

Work-related musculoskeletal symptoms among car mechanics: a descriptive study

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A questionnaire concerning musculoskeletal symptoms (MSS) and working environment was answered by 100% of 103 car mechanics in 12 different garages. Almost all the mechanics had been troubled with MSS at work the past year. The most common MSS were symptoms from the low back, neck, head and shoulders. When asked which symptoms had been most troublesome at work most mechanics reported symptoms from the low back, upper back, shoulders and neck. Symptoms from the shoulders, low back and upper back were associated with absence from work due to MSS (OR = 4.2, 2.3 and 2.1 respectively). Mechanics between the ages of 30 and 40 reported significantly more shoulder symptoms than both younger and older colleagues ($p < 0.001$). It seems that symptoms from the back and shoulders restrain car mechanics' work more than any other MSS. The mechanics' most common working postures may contribute to the development of back and shoulder symptoms.

Key words: Absence from work; car mechanics; ergonomics; work-related musculoskeletal symptoms.

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INTRODUCTION

Musculoskeletal disorders account for a large number of workers' compensation days and disability in the Western World. There is a widespread recognition of the multifactorial nature of musculoskeletal disorders with varying attention to individual, physical and psychosocial factors that might contribute to the development of such symptoms. Associations between working environment and musculoskeletal symptoms (MSS) have been reported in many studies.¹⁻³ A review by Kuorinka *et al.*³ reported ergonomic factors such as awkward working postures, static load and task invariability to be some of the most important risk factors for MSS. Psychosocial factors such as high workload and pacing, and lack of social support are also suggested as possible risk factors in many studies.^{2,4,5}

Car mechanics mostly work standing on a floor made of cement or of similar hard materials. People who continuously stand while working are more likely to suffer from pain and aching in the legs and low back than others.⁶⁻⁸ In a study of car mechanics' working postures Kant *et al.*⁹ found that many car repairs are

done under the bonnet and underneath the car. This work requires that mechanics have to work for prolonged periods with their spine flexed forward and/or with their arms flexed at or above shoulder level. These working postures are strenuous for the back and shoulders. According to Kuorinka *et al.*,³ there is particularly good evidence for an association between shoulder tendinitis and working with the arms flexed or abducted. In addition to these factors the mechanics have to assume many other awkward working positions,⁹ and they have fairly high work demands. All these factors may contribute to the development of MSS.

Few studies concerning work-related MSS among car mechanics have been published. In a study on rationalization in garages and its effect on health Houben *et al.*¹⁰ found that 'occupational strain' (physical climate and psychosocial factors) correlated significantly with locomotor problems. From a list of 20 possible locomotor problems, 87 out of 120 car mechanics reported one or more. However, Houben *et al.* did not describe the possible locomotor problems, nor did they report associations between physical ergonomic factors and these problems.

Since little is known about MSS among car mechanics, the aim of the present study was to investigate the occurrence of self-reported MSS in this group of workers. We also wanted to record which symptoms the

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mechanics regarded as the most troublesome at work, and to see whether these symptoms were related to absence from work. In addition, we wanted to record the mechanics' own opinions about the causes of their pain and discomfort. This type of information is useful for preventive work against MSS within this group of workers.

MATERIALS AND METHODS

A cross-sectional study was performed. A total of 12 garages were randomly selected from 25 garages associated in an occupational health service in Bergen, Norway. This particular occupational health service had been established the same year. The number of employed mechanics in the garages varied from three to 15 mechanics (mean = 8.6 mechanics). No garages repaired lorries, buses or other heavy vehicles. All the car mechanics working in the twelve garages ($n = 103$) were asked to participate in the study.

The mechanics answered a self-administered questionnaire concerning age, years working as a car mechanic, and occurrence of MSS in the past 12 months (one-year prevalence). Presence of MSS was defined as ache, pain or discomfort in any of the 10 body regions presented in Figure 1. This way of recording the occurrence of MSS was the same as in the Standardized Nordic Questionnaire for the Analysis of Musculoskeletal Symptoms (SNQ),¹¹ except that the 'head' was added to the nine defined body regions in this questionnaire. The same mannequin as in SNQ was used.

In addition we asked the mechanics to give a score from one to four on how troubled they had been at work due to MSS during the past 12 months, and also which symptoms had been the most troublesome at work during the past year. Furthermore, the mechanics were asked to give their opinion about the three most important causes of their pain and discomfort.

A question concerning absence from work due to MSS the past year was answered with yes or no. Those who stated that they had been absent due to MSS were also asked to report the total number of days they had been absent from work due to MSS during the past year.

Information about the physical environment and working postures was also obtained from the questionnaire. The mechanics were asked to give a score on a four point scale on how well the garage was equipped with tools, vehicle lifts and other equipment, and whether they mostly used a vehicle lift, a greasepit or both. They were also asked how many hours, in an ordinary working day, they were working under the car, under the bonnet, inside the car and in the front, back, or on the side of the car.

The study was performed in co-operation with the local car trade employers' association and the employees' representatives in charge of health and safety in the garages. The employers received a letter with information

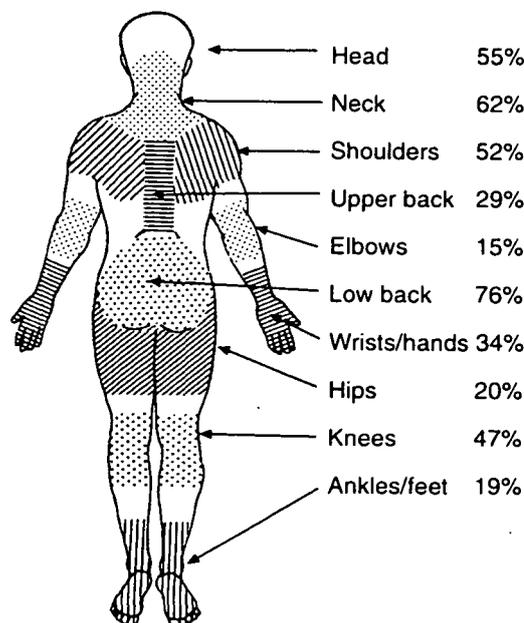
about the study from the employers' association. All the employers, the representatives and the employees were given oral and written information about the study by the project leader. At each garage all the mechanics were gathered in a meeting where the questionnaires were distributed, answered and collected. In this meeting the project leader was available for questions.

The results were summarized in descriptive statistics. Associations between age, years of employment as a mechanic, MSS-related absence from work, a symptom index and trouble at work due to MSS were analyzed in a univariate correlation analysis. The separate effects of age and years of employment on how troubled the mechanics had been at work due to MSS was evaluated by a multiple regression analysis. Univariate correlation analyses were performed to analyze associations between occurrence of MSS and working postures, and between MSS and how satisfied the mechanics were with their equipment at the garage. Estimation of the odds ratio and its 95% confidence interval was performed to evaluate associations between the presence of troublesome symptoms at work and MSS-related absence. The relationship between age and troublesome symptoms at work was analyzed by a χ^2 test. The analyses were performed using SPSS 6.0 computer package.¹² The significance level was set to 0.05.

RESULTS

The questionnaires were answered by 100% of the mechanics in the twelve garages ($n = 103$). The mean age of the mechanics was 34.6 years (SD = 10.7, range = 19–64), the mean period of employment as a car mechanic was 15.0 years (SD = 10.9, range = 1–48), and the mean working hours per week was 37.0 h (SD

Figure 1. One-year prevalence of musculoskeletal symptoms (pain, ache or discomfort) among car mechanics ($n = 103$).



= 3.3, range = 8–42). As there was only one female mechanic, sex differentiation was not carried out.

One-year prevalence of MSS

A total of 96% of the mechanics reported that they had been troubled with pain, ache or discomfort in one or more of the ten defined parts of the body during the past 12 months. Symptoms from the low back (76%), neck (62%), head (55%) and shoulders (52%) were the most common (Figure 1). Symptoms from the neck and/or the shoulders were reported by 74% of the mechanics. On average, the mechanics had experienced symptoms from 4.2 of the 10 defined parts of the body.

Twenty-eight per cent of those reporting MSS the past year had been absent from work due to the symptoms. The mean number of days lost in this group was 27 days (median = 10, range = 3–270). All of those reporting MSS had been troubled with symptoms at work. Twelve per cent had been 'very troubled' at work, 51% 'troubled' and 37% 'less troubled'.

An index for the number of reported MSS was created. Table 1 shows that a high number of the reported symptoms correlated significantly with being very troubled with MSS at work ($n = 103$). The analyses also show that older mechanics were more troubled with MSS at work than younger mechanics, and the older mechanics reported a higher number of symptoms. The older mechanics had, however, not been absent from work more than the younger mechanics. A high number of years as a mechanic was also a variable which was significantly correlated with being troubled at work due to MSS. Age was strongly correlated to years of employment as a mechanic. A multiple regression analysis showed a significant effect of age, and a reduced non-significant effect of years of employment related to how troubled the mechanics had been at work due to MSS.

Self-reported causes to MSS

The causes of MSS are multifactorial,³ and it is difficult to sort out which risk factors are the most important.

The mechanics were asked what three causes of their pain and discomfort they considered most important. Out of nine alternative answers, 88% regarded physical stress at work, 53% regarded psychological stress at work and 32% regarded lack of physical exercise as the most important causes to their symptoms (Figure 2).

Even though most mechanics were convinced that their physical working environment was an important cause of their MSS, 87% reported being satisfied or very satisfied with how well their garage was equipped with tools, vehicle lifts and other equipment. All the mechanics had vehicle lifts available, and only one used a greasepit. Dividing the car mechanics' work into four different tasks which essentially gave four different working postures, the mechanics reported that they, on an ordinary working day, worked approximately 2.6 h under the bonnet, 2.1 h under the car, 1.7 h in the front, back, or on the side of the car, and 1.3 h inside the car.

No significant association between the occurrence of MSS and satisfaction with the equipment in the garage was revealed (univariate correlation analysis).

Figure 2. Self-reported causes to the car mechanics' musculoskeletal symptoms (MSS) ($n = 103$). The car mechanics reported the three most important causes out of the nine alternatives shown in the figure.

Legend: A = age; B = physical stressors at home; C = psychological stressors at home; D = physical stressors at work; E = psychological stressors at work; F = lack of physical exercise; G = other diseases; H = other causes; I = uncertain.

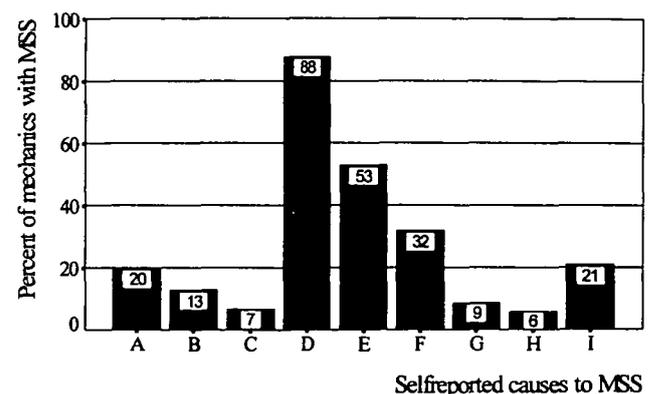


Table 1. Pearson correlations between age, years of employment as a mechanic, degree of how troubled the mechanics had been with musculoskeletal symptoms (MSS) at work, how many body regions from which the mechanics had had symptoms the past 12 months, and days of MSS-related absence from work the past 12 months ($n = 103$).

	Age	Years of employment	Troubled at work	Symptoms index	MSS-related absence
Age	1.00				
Years of employment	0.93**	1.00			
Troubled at work due to MSS	0.24*	0.20*	1.00		
Number of symptoms index	0.19	0.15	0.51**	1.00	
Days of MSS-related absence	0.01	0.02	0.35**	0.18	1.00

* $p \leq 0.05$; ** $p \leq 0.001$

Also, no significant association was found between MSS and the reported hours spent on the four working tasks/working postures described above (univariate correlation analysis).

The most troublesome MSS at work

Figure 3 shows the MSS which the mechanics reported as being the most troublesome at work. Since some mechanics had more than one symptom, the total is more than 100%. Symptoms from the low back (43%), upper back (28%), shoulders (23%) and neck (23%) were most frequently experienced as the most troublesome symptoms at work. Note that this distribution is somewhat different from the distribution of the most commonly experienced symptoms.

As many as 98% of the mechanics reporting symptoms from the upper back reported that these symptoms had been the most troublesome at work. All of these mechanics also reported that symptoms from the low back were the most troublesome. Of those who had experienced low back pain, 57% had

Figure 3. Musculoskeletal symptoms (MSS) among car mechanics ($n = 103$) reported to be the most troublesome at work the past year. The one-year prevalence of MSS is also shown.

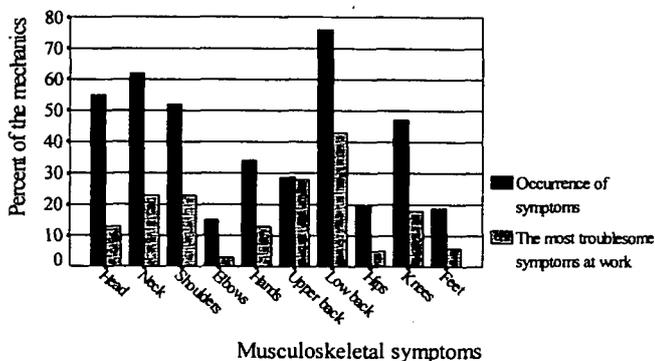


Table 2. Absence due to musculoskeletal symptoms (MSS) during the past year among car mechanics ($n = 101$), related to symptoms experienced as the most troublesome MSS at work. Odds ratio (OR) is calculated from frequency of the given symptoms (yes/ no) among the mechanics who reported absence from work due to MSS (yes/no).

Body regions	Most troublesome symptoms at work		All others		OR	95% CI
	Absence/total*	%	Absence/total**	%		
Head	4/13	31%	24/88	27%	1.2	0.3-4.2
Neck	8/22	36%	20/59	25%	1.7	0.6-4.6
Shoulders	12/23	52%	16/78	21%	4.2	1.6-11.3
Elbows	0/2	0%	28/99	28%	—	—
Hands/wrists	5/13	39%	23/88	26%	1.8	0.5-5.9
Upper back	11/28	39%	17/73	23%	2.1	0.8-5.4
Low back	16/43	37%	12/58	21%	2.3	0.9-5.5
Hips	2/5	40%	26/96	27%	1.8	0.3-11.4
Knees	6/18	33%	22/83	27%	1.4	0.5-4.1
Ankles/feet	0/6	0%	28/95	30%	—	—

* Number of mechanics who had been absent from work due to MSS among the total number of mechanics who reported symptoms from the specified body region as the most troublesome symptoms at work.

** Number of mechanics who had been absent from work due to MSS among the total number of mechanics who did not report symptoms from the specified body region as the most troublesome at work.

experienced this symptom as the most troublesome at work, while 43% of those with shoulder symptoms, 36% of those with neck symptoms, and 23% of those with head symptoms had experienced these symptoms as the most troublesome at work.

In this study the mechanics were asked whether they had been absent from work due to MSS. They were not asked which particular symptom had caused the absence. However, it was of interest to see whether the symptom stated to be the most troublesome at work had been an important cause of the recorded MSS-related absence. The odds ratio between symptoms reported to be the most troublesome at work and MSS-related absence was estimated (Table 2). Car mechanics who reported shoulder symptoms to be the most troublesome at work had a 4.2 higher risk of being absent from work than mechanics who did not experience shoulder symptoms as the most troublesome. There was also a higher, but non-significant, risk of being absent from work for mechanics who reported back symptoms as their most troublesome symptoms at work.

A possible difference in the distribution of the symptoms reported to be the most troublesome according to age was tested by a χ^2 test ($n = 103$) (Table 3). The only symptoms showing a significant association with age were those from the elbows and shoulders. Only three mechanics reported elbow symptoms as the most troublesome. All these three were more than 40 years old. The group of mechanics who most often reported shoulder symptoms to be the most troublesome were between 30 and 40 years old.

DISCUSSION

MSS are very common among car mechanics since 96% reported one or more symptoms the past year.

Table 3. Occurrence of musculoskeletal symptoms experienced as the most troublesome symptoms at work the past year among car mechanics ($n = 102$), related to age

Symptoms from	< 30 years ($n = 40$)	30–40 years ($n = 28$)	> 40 years ($n = 34$)
Head	5 (13%)	3 (11%)	5 (15%)
Neck	7 (18%)	7 (25%)	9 (27%)
Shoulders*	5 (13%)	14 (50%)	4 (12%)
Elbows**	0 (0%)	0 (0%)	3 (9%)
Hands/wrists	6 (15%)	2 (7%)	5 (15%)
Upper back	9 (23%)	8 (29%)	12 (35%)
Low back	16 (40%)	12 (43%)	16 (47%)
Hips	2 (5%)	3 (11%)	0 (0%)
Knees	9 (23%)	3 (11%)	6 (18%)
Ankles/feet	4 (10%)	2 (7%)	0 (0%)

* Pearson $\chi^2 = 16.66$, $p = 0.00024$

** Pearson $\chi^2 = 6.18$, $p = 0.045$

All of the mechanics had been troubled with MSS at work, and the oldest mechanics were the ones who had been most troubled.

Low back symptoms were the most commonly reported among the car mechanics, and these symptoms were also reported by most mechanics to be their most troublesome at work. The other most troublesome symptoms at work were upper back symptoms, shoulder symptoms and neck symptoms. More than 50% of the mechanics who reported low back symptoms, and almost all of those with symptoms from both the upper and low back, experienced these symptoms as the most troublesome at work. The present study also shows associations between symptoms from the upper and low back, reported as the most troublesome symptoms at work, and absence from work due to MSS. The mechanics in our study reported that they worked under the bonnet for 2.6 h a day. This entails working in a more or less stooped position with their back flexed, and often with their back twisted.⁹ Often, workers have to assume non-neutral trunk postures while working under, inside and at the side of the car.⁹ In her review of low back pain and its risk factors Riihimäki¹ showed that associations between low back pain and working in twisted, bent and/or other non-neutral trunk postures had been revealed in many studies. Holmström *et al.*¹³ found among construction workers significant relations between low back pain and working in a stooped position for one hour a day or more. Car mechanics also work almost all day standing.⁹ According to Magora,⁶ Couture⁷ and Ryan,⁸ workers who have to work standing for prolonged periods have a higher risk of back symptoms than workers who can vary between sitting and standing. The results in the present study are supported by the results in the referred studies. Therefore it seems reasonable to assume that it is particularly difficult to work as a mechanic when troubled with back symptoms, and that back symptoms may be caused or aggravated by the physical working environment in garages.

Shoulder symptoms were reported as the fourth most common among the mechanics. When looking at the most troublesome symptoms at work, only back symptoms were more frequently reported than shoulder symptoms. As many as 43% of the mechanics with shoulder symptoms regarded these as the most troublesome at work. The mechanics with shoulder symptoms reported significantly more MSS-related absence than did any other workers, and the mechanics between the ages of 30 and 40 were more troubled with shoulder symptoms than both younger and older colleagues. In the present study, the car mechanics reported that they worked under the car approximately 2.1 h per day. This work implies working with the arms raised overhead. In addition, car mechanics often have to work with their arms at or above shoulder level while they are working under the bonnet.⁹ Several studies have revealed associations between shoulder symptoms and working with the arms raised overhead.^{13–15} Kuorinka *et al.*³ concluded that the epidemiological literature is most convincing on the work-relatedness of shoulder tendinitis, and that there is consistency across studies showing increased risk of such symptoms with repetitive and overhead work. The referred literature concerning shoulder symptoms and our findings regarding MSS indicate that, in addition to back symptoms, shoulder symptoms among car mechanics seems to be caused or aggravated by the physical working environment in garages.

As this study has a cross-sectional design, a healthy worker effect may be expected since workers with severe MSS are not likely to stay in this type of work. This is supported by the fact that the average age of the car mechanics in this study was relatively low, and that the mechanics between the ages of 30 and 40 years more often reported severe shoulder symptoms than both younger and older colleagues.

A self-administered questionnaire was used in this study. A part of the SNQ was used to record MSS. The test-retest reliability for this questionnaire was found to be satisfactory.^{11,16} Several studies have found the validity of the SNQ acceptable for assessing the prevalence of MSS.^{16–19} Since the occupational health service conducted this study, it may be possible that the mechanics have over-reported MSS and given biased answers, because they may have been interested in an improvement of their working environment. Holmström *et al.*, working for the Swedish construction industry's occupational health service, also conducted their study among workers connected to the health service.^{13–17} They found a tendency of under-reporting of low back trouble among workers answering questionnaires, arguing against major over-reporting in this study.

In this study the response rate was 100%. This was probably because the study was conducted in close co-operation with both the employers' association and the union representatives, and because the questionnaires were distributed and collected in a special meeting. The participating garages were connected to

an occupational health service that had recently been started. If there is a difference between the participating garages and garages not connected to a health service, it is most likely that the health status and the working environment in the participating garages are superior to the others.

No control group was established in the present study, which may present some difficulties in interpreting some of the results. It seems, however, that MSS are common among the Norwegian mechanics since the one-year prevalence of MSS was higher among the mechanics (94%, headache not included) compared with the population in a Norwegian community (82%).²⁰ This population-survey comprised 2,740 adult inhabitants who answered the same question concerning MSS as used in the present study. The mean age was 41.5 years (calculated indirectly from Table 1 in this paper), and the men (48%) reported less symptoms than the women for all body regions.

Holmström *et al.*¹³ used SNQ to survey the one-year MSS-prevalence among 1,773 Swedish construction workers (mean age = 39.5 years, one female). They found that 92% of the workers had experienced MSS over the past twelve months. Low back symptoms were reported as the most common, followed by symptoms from the knees, shoulder and neck. A Swedish study²¹ concerning MSS among 137 car mechanics (mean age = 33 years, 100% male) also used the SNQ. In this study, 84% reported one or more symptoms. Low back symptoms were the most common, while symptoms from the wrists/hands, and from the neck, shoulders and knees were respectively the second and third most common symptoms. The results in the present study were overall quite similar to the referred studies among Swedish construction workers¹³ and car mechanics,²¹ but the Norwegian mechanics reported slightly more MSS. This difference was especially evident for neck and shoulder symptoms.

Increasing age is known to be associated with an increasing prevalence of MSS.²² In different occupations years of employment has also been shown to be associated with MSS,^{13,23} which argues for a causal relationship between working environment and MSS. In the present study both increasing age and years of employment as a mechanic were associated with being troubled at work by MSS. However, the significant association between MSS and years of employment as a mechanic disappeared when analyzed together with age in a multiple regression analysis. This may well be due to the fact that age and years of employment were highly correlated in this study; it is thus difficult to separate the effects of the two variables.

We did not find any significant associations between MSS and how the mechanics described their equipment, or any significant associations between MSS and how long they were working in different postures on an ordinary working day. This can probably be explained by the fact that mechanics have to assume strenuous working postures in spite of a well-equipped

garage, and that the differences in mechanics' working environment and working postures are too small to give measurable differences in the occurrence of MSS.

Studies have shown that psychosocial factors and stress are associated with MSS.^{2,4,5,13} Houben *et al.*¹⁰ have for instance shown significant associations between MSS among car mechanics and time pressure and mental load at work. Fifty-one per cent of the mechanics in our study considered psychological stress at work to be an important cause of their MSS. This shows that psychosocial factors, in addition to physical ergonomic factors, are of importance to the development of MSS among car mechanics. Psychosocial factors and stress at work can also be of importance for how workers are able to cope with their symptoms while at work.²⁴⁻²⁶

CONCLUSION

A high prevalence of back and shoulder symptoms, MSS-related absence from work and a probable presence of a healthy worker effect among car mechanics who regard their shoulder symptoms as the most troublesome at work, indicate that it is especially difficult for car mechanics to work with back and/or shoulder symptoms. Due to the cross-sectional design of this study it is difficult to say whether the working environment is an important cause of these symptoms or only symptom-aggravating. However, the car mechanics' description of their working postures, their opinion about the causes to their MSS and the referred literature concerning work-related causes of back and shoulder symptoms supports an assumption that the working environment in garages is one important cause among other contributing factors of these symptoms among car mechanics.

The mechanics have to assume strenuous working postures even though the mechanics regard the garages as well-equipped. To prevent work-related MSS among car mechanics it therefore seems necessary to improve both the ergonomic and the psychosocial working environment in garages. The strenuous working postures must be reduced to a minimum by changing the traditional manner of repairing cars, and/or organizing the work in such a way that the car mechanics can avoid working too long or too often in these postures.

Further research is needed to identify work-related causes to MSS among car mechanics. Intervention studies are also necessary to give information about how these work-related disorders can be reduced.

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