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SELF-REPORTED MUSCULOSKELETAL PROBLEMS AMONGST PROFESSIONAL TRUCK DRIVERS

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Abstract

Occupational driving has often been associated with a high prevalence of back pain. The factors that contribute to cause the pain are diverse and might include prolonged sitting, poor postures, exposure to whole-body vibration, and other non-driving factors such as heavy lifting, poor diet or other psychosocial factors. In Europe, truck drivers are likely to be considered an 'at risk' group according to the Physical Agents (Vibration) Directive and therefore risks will need to be reduced. This questionnaire-based study set out to examine the relationship between musculoskeletal problems and possible risk factors for HGV truck drivers to help prioritize action aimed at risk reduction. Truck drivers (n=192) completed an occupational questionnaire with two measures of vibration exposure (weekly hours and distance driven). Items on manual handling, relevant ergonomics factors and musculoskeletal problems were also included. Reported exposures to vibration ranged from 12 to 85 hours per week, with a mean of 43.8 hours. Distances driven ranged from 256 to 6400 kilometres (mean 2469 km). Most of the respondents (81%) reported some musculoskeletal pain during the previous 12 months, and 60% reported low back pain. Contrary to expectations, vibration exposures were significantly lower among those who suffered musculoskeletal symptoms when distance was used as an exposure measure. Manual handling and subjective ratings of seat discomfort were associated with reported musculoskeletal problems.

1. Introduction

Truck drivers comprise a large population that are exposed to many risks associated with low back pain. High-mileage drivers have often been associated with high prevalence of musculoskeletal pain (e.g. Gyi and Porter 1998, Porter and Gyi 2002, Porter et al. 1992); poor postures in some types of truck have been linked with neck and trunk pain (Massaccesi et al. 2003); drivers are exposed to whole-body vibration for extended periods of time, and this has been associated with low-back pain (e.g. Seidel and Heide 1986, Hulshof and van Zanten 1997, Bovenzi and Hulshof 1999, Mansfield, 2005). Among the population of occupational drivers, additional factors may contribute to the symptoms reported. Chief among these is prolonged sitting, generally in a posture that is constrained by the driving task. This sitting leads to the expulsion of fluids from the inter-vertebral discs and reduces their ability to cushion the spine (Pope et al. 1998). Truck drivers are exposed to further occupational stressors: they are routinely required to complete strenuous physical work, including loading heavy goods, decoupling trailers, strapping down tarpaulins and jumping up and down from cabs and trailers. These mechanically demanding activities are often carried out following long periods of inactivity, and a lack of preparedness is thought to be especially strenuous for the ligaments and muscles of the low back (Phillips 2003). Some truck drivers feel constrained to an unhealthy diet (e.g. Jack et al. 1998) and other lifestyle factors such as a insufficient exercise and smoking can affect susceptibility to low-back pain. The latter is said to cause malnutrition of the spinal discs, which results in greater vulnerability to mechanical stress (Ernst

1992). Some of these negative lifestyle factors may well be present to a greater extent among truck drivers than the general population.

It is difficult to extract the influence of any one risk factor present in driving trucks. Therefore, a risk management strategy requires a holistic approach, such that all potential physical stressors are monitored and minimized. This is the strategy employed in the Physical Agents (Vibration) Directive (European Commission, 2002). Although the Directive has a primary focus on vibration, all risks must be minimized: 'ergonomic design' and 'design and layout of workplaces' are specifically mentioned in the document. The Directive was enforced across the EU in 2005, and many truck drivers exceed the Exposure Action Value thereby requiring action from their employers (e.g. Paddan and Griffin 2002). One required aspect of this action is health surveillance, although it is difficult to practically implement: although it is relatively straightforward to identify those reporting some back troubles, there are no reliable methods to categorically link any back pain to any specific pathogen and therefore effective risk minimization is difficult.

This paper reports a questionnaire study that was designed to identify the prevalence of musculoskeletal problems amongst truck drivers, whilst obtaining additional information such that links between specific risk factors and back pain could be investigated. Recommendations could therefore be made to assist in prioritizing risk management strategies. One limitation of a questionnaire approach is that it is, by design, subjective rather than objective in nature. However, such methods are well established and have been

validated in many contexts including physical exertion (e.g. Borg and Kaijser, 2006), acoustics (e.g. Kuwano and Namba, 1985), and musculoskeletal stresses (e.g. McGill and Brown, 2005; Arvidsson et al., 2006). Furthermore, in many cases, pathology specific to reported pain can be difficult to identify and therefore subjective methods can be appropriate for studies of musculoskeletal problems. Finally, it is not usually practical to use objective diagnostic testing for cohorts as large as that reported here.

2. Methods

2.1 Questionnaire development

The primary means of investigation was a bespoke questionnaire. This was devised to identify the prevalence of musculoskeletal disorders, to indicate occupational and leisure vibration exposure, and to give information on lifestyle factors and other potentially confounding factors. In order to be compatible with existing research, vibration exposure was evaluated using questions similar to those from a larger Medical Research Council study (Palmer et al. 1999). The section on musculoskeletal disorders was based on the updated version of the standard Nordic Musculoskeletal Questionnaire (Kuorinka et al. 1987, Dickinson et al. 1992). Additional items on ergonomic factors were included, based on issues raised within Porter and Gyi's (2002) study of musculoskeletal troubles among car drivers.

Section 1 dealt with current employment history (including exposure to lifting and night shift work), section 2 examined sources of and duration of whole-body vibration exposure, including seasonal and non-occupational exposures, and details of relevant ergonomics factors. The third and fourth sections comprised the general and low back-specific sections of the Nordic Musculoskeletal Questionnaire, and the final section was for the collection of personal details. The questionnaire was constrained by the need for accuracy in an appropriate, short format. The full questionnaire is shown in the Appendix. The study was approved by Loughborough University Ethical Advisory Committee.

2.2 Questionnaire administration and sampling

The questionnaire was completed by 192 truck drivers who were randomly sampled from customers at rest areas in England and Scotland. The investigator was present on each occasion, during which customers were approached and the aims of the investigation were briefly outlined. Approximately 30% of those approached refused to participate. The questionnaire took between 4 and 15 minutes for self-completion. Approximately 1 in 10 questionnaires were administered in an interview style to gain responses from those who did not have reading glasses with them.

3 Results

3.1 Demographics

Two females and 190 males completed the questionnaire. A wide range of ages was represented (22 to 71 years), and this was strongly correlated with industry experience (*Spearman's $\rho = 0.631$, $p < 0.01$*). The mean stature (1.78 m) of the sample was slightly above the mean value for UK males (Peebles and Norris 1998). The mean body mass index (BMI) was 28.6 kg/m² and was above the UK mean for adult males (25-26 kg/m², Gregory et al. 1990). The BMI of the study population is generally accepted as being in the 'overweight' category. Smokers comprised 41% of the respondents, 11% were ex-smokers, the remaining 48% were non-smokers. The majority of the sample was right-handed. Demographic details are summarized in Table 1.

Table 1 about here.

3.2 Vehicles

Vehicles were categorised into primary, secondary and tertiary according to use. Heavy Goods Vehicles (>3.5 tonnes; HGVs, n=172) were the most numerous primary vehicles, with Light Goods Vehicles (<3.5 tonnes; LGVs) and cars the primary vehicles for 10 and 5 respondents respectively. Secondary and tertiary vehicles included cars, off-road vehicles, pallet trucks and military tanks. Approximately one third of respondents used other types of

vehicles occasionally or only at certain times of the year. These included forklift trucks, cars and specialized vehicles such as road scarifiers and dump trucks. Vehicle ages ranged from less than 1 to 33 years, with a mean of 4.2 years.

3.3 Seat comfort

Mean seat comfort of the primary vehicle was rated as 3.81 on a 7-point scale (7 being most comfortable), and this varied significantly between vehicle manufacturers (1-way ANOVA; $p < 0.05$, 2-tailed). Seat comfort was not related to vehicle age. The majority (83.2%) of primary vehicles were equipped with suspension seats; as expected these were rated as being significantly more comfortable than conventional seats (independent samples t-test; $p < 0.05$, 2-tailed). In agreement with the work of Krause et al. (1998), hard-to-adjust suspension seats were rated as being significantly more uncomfortable than those that were easy to adjust (independent samples t-test; $p < 0.05$, 2-tailed).

3.4 Vibration exposure

Most truck drivers reported vibration exposure from a single vehicle. The mean “time that the engine was running or power on” was 43.8 hours (range 12 - 85 hours) per week (Figure 1). A mean of 2469 kilometres (1534 miles) was reported as the distance driven in the previous week; this ranged from 256 to 6400 kilometres (159 to 3977 miles). It was anticipated that the

accuracy of exposure information would be high, since the majority of vehicles were HGVs and most HGV drivers are legally obliged to collect and archive tachograph data. The two measures (hours of exposure and distance travelled) were correlated (Pearson's $p=0.343$, $p<0.01$, 2-tailed), although the low strength of the relationship indicates that vehicles were driven at a range of average speeds.

Figure 1 about here

Exposure information for non-occupational vehicles was also collected. Respondents reported a mean of just under 5 hours of exposure per week from these sources (car or van, train, bus, coach, or motorcycle). A mean of 48.4 hours weekly exposure to vibration was reported overall.

3.5 Musculoskeletal problems

Most participants (81%) reported musculoskeletal problems ("ache, pain, discomfort") in at least 1 area in the past 12 months, with 2.83 problems reported on average. The greatest proportion of problems was from the low back (60%), with high numbers reporting shoulder, knee and neck trouble (39%, 35% and 34% respectively, see Figure 2). Just under a third of respondents reported prevention of normal work due to musculoskeletal trouble, and just over a third reported having had trouble in the last 7 days.

Figure 2 about here

Low back trouble at some point during their life was reported by 70% of the sample. Referring to the worst episode, this was rated as 'mild' by 36.5%, 'severe' by 38.3%, and 'very, very severe' by 25.2%. Those who reported more severe low-back pain had taken significantly more time off work during the previous year ($p < 0.05$, Chi-square). The majority (86%) of those reporting back trouble at some point during their lives claimed that the trouble had occurred in the past 12 months (Figure 3). For most, the number of days of low back pain was between 1 and 30. Despite the high prevalence of pain in this group, 71% stated that their work was unaffected in the previous 12 months.

Figure 3 about here

Work and leisure factors were blamed for low back pain in approximately equal measures. Answers in a catch-all 'other' category pointed out factors such as posture, lifting, wear and tear and old age. A quarter of respondents reported having visited a doctor, physiotherapist or chiropractor during the last 12 months; a similar proportion to those whose reported pain was severe.

About one quarter (26%) of respondents had injured their low backs in an accident, most (79%) of which had occurred at work. Those who had ever had an accident reported significantly more musculoskeletal problems in the past 12 months than the non-accident group (independent samples t-test; $p < 0.001$, 2-tailed).

3.6 Vibration and musculoskeletal problems

A dose-response relationship between vibration exposure and musculoskeletal symptoms was anticipated. Contrary to expectations, those who suffered musculoskeletal problems reported slightly less exposure to driving when assessed in terms of miles driven per week or hours driven per week. This relationship was unexpected, and was found to be significant for weekly distance driven (independent samples t-test, $p < 0.01$) but not for hours of exposure, which was nonsignificant.

3.7 Manual handling and musculoskeletal problems

Respondents who reported lifting weights of 10 kg or more on an average day reported significantly more musculoskeletal symptoms than those reporting no heavy lifting (independent samples t-test; $p < 0.05$, 2-tailed). Similar findings were observed for those handling weights of 25 kg or more ($p < 0.05$).

4 Discussion

By using questions drawn from published standardized questionnaires, these results may be compared with those of previous studies. Caution is required when making these comparisons as some questionnaires were administered in different languages and with slightly different wording. The study of Mansfield and Marshall (2001), for example, asked respondents to circle areas of pain, aching or discomfort felt after rally driving and results therefore, by design, reflect instant measures (with the purpose of limiting immediate exposures to immediate pain), whereas the Nordic Musculoskeletal Questionnaire (as used in modified form in this study) records incidence of symptoms in the past year in addition to more recent troubles (i.e. "...in the past 7 days").

The 12-month prevalence for low back pain in this sample was 60%, similar to that of the truck drivers of Magnusson et al. (1996) and Schwarze et al. (1998) (Figure 4). This proportion is lower than that found among Porter and Gyi's (2002) sample of business drivers, which was 66%. Similar distances driven and exposure times were expected within these groups, but the more upright and less constrained posture of truck drivers could contribute to the reduced prevalence of low back pain. Among Bovenzi and Zadini's bus drivers (1992), high levels of bending and twisting, long working hours and psychosocial factors may have led to the levels of low back pain observed; these factors would be less prominent among truck drivers. Similarly, data from street

cleaning vehicles, which require regular twisting, have shown higher prevalence of neck pain (up to 87%) than those found here (Massaccesi et al. 2003) . The relatively high levels of back pain observed among Bovenzi and Betta's (1994) tractor drivers may be attributed to greater levels of vibration, shock, bending and twisting often found among operators of agricultural machinery. A comparison of the present sample with the control groups of Bovenzi and Hulshof (1999) and Porter et al. (1992), shows that the proportion of truck drivers who report low back pain is considerably elevated.

Figure 4 about here

Ergonomics factors in the cab were found to affect perceived seat comfort, but did not contribute to the time absent from work. Elevated incidences of low back pain, shoulder, neck and knee pain were reported, but the proportion of respondents reporting that their activities were affected appeared to be somewhat low. Those who reported having had an accident, and particularly whose worst low back pain had been severe reported having taken more time off work. No significant relationships were found between age and musculoskeletal trouble / sickness absence data.

Contrary to initial expectations, lower exposures to vibration are reported by those with musculoskeletal symptoms. This relationship is significant where distance driven is used as the exposure measurement. This probably reflects the measure's improved accuracy over hours of exposure, which will include time that a truck has stopped but is idling, with low levels of shock and

vibration. The calculation of weekly exposures required some mental arithmetic (and possibly guesswork) on the part of the respondents. It is not possible to verify the accuracy of these figures. Distance data can be corroborated by tachograph evidence and so will be less subject to interpretation than exposure time.

The pattern shown may be partly attributed to the 'healthy worker effect' (selective survival), in which employees who are suffering discomfort as a result of work will be more likely to deselect themselves from a job. At another level, those suffering discomfort may put themselves forward for fewer hours of work, and this would show via reduced exposures.

The cross-sectional nature of this study is a limiting factor. The approach is not ideal for the design of a dose-response relationship, particularly where confounding factors such as posture and the healthy worker effect are likely to exert a powerful influence. Quantification of vibration exposure was adapted from questions from a large-scale postal survey; the format and wording of this may not have been ideal for the current application.

It is possible that systematic biases may have affected the data in at least two ways. The high Body Mass Indices observed may be unrepresentative of the BMIs of the entire population of truck drivers, perhaps as a result of the range of food available at rest areas from which the population was sourced. Truck drivers are known to feel constrained in the food that they are able to eat, partly due to problems of keeping 'healthy' food fresh, risk of spillage if eating

in the cab, and perceived high prices in restaurants (Jack et al. 1998). High BMI would be expected to correlate with back pain (e.g. Peltonen et al. 2003). However, although a trend was observed in the expected direction, those reporting back pain did not have a significantly higher BMI than those not reporting back pain. Significantly higher BMIs were observed for those reporting knee and foot/ankle problems ($p < 0.05$ and $p < 0.005$, respectively). Selective admission of those with back pain may also have presented a bias among the data set; it is possible that a proportion of those who refused to complete the questionnaire were those who felt they would not be able to contribute.

Data gathered in this study shows that the majority of truck drivers experienced low back problems in the past 12 months. Therefore, the population must be considered 'at risk' and therefore, according to the Physical Agents (Vibration) Directive, risks must be minimized. As significant correlations were observed between manual handling and musculoskeletal symptoms and between seat comfort and symptoms, controlling the risks from these two factors should be prioritized by employers. Specific manual handling legislation already exists and general guidance should be applied for truck drivers (e.g. UK Manual Handling Regulations, HSE 2004). For example, lifting aids are available and these should be available and drivers trained in their use. Seat comfort should be improved where possible. Vehicle seats should be appropriate and adjusted correctly for each driver. Seats should be well maintained and replaced when necessary.

5 Conclusions

Results show a higher 12-month prevalence of low back pain among the sample of truck drivers than that of the combined control groups of Bovenzi and Hulshof (1999) and Porter et al. (1992). The proportions are comparable with the vibration-exposed subjects of Bovenzi and Hulshof and the truck drivers of Magnusson et al. (1996) and Schwarze et al. (1998). The results indicate an association between truck driving and musculoskeletal symptoms. The data suggest the opposite association to that expected: higher mileage truck drivers tend to report a lower incidence of musculoskeletal disorders, indicating that other factors are clearly affecting the dose-response relationship. Manual handling and seat discomfort were associated with musculoskeletal problems. Interventions aimed at improving handling and seat comfort should therefore be prioritized when devising a risk reduction strategy for truck drivers.

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Captions to figures and tables:

Table 1: Demographic Details for 192 truck drivers who participated in the study.

Figure 1 Self-reported exposure to whole-body vibration reported in terms of (a) hours driven and (b) kilometres driven per week.

Figure 2 Percentage of respondents reporting musculoskeletal troubles in the last 12 months, last 7 days and percentage of respondents whose 'normal work' has been prevented.

Figure 3 Total duration of back trouble reported for previous 12 months within low back pain group

Figure 4 Low back pain prevalence by study (12m=12 month prevalence, LP=lifetime prevalence, PP=point prevalence, REG= "regular")

Table 2: Demographic Details for 192 truck drivers who participated in the study.

Variable	Range	Mean	Std. Dev
Age:	22 – 71 years	45.8 years	10.2
Industry Experience:	0 – 52 years	19.4	13.1
Weight:	57 – 152 kg	90.2 kg	16.8
Stature:	1.57 – 1.98 m	1.78m	10.2
BMI:	18.78 – 44.7	28.6	4.7
Smoking:	41% smokers / 48% non-smokers / 11% ex-smokers		
Handedness:	92% right-handed / 7% left-handed / 1% ambidextrous		

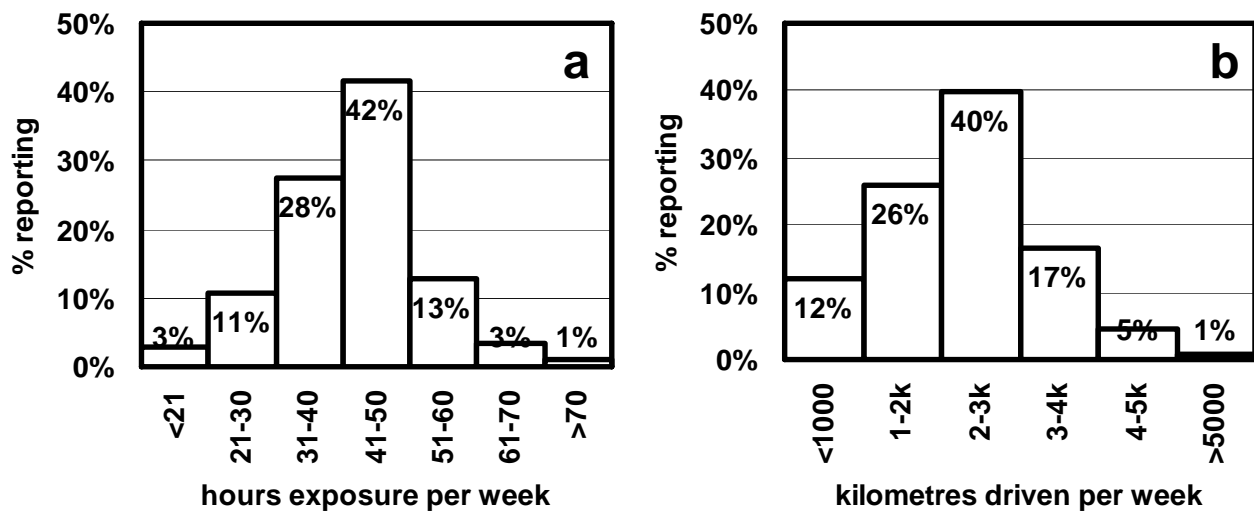


Figure 1 Self-reported exposure to whole-body vibration reported in terms of (a) hours driven and (b) kilometres driven per week.

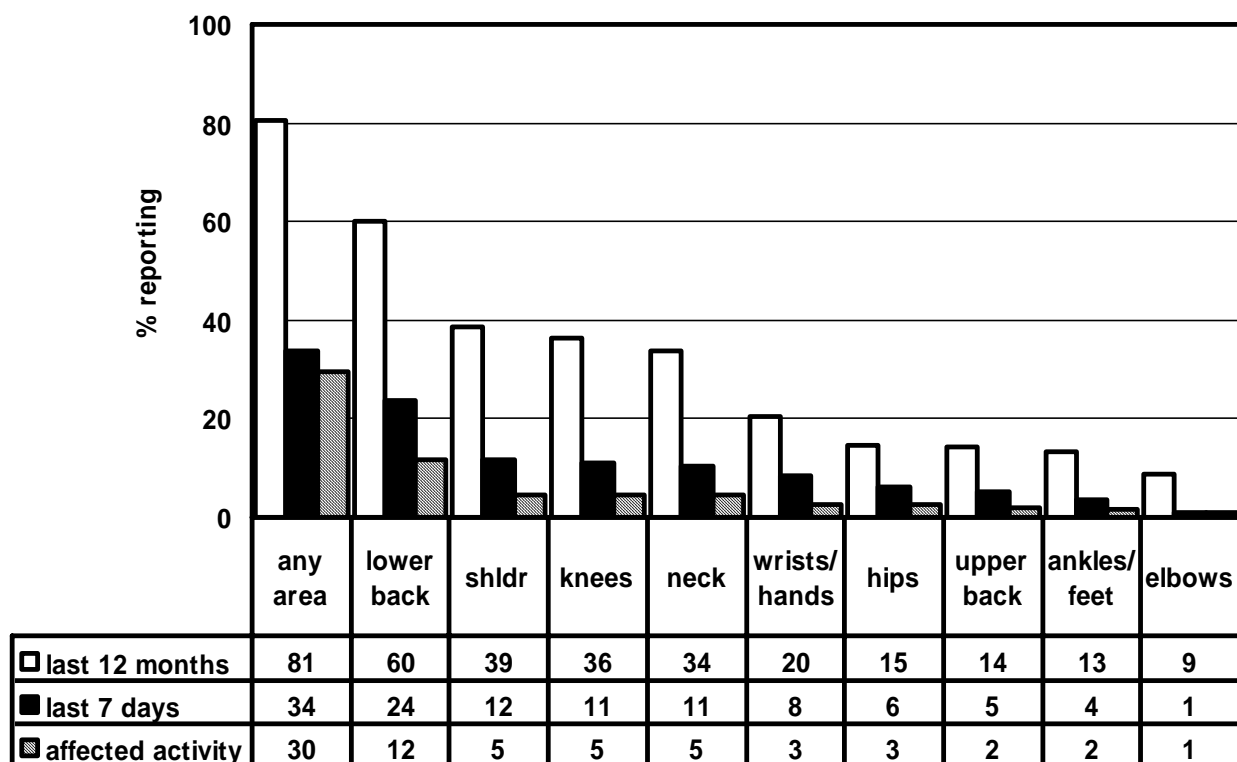


Figure 2 Percentage of respondents reporting musculoskeletal troubles in the last 12 months, last 7 days and percentage of respondents whose 'normal work' has been prevented.

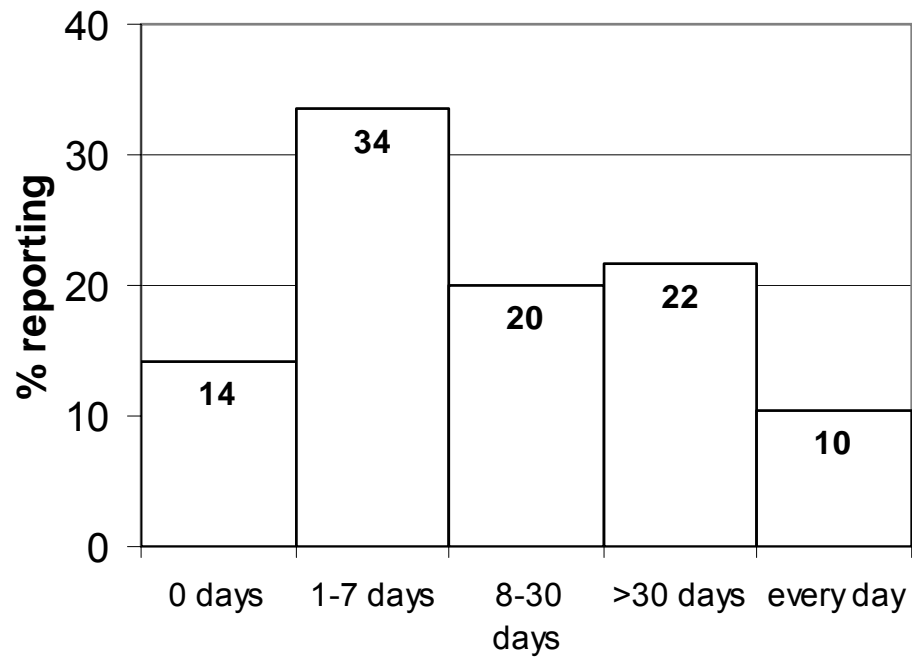


Figure 3 Total duration of back trouble reported for previous 12 months within low back pain group

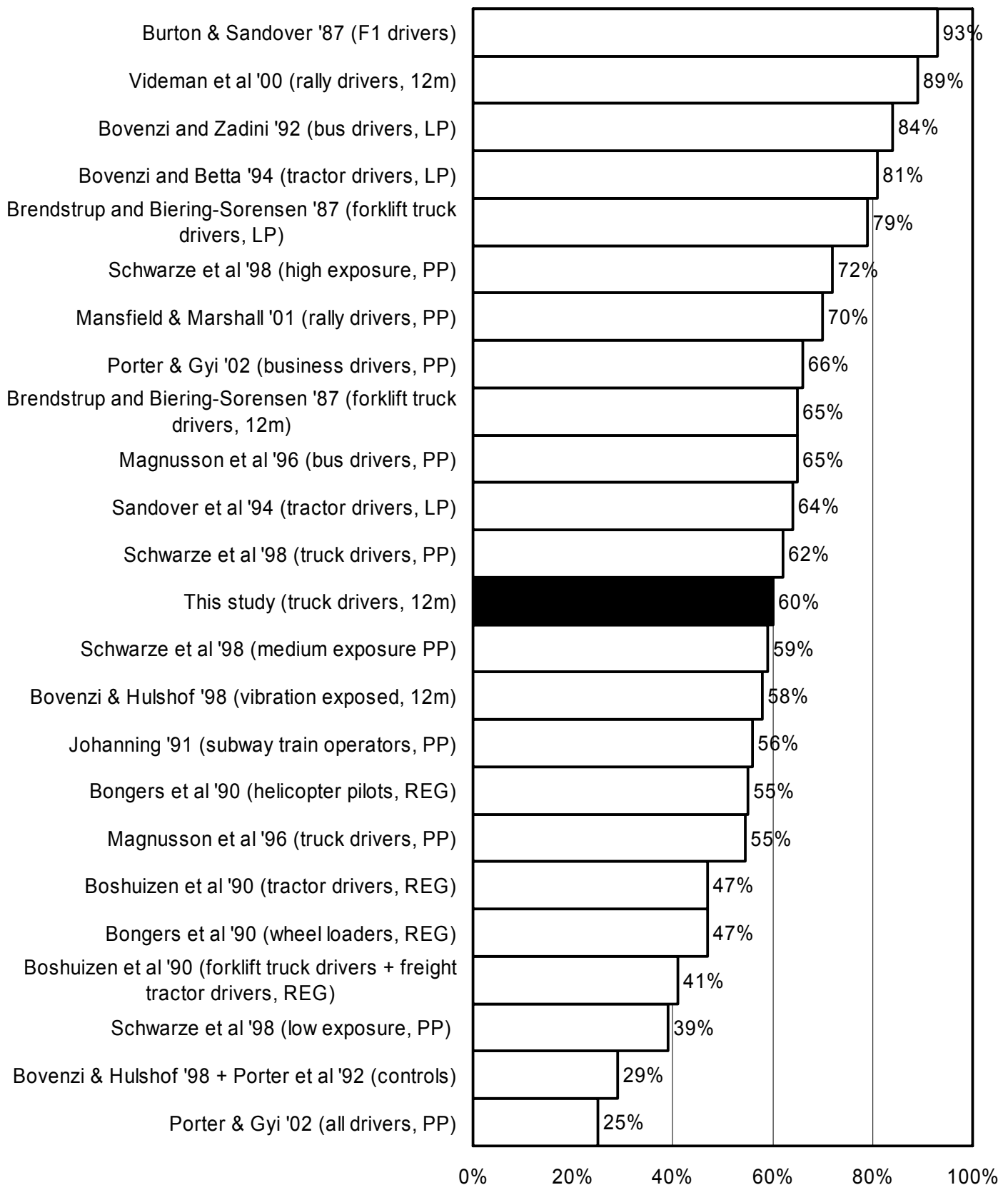


Figure 4 Low back pain prevalence by study (12m=12 month prevalence, LP=lifetime prevalence, PP=point prevalence, REG=“regular”)

Appendix: Questionnaire used in the study.