. There was some evidence that special corset and massage on driver’s back can reduce the degree of pain among drivers in plateau areas. There was few evidence presented that administrative control interventions such as intervene activities to raise awareness of musculoskeletal health, implement the program to prevent musculoskeletal disorders, introduce a standardized fitness-for-duty and also train the occupational health services were increased awareness regarding prevention of musculoskeletal disorders among motor vehicle workers.

Tiemessen [36] evaluated the effect of intervention program which were implemented towards 126 drivers. The result found there were no significant changes in whole body vibration (WBV) exposure for the drivers due to implementation of the program. Nonetheless, using personal protective equipment (PPE) as the intervention to reduce MSD among drivers at plateau areas was found positive effect in reducing the degree of back pain.

Discussion:

This systematic review identified several types of interventions used to help in reducing MSD among motor vehicle workers, and most interventions had positive effects in spite of known difficulties in increasing individual awareness regarding MSD. This study found administrative control as the most common type of interventions used to reduce MSD compared to other types of control such as engineering control and PPE. Clearly administrative control can be less effective compared to engineering control but the initial cost of engineering control can be higher than the cost to implement administrative control reference. Thus, more organization preferred to conduct training or program rather than remodeling or redesign the vehicles. Available evidence suggests that engineering control may have been more effective for the reduction in the prevalence of back pain among forklift workers [31].

One review in this study which was used engineering control found that ergonomic low back support was not effective on low back and neck-shoulder subjective fatigue but it is just to limit LBP increase during driving. Conversely, early studies have indicated that sitting without lumbar support and a backrest could increase disk pressure and the electromyographic activities of back muscles. There was some evidence stated that an ideal sitting posture can be obtained by providing a backrest [17] and lumbar support with continuous passive motion improves comfort in simulated automobile seating both in healthy and LBP subjects [28]. However, the ineffectiveness of using lumbar support in reducing LBP in this study probably due to some mistake when handling the intervention or the participants were not complied in the intervention.

There were many studies had focused on MSD among workers who driving a car, truck, tractor and so on. However, there is only few or no studies was done related to MSD among riders who use bicycle or motorcycle as a medium of transportation in doing their jobs for example postal delivery workers. In fact, the tendency to develop MSD among people who spend lots of time on motorbike or bicycle is higher compared to people who use other mode of transportations. It is undeniable that workers who are riders are exposed more to hazards in their surroundings. Besides, the motorcycle itself has limitations in terms of space and poses a complicated challenge for any motorcycle design adjustments [17]. None of these studies attempted to implement intervention in order to reduce MSD towards motorcyclists’ worker. More comprehensive accounting of motor vehicle types and implementation of intervention towards all categories of motor vehicle workers can strengthen a number of these studies.

Conclusion:

Overall, among several types of intervention used to reduce MSD, the most common type of intervention that usually applied towards motor vehicle workers is administrative control intervention. However, this type of intervention is not effective as engineering control intervention which provide more positive effects. Nevertheless, the initial cost to implement engineering control intervention is higher than administrative control intervention. Thus, even though there are many intervention strategies that can be used to prevent MSD among motor vehicle workers but it depends on the organization itself to make a decision based on their preferable types of intervention.
Table 1: Review of systematic reviews related to intervention to reduce musculoskeletal disorders among motor vehicle workers at workplace.

<table>
<thead>
<tr>
<th>AUTHOR/YEAR</th>
<th>STUDY DESIGN</th>
<th>STUDY LOCATION / POPULATION</th>
<th>INTERVENTION / CONTROL</th>
<th>RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gyi, 2013</td>
<td>Intervention study</td>
<td>United Kingdom Organizations with a cohort of business drivers. Four companies were selected to take part. (Sample size has not being provided).</td>
<td>Intervention activities to raise awareness of musculoskeletal health in drivers (administrative control)</td>
<td>The approach raised management awareness of the risks to drivers and was successful in affecting change.</td>
</tr>
<tr>
<td>Shinozaki, 2001</td>
<td>Intervention study</td>
<td>Japan 260 male blue collar workers including 27 forklift workers and 55 white collar workers of a copper smelter.</td>
<td>Personal approach (administrative control) and facility approach (engineering control)</td>
<td>The initial prevalence of low back pain (LBP) was 63%. After first intervention (personal approach) the prevalence of LBP fell to 56%. After second intervention (facility approach) prevalence of LBP decreased to 33%.</td>
</tr>
<tr>
<td>Tiemessen, 2009</td>
<td>Intervention study</td>
<td>Netherlands 126 drivers were included in the study.</td>
<td>The intervention program consisted of four different parts: (a) individual health surveillance (b) an information brochure (c) an informative presentation and (d) a report concerning the results of the performed field measurements. (administrative control)</td>
<td>No significant changes (P=0.36) in WBV exposure for the drivers due to implementation of the intervention program.</td>
</tr>
<tr>
<td>Vecoli, 2012</td>
<td>Intervention study</td>
<td>Italy Public bus drivers. (Sample size has not being provided).</td>
<td>Vibration of the driver lumbar back was measured real time with or without wearing corset. (PPE)</td>
<td>Special corset for drivers and massage on back by themselves can reduce the degree of the pain</td>
</tr>
<tr>
<td>Yu, 2002</td>
<td>Intervention study</td>
<td>China 1132 male drivers in plateau areas</td>
<td>The authors trained occupational health services (OHS) in the experimental group in the use of the program. OHS in the control group were asked to deliver care as usual. (administrative control)</td>
<td>Process evaluation revealed a positive influence on company policy toward WBV, attitude and intended behavior of forklift drivers, and a trend towards an increase in knowledge of OHS professionals and company managers.</td>
</tr>
<tr>
<td>Hulshof, 2006</td>
<td>Intervention study</td>
<td>Netherlands 15 OHS, 32 OHS professional,26 companies and 260 forklift drivers</td>
<td>Introduce a standardized fitness-for-duty evaluation of commercial truck drivers who present for their comprehensive Department of Transportation (DOT) physical examination. (administrative control)</td>
<td>There was a 54% reduction in the low back pain incidence rate and an associated 45% reduction in workers’ compensation costs from 1999 to 2006.</td>
</tr>
<tr>
<td>Berestnev, 2014</td>
<td>Intervention study</td>
<td>Philadelphia, USA Commercial truck drivers. (Sample size has not being provided).</td>
<td>All subjects were studied twice and the use of ergonomic low back support was randomized. (engineering control)</td>
<td>Low back support had no effect on low back and neck–shoulder subjective fatigue and neck–shoulder pain but tended to limit the LBP increase during driving.</td>
</tr>
<tr>
<td>Leinonen, 2005</td>
<td>Intervention study</td>
<td>Finland 40 voluntary urban bus drivers, 25 with recurrent low back pain and 15 with healthy back participated in the study</td>
<td>Ergonomic controls that can be implemented are air floatation seats or damping devices and an inclined backrest. Steps, handles, and railings can be installed on all buses and commercial vehicles in easily accessible locations. Drivers should also be instructed to wear supportive shock absorbing footwear. (engineering control)</td>
<td>A review of the literature of the etiology of low back pain and injury among professional drivers is presented, and possible ergonomic controls have been recommended.</td>
</tr>
<tr>
<td>Lyons, 2002</td>
<td>Systematic review</td>
<td>Portsmouth, USA Professional drivers. (Sample size has not being provided).</td>
<td></td>
<td></td>
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</table>
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REFERENCES