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# OCCURENCE OF MUSCULOSKELETAL DISORDERS IN WOODCUTTERS

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**Keywords:** forestry, woodcutters, musculoskeletal disorders.

**Abstract:** *This paper presents the results of an analysis of musculoskeletal disorders suffered by woodcutters. The research involved a group of 77 woodcutters. A questionnaire designed by the authors was used, containing questions relating to anthropometric and social characteristics of the respondents, their conditions of work, a subjective evaluation of the occurrence and intensity of disorders. The results indicate a high level of load on the musculoskeletal system among woodcutters. Of the respondents, 47% complained of frequent pain in the lower back, 35% of upper back pain, and 29% of hand and wrist pain. The complaints most often reported before beginning work included pain in the lumbar spine (40%) and in the hands (right hand 26%, left hand 21%). The figure for complaints in other parts of the body did not exceed 20%. After work, pain in the lumbar section of the spine was reported by 56% of respondents, in the right hand by 56%, and in the left hand by 58%. The greatest increase in frequency of symptoms was recorded for the left hand (37%), followed by the right hand (30%) and lumbar spine (16%).*

## 1. Introduction

Musculoskeletal disorders are the most common health problem connected with the performance of work. It is estimated that approximately 25% of workers in European Union countries (EU-27) complain of spinal pain, and 23% of muscular pain. In EU countries 62% of workers have at least a quarter of their working time occupied with repetitive movements of the hands and arms, 46% painful and uncomfortable postures, and 35% the carrying or moving of heavy loads (Introduction, 2007). Apart from workers' physical suffering, diseases of the musculoskeletal system cause significant economic and general social costs.

The group most at risk of diseases of the musculoskeletal system are manual workers, both qualified and unqualified. Groups of workers with a particularly high risk of suffering musculoskeletal disorders are primarily those in the agricultural, forestry and fishing sectors (Introduction, 2007). Forestry activities are carried out manually or motor-manually, requiring a large physical effort. Classification of the difficulty of work based on energy expenditure makes it possible to identify categories of heavy and very heavy work (Grzywiński, 2007). Particularly unfavourable working conditions are experienced by woodcutters, where intensive physical effort is accompanied by vibrations, noise and variable weather conditions (Fibiger, 1976; Hulse and Gunstone, 1998; Hildebrandt et al., 2002; Grzywiński, 2003). Also of significant importance for the development of musculoskeletal disorders is the adoption of unnatural and forced postures of the body when working tasks are carried out (Hagen, 1990; Hagen et al., 1998; Grzywiński et al., 2005).

Research on the variability of woodcutters' working postures and the degree to which they are forced during the cutting of trees with chainsaws has shown that such work is most often performed in a posture with a large forward inclination (more than 60°) with legs straight or bent (Grzywiński et al., 2005). This posture is dependent on the place where the tree is cut, just above ground level. More rarely operators adopt a squatting posture or kneeling on one knee. A standing posture with the back straight or slightly bent (up to 20°) is adopted infrequently, when the lie of the land allows it.

In terms of the repetitiveness of the workload of an operator of a chainsaw, the danger is small except in the case of delimbing operation (Bielski, 1987; Grzywiński, 2003). The greatest exposure occurs when timber is cut from young conifers, as here delimbing accounts for a large proportion of the working day. A working model is also sometimes encountered where different workers perform only single operations in the timber cutting process (felling, delimbing, cross-cutting), for example a qualified woodcutter fells trees, while the branches are pruned by an unqualified worker. This arrangement is particularly hazardous in view of the high level of repetitiveness of movements and the lengthened time of exposure to vibrations and noise.

Because of the simultaneous occurrence of the most serious ergonomic risk factors, operators of chainsaws are particularly at risk of developing musculoskeletal disorders. It therefore seems particularly important to make detailed analyses both of working conditions and techniques and of the occurrence and intensity of work-related musculoskeletal disorders. On this basis it will be possible to develop suitable recommendations for prevention, appropriate to the specific nature of the job. The results should also be used as element of education, and be propagated during the training undergone by those who are to work as woodcutters operating chainsaws.

## 2. Materials and methods

The research was carried out on a group of 77 woodcutters in western and northern Poland, chiefly during autumn and winter. The same population of woodcutters was surveyed by questionnaire twice: before starting work and at the end of the working shift. A questionnaire prepared by the authors was used (Grzywiński and Wandycz, 2005©), containing questions about the anthroposocial characteristics of respondents, working conditions and a subjective evaluation of the occurrence and intensity of musculoskeletal disorders.

## 3. Results

### 3.1 Characteristics of the woodcutters

Anthropometric characteristics and data on number of years worked by the surveyed group of woodcutters can be found in Table 1. The majority of the surveyed chainsaw operators were residents of rural areas (80%), the remainder being resident in towns, of whom 14% lived in towns with a population of up to 20 000, and 6% in larger towns. The great majority of respondents (91%) had only primary or vocational education; only 9% had completed high-school education (Table 2). Vocational qualifications in forestry were claimed by 13% of the woodcutters, most of these being graduates of forestry vocational schools. A large majority of respondents were right-handed (86%). Apart from their forest work, 34% of the woodcutters also owned or assisted on a farm (Table 2).

**Table 1.** Basic anthropometric characteristics of the surveyed woodcutters (n=77)

| Features | X ± SD |
|---|---|
| Age (years) | 36,3 ± 10,0 |
| Body weight (kg) | 80,5 ± 10,7 |
| Height (cm) | 175,5 ± 6,8 |
| Years worked in forestry | 9,3 ± 8,4 |
| Years worked with chainsaw | 7,4 ± 7,4 |

**Table 2.** Selected characteristics of the study group of woodcutters (n=77)

| Features | | [%] |
|---|---|---|
| Place of resident | Village | 80 |
| | Town up to 20 000 | 14 |
| | Town over 20 000 | 6 |
| Education | Primary or vocational | 91 |
| | Secondary | 9 |
| Forestry school graduate | Yes | 13 |
| | No | 87 |
| Right-hand or left-hand | Right-handed | 86 |
| | Left-handed | 14 |
| Running or helping on a farm | Yes | 34 |
| | No | 66 |

Data on years spent working in forestry and with chainsaws among the surveyed group of woodcutters is shown in Figure 1. The largest group is those having worked in forestry for 2-10 years (53%). Another 18% of respondents had worked one year or less. The distribution of years worked with chainsaws is similar. One half of respondents had worked with a chainsaw for between 2 and 10 years, and 26% for up to one year. The greater number of respondents in these two categories in the case of chainsaw work than in the case of forestry work results from the fact that some forestry workers performing other tasks had qualified as operators and switched to work with chainsaws. However new forestry employees are now generally already qualified and begin working with a chainsaw straight away.

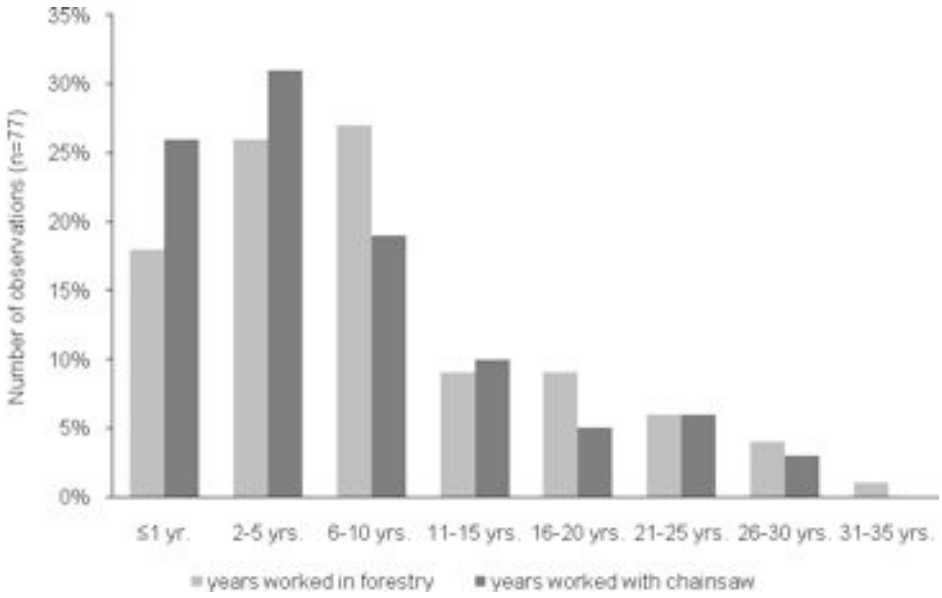
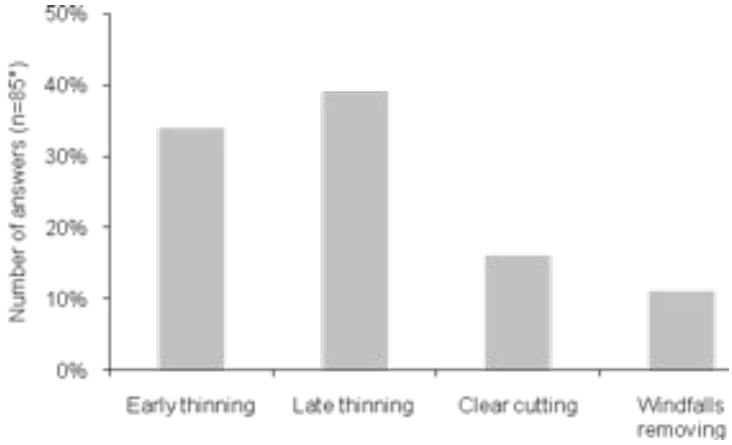



**Figure 1.** Years worked in forestry and with chainsaw by the surveyed woodcutters

### 2.2 Work organization

A list of actions performed by chainsaw operators in the week preceding the survey is shown in Figure 2. In that week, most of the woodcutters had been harvesting timber from young stands under early thinning (34%) or late thinning (39%). A total of 16% of respondents had worked in final cutting stands, and 11% on the removal of wind-damaged trees (windfalls). In view of the specificity of work in stands of younger trees, a large proportion of the working day was taken up with branch delimbing. Due to the small sizes of

the trees, this task is onerous as it requires bending of the back for long intervals, a fact mentioned by 14% of the woodcutters (Figure 7).




* 7 persons listed two categories, 1 person three categories

**Figure 2.** Work performed in the week preceding the survey (n=70)

During the working shift 43% of woodcutters had worked with a chainsaw for less than six hours, and 53% from 6 to 8 hours. In the case of three persons the time spent working with a chainsaw exceeded 8 hours daily (Figure 3). The probable reason for the extended working time was the piecework remuneration system.

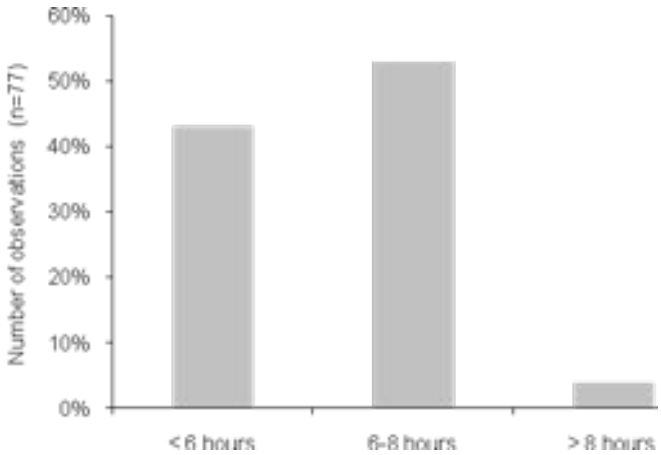



**Figure 3.** Time worked with a chainsaw during a shift

Respondents were also asked about the time spent working with a chainsaw in a calendar year; the results appear in Figure 4. A time of less than 6 months a year working with a chainsaw was declared by 20% of the woodcutters, while 22% were employed cutting timber for 6 to 9 months. The highest number, 36%, were in the range 10 to 12 months, while 22% worked with a chainsaw for the entire year. Some forestry work is of a seasonal nature (silvicultural work). Woodcutters were also employed in other branches of forestry, for example in forest silviculture doing spring planting and reforestation. It should also be assumed that those working less than 6 months a year with a chainsaw also took seasonal employment outside forestry (agriculture, construction).

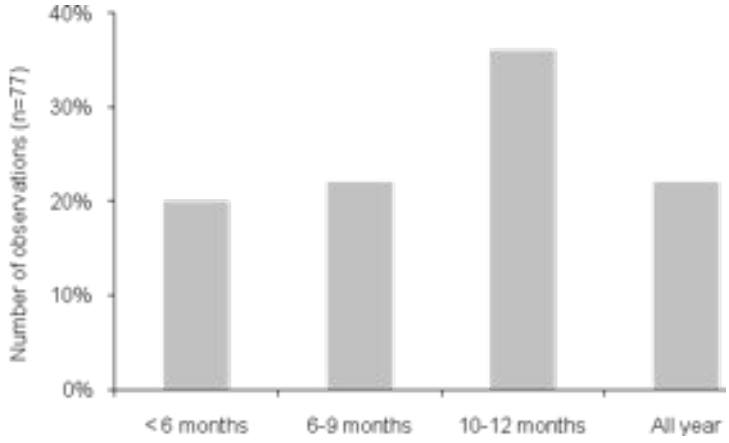



**Figure 4.** Time worked with a chainsaw in a calendar year

### 3.3 Psychophysical workload

Most of the surveyed woodcutters (78%) stated that they began work rested, 14% had no opinion, while 8% reported tiredness (Figure 5). The great majority of those surveyed considered their job to be typical manual work. A total of 54% of respondents believed their work to cause medium physical tiredness, while 21% reported a large degree of physical fatigue after work. One quarter described working with a chainsaw as causing a small degree of tiredness (Figure 6).

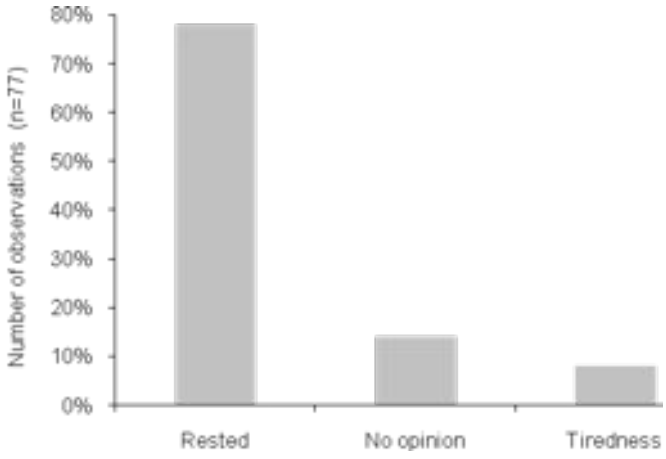



**Figure 5.** Psychophysical state of the woodcutters before starting work

Most respondents (69%) considered the level of mental tiredness to be small, while 28% described it as medium. Only 3% of respondents stated that their work caused significant (high) mental fatigue (Figure 6). A significant contribution to the level of the psychological load comes from the monotonous nature of work. Woodcutters did not regard monotony as a significant onerous factor in the cutting of timber. Only 23% of respondents considered their work monotonous.

More than half (56%) of respondents stated that their working posture when using a chainsaw could be described as comfortable. The other 44% most commonly gave the following as reasons for discomfort resulting from uncomfortable working posture: bending of the body, type of actions performed, and terrain conditions.

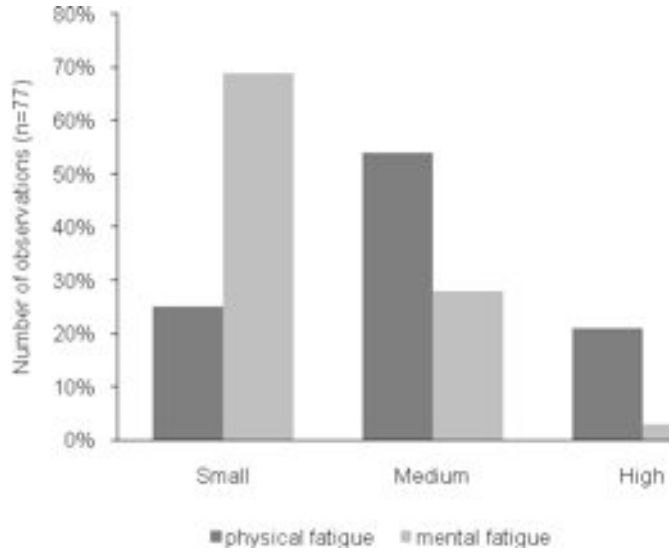
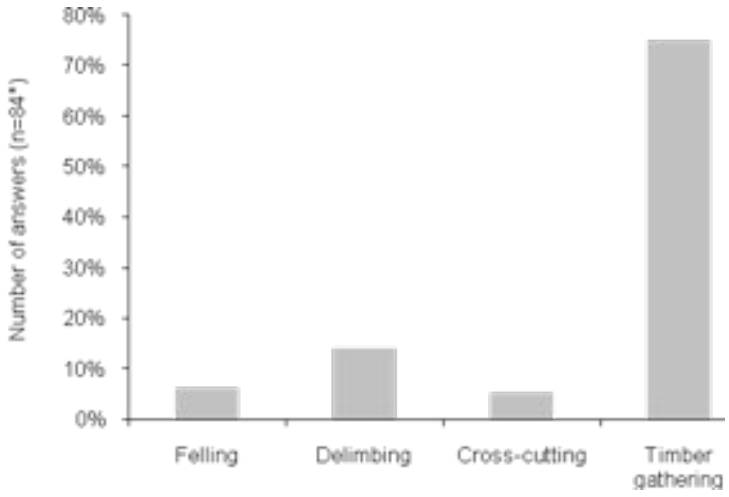



**Figure 6.** Physical and mental fatigue of the woodcutters after work

The activity in the timber harvesting process which respondents considered most onerous was the carrying and piling of round timber (75% of replies), while 14% of them indicated delimbing, 6% felling, and 5% cross-cutting (Figure 7). A total of 77 operators gave 84 replies, with 70 persons indicating one activity and 7 two activities.




* 7 persons indicated two answers

**Figure 7.** Subjective evaluation of the inconvenience of activities performed in the timber harvesting process (n=77)

### 3.4 Analysis of musculoskeletal disorders

A comparison of the musculoskeletal disorders reported by woodcutters before and after work appears in Figure 8. The most commonly reported complaints before starting work were pain in the lower back

(40%), followed by pain in the hands (26% the right, 21% the left). The proportion reporting disorders relating to other parts of the body did not exceed 20%. After work, lower back pain was reported by 56% of those surveyed, pain in the right hand by 56%, and pain in the left hand by 58%. The increase in frequency of the symptoms was 16% in the case of the lower back, 30% for the right hand and 37% for the left hand. There was also observed a significant increase in the frequency of symptoms of pain in the shoulders, elbows, thoracic spine, and knees (Figure 8). In the case of the feet, thighs and neck the increase in pain symptoms after work did not exceed 10%.

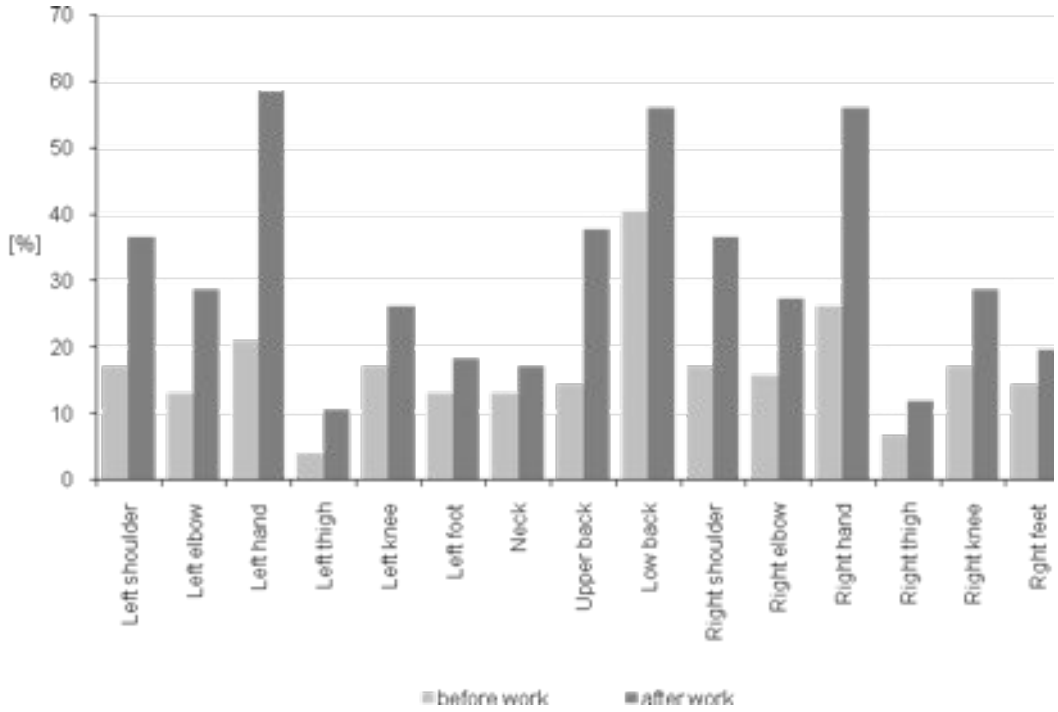



**Figure 8.** Proportions of musculoskeletal disorders reported before and after work by part of body (n=77)

Analysing the number of woodcutters reporting disorders in particular parts of the body before and after work, we can observe that the greatest increase came in the case of the left hand and the back (Figure 9). After work there was an almost threefold increase in the number of persons reporting pain or discomfort in those parts of the body. Moreover twice as many respondents indicated disorders relating to the shoulders, left elbow and right hand.

A significant place among the musculoskeletal disorders reported by the woodcutters is occupied by the upper part of the body, in particular the lumbar spine and the hands (Figure 10). Frequent lower back pains were reported by 47% of respondents, while 3% suffered complaints almost continuously. Back pain (thoracic spine) was felt constantly by 3% of woodcutters, frequently by 35%, and infrequently by 48% . The fewest disorders were reported by operators in the region of the shoulders, where 62% felt pain infrequently and 25% never. The percentage of operators with frequent shoulder disorders was 25%, while those with continuous complaints – similarly to the case of the lower and upper back – numbered 3%. Significant intensification of disorders in operators of chainsaws was reported in the case of the hands. Constant pain of the joints of the fingers, hand or wrist was reported by 5% of operators, while frequent disorders were declared by 29% (Figure 10).

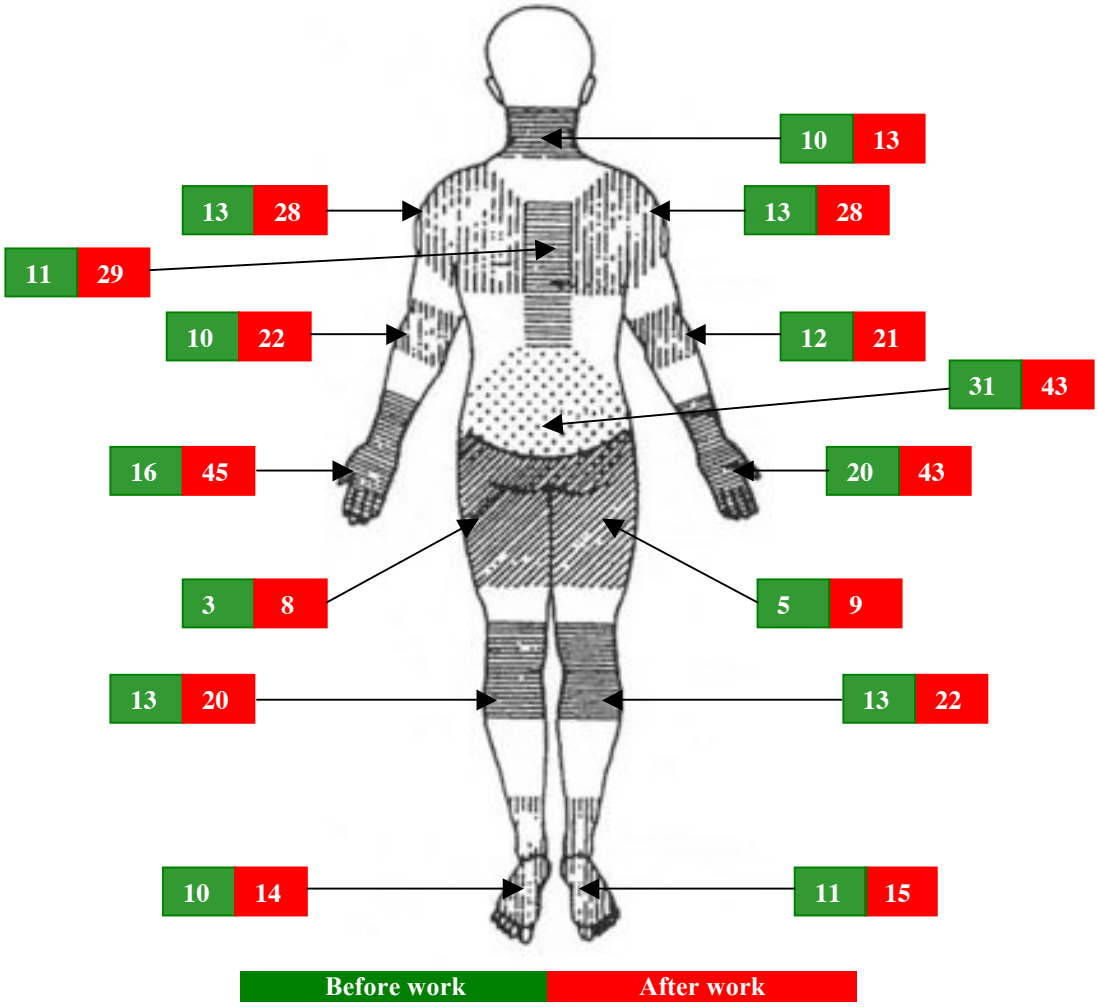



**Figure 9.** Number of woodcutters reporting musculoskeletal disorders before and after work (n=77)

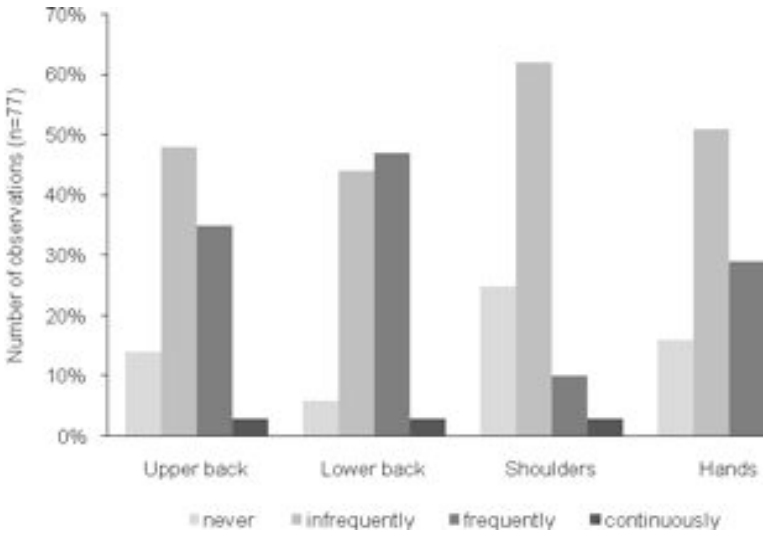



**Figure 10.** Percentage of reported musculoskeletal disorders (n=77)

## 4. Discussion and conclusions

Analysing the results of the surveys carried out among operators of chainsaws, there was found to be a significant risk of the musculoskeletal disorders connected with the operation of such machines. Parts of the body particularly at risk are the hands and the lumbar spine. The presence of pain in these parts of the body was reported by the respondents even before starting work. Increased frequency of complaints following work was highest in these places, compared with other parts of the body. Before work, pain in other parts of the body (neck, shoulders, elbows, upper back, thighs, knees, feet) was reported by few respondents. After work there was an increase in disorders in all of the analysed parts of the body, particularly in the case of the upper back, shoulders, elbows and knees.

Pain in the lower section of the spine occurs in persons performing manual work, particularly in uncomfortable forced postures of the body. Considering the working posture most commonly adopted by woodcutters (standing heavily inclined, with legs bent) and the operation of a chainsaw in this posture, the listed parts of the body are typical areas for musculoskeletal disorders in woodcutters (Hagen et al., 1998; Gallis, 2006). A squatting posture makes it possible to reduce the load on the lumbar spine, but it is more rarely adopted than standing posture, in view of its lower operational efficiency (Grzywiński et al., 2005).

A significant health problem found among woodcutters is disorders relating to the hands. Pain in both hands after working was reported by more than half of respondents (Figure 8). A woodcutter works with a chainsaw with both hands, holding it by the supporting (front) handle and the controlling (rear) handle. Operation of a saw weighing 6–9 kg for many hours causes a large load on the muscles of the upper limbs and shoulders. A reduction in the load on the hands during work with a chainsaw can be obtained by using an appropriate grip, particularly on the controlling handle, thus avoiding strong bending at the wrist during work with the chainsaw in the horizontal plane in the course of felling and delimbing (Tomczak et al., 2007). Another element of prevention is ensuring the proper condition of the chainsaw's anti-vibration system and cutting system.

Apart from correct working techniques, organization of work is equally important in the prevention of musculoskeletal disorders (Grzywiński and Wandycz, 2006). More than half of respondents (53%) worked with a chainsaw from 6 to 8 hours daily, and 4% more than 8 hours. Such a long time spent on work requiring intense physical effort causes the body to become fatigued. In addition, 34% of respondents owned or assisted on a farm.

A cause for concern is the high rate of symptoms reported by workers in the morning, before starting work. This indicates insufficient bodily regeneration during the nightly rest period, and may be related to the taking on of other activities after work (farming, building). Most frequently these involve manual work of a similar nature to that performed in the forest (carrying and moving loads, forced postures of the body), hence causing accumulation of the load and intensification of musculoskeletal disorders.

The development of musculoskeletal disorders is a relatively long-term process. A greater increase in complaints can be expected among older workers who have been working with chainsaws for a greater number of years. Also significant in this case may be the age at which operators began working as woodcutters and the nature of the work they performed previously. Of the respondents, 15% had been doing the job for more than 15 years. However, the difference between the number of parts of the body for which complaints were reported before and after work is not markedly correlated with the number of years spent working with a chainsaw.

The following conclusions can be drawn from the research:

- timber cutting using a chainsaw causes a high risk of the musculoskeletal disorders in woodcutters;
- parts of the body particularly at risk are the lumbar spine and the hands, and pain symptoms were reported by almost one half of respondents even before starting work;
- the greatest increase in proportion of reported musculoskeletal disorders after work was found for the hands, upper back, shoulders, elbows and lower back;
- the nature of the activities performed and the working environment do not make it possible to eliminate completely the reasons for the occurrence of musculoskeletal disorders in woodcutters;
- preventative action should take account above all of appropriate organization of work (variation in the tasks performed, even distribution of breaks), adherence to permitted working time standards during the shift, and the drawing of attention to correct working techniques.

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