

DEGREE OF FATIGUE IN INDIVIDUAL PARTS OF THE BODY OF PROFESSIONAL TREE CLIMBERS AFTER THE PERFORMANCE OF THEIR WORK – A SURVEY

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SUMMARY

Objectives: Work of an arborist – tree climbing – is a dangerous activity associated with great physical effort, influenced by incorrect body posture and significantly stressed individual parts of the body. This research was initiated with the objective to draw attention to this hitherto little explored issue connected with ergonomics of the work of tree climbers. The goal of the research was to gather information about the fatigue of individual parts of the human body in professional tree climbers who access trees using so-called rope techniques (ascent to the tree crown, movement in the tree crown, descent from the tree crown) by means of a questionnaire.

Methods: The assessment included 12 body parts (8 in the upper body, 4 in the lower body), with each part being divided into right and left parts. The research was conducted in the Czech Republic, 98 respondents were professional tree climbers. The questionnaire contained two sections of questions. Questions from the questionnaire were analysed, evaluated and plotted into clear graphs which were then statistically quantitatively described. Furthermore, the linear relationship between the duration of work performance and the occurrence of fatigue in individual parts of the body was assessed (Pearson's correlation coefficients).

Results: Results indicated that the most stressed part of the body of tree climbers who access trees using rope techniques is the area of wrist and hands. On the other hand, the least stressed part of their body is lower leg. Furthermore, the results of Pearson's correlation analysis show that the relationship between the number of hours and the occurrence of musculoskeletal problems is weak, unstable, and nonlinear in most body segments.

Conclusions: The research has shown that arborists who care for trees using rope techniques are exposed to varying degrees of fatigue in different parts of the body.

Key words: ergonomics, musculoskeletal disorders, arboriculture, tree climbing, urban forestry

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INTRODUCTION

Arboriculture is increasingly capturing attention, especially as far as the care of trees in large cities is concerned where urban greenery and trees have to be enhanced and looked after due to their strategic role in fighting climate change and improving quality of living. Arboriculture places high demands on manpower; therefore, a complex and professional approach is needed in the management and maintenance of trees in cities as well as in the protection of workers and inhabitants during all stages of these works (1). The growing emphasis on sound planning, maintenance and treatment of trees in cities or at the interface of urban and forest environments leads to increased demand for experts and persons employed in this sector (2). Caring for trees in cities is a highly demanding activity (3), and a complex and professional approach is necessary. Trees need to be treated by professional arborists – tree climbers so that their failure and subsequent damage, loss on property or injury to persons are prevented. The

most frequently applied method used by tree climbers to access trees in the urban environment is tree climbing (rope) technique.

The use of these techniques allows a range of operations (e.g., climbing trees, felling, cabling, pruning, removing trees) (1). Climbing is often necessary to provide proper treatment to trees but it is dangerous and difficult. Tree climbers work outdoors and are exposed to environmental impacts (4) such as extreme temperatures, noise or vibrations but also to psychosocial/cognitive aspects including problems with the time schedule (5). At the same time, their work is highly physically demanding and requires human energy (6) as well as physical ability (7), muscle strength and engagement of nearly all muscles in human body. It also includes work at heights and tree climbers use dangerous tools in their work such as handsaws or chainsaws. There are also other problems such as social risks associated with the stability of trees, insects, allergies, maintenance costs, pruning and regeneration of losses caused by tree failure or fall of branches (8).

Equipment used by tree climbers includes ropes used for ascending the tree crown and moving therein and friction systems ensuring safety of arborists (9). Nevertheless, tree climbers should bear in mind that some ropes are not suitable for their work (10). Typical in the work of tree climbers is also creation of knots that are necessary for their safety (9). As the knots are usually made by each tree climber himself, it follows that he is also himself responsible for his own safety. Julius et al. (11) add that although many devices are currently available, which allow safe ascent into the crown and comfortable displacement therein, tree climbing still remains a dangerous profession.

As a solution of risks associated with the care for trees in arboriculture, safety standards (norms) were developed in many countries either based on industrial consensus, government regulation, social insurance, or collaboration among the relevant institutions (11, 12). Out of 14 unique arborist safety standards, all contained specifications for climbing ropes and harnesses, 13 contained instructions for preloading the tie-in point (TIP) before ascending into the tree crown, and 10 referred to the selection of TIP which could withstand load expected for the given work (12). All or nearly all norms focus on some aspects of climbing safety but fewer norms give explicit and detailed instructions how to avoid accidents and injuries (12).

Arboriculture is a special discipline currently making great progress in scientific research and technical solutions (13). However, ergonomic research in arboriculture is relatively new and there is little information about the work of arborists in connection with work ergonomics.

There is currently no study or research dealing with musculoskeletal disorders (MSD) and symptoms of tree climbers. This fact is the main reason why this research was initiated. Its objectives were to monitor the prevalence of musculoskeletal symptoms in tree climbers using an online questionnaire; to assess the degree of fatigue in individual body parts of tree climbers at the end of their working day; and to warn about the physically demanding work of tree climbers with impact on the stress of individual parts of their body.

MATERIALS AND METHODS

Data Collection

An online questionnaire was created in order to gain information and new findings about the fatigue of individual parts of tree climbers' bodies upon the end of their working day, i.e., about stress affecting their musculoskeletal systems. It should be pointed out that respondents assessed the stress causing fatigue of individual parts of their body at the end of the working day during which they used tree climbing techniques for working in trees. This means that they were using only ropes and related aids for getting up to the tree crown, down from the tree crown and for moving within the tree crown. The questionnaire produced in the software Google Forms was presented to professional tree climbers in electronic form (online). Participation was entirely anonymous (respondents did not know answers of the others, no sensitive data were required from them) and voluntary. The respondents did not receive any remuneration for filling the questionnaire and could end it whenever they

wanted. Before starting with the questionnaire, respondents were informed about its content, purpose, anonymity as well as with the fact that data therefrom would be used for research, i.e., that data obtained from the questionnaire would be published in a journal. All respondents consented with their participation in the research as well as with the disclosure of data which they provided in the questionnaire. The questionnaire was sent to an arborist group on a social network, where it was shared with all members. This meant that any member of the group could fill out the questionnaire, regardless of age, work experience, daily working hours, etc.

Data were collected from 12 October 2022 to 19 January 2023 and were provided by 98 respondents (professional tree climbers) working in the Czech Republic.

The questionnaire presented to respondents consisted of two parts. The first part was to find out personal and general information about respondents, which the author further worked with when evaluating and processing data from the second part of the questionnaire. The first group included six questions. Questions in the second part of the questionnaire related to individual parts of the body of tree climbers and degree of fatigue they feel in these body parts at the end of the working day (based on physical exertion, working in extreme positions, and movements performed by different parts of the body.). As shown in Figure 1, respondents were to evaluate the degree of fatigue felt on the specific part of their body at the end of their working day (right and left side separately). The scheme which the respondents were to specify the degree of fatigue felt in the individual parts of their body was included in the questionnaire. The degree of fatigue was evaluated based on the following scale: 0 – none at all, 1 – mild, 2 – average, 3 – severe, 4 – excessive. Respondents were to choose only one option for a certain body part.

Questions (and possible variants of answers) in the first part of the questionnaire included: sex (male/female); age (18–20, 21–25, 26–30, 31–35, 36–40, 41–45, 46–50, 51–55, 56 and more); “How long have you been working as tree climber?” (number of years); “How many hours per week approximately you spend for tending trees with the use of rope technique?” (ascent + descent + moving in the crown); “Do you suffer from health problems/disease that could affect your performance of the work of tree climber?” (if so, please specify); “Do you consider yourself a physically active person? Do you do sports or exercise?” (if so, how many hours per week approximately).

Data Analysis and Processing

For clear data processing and interpretation, body parts were divided into two groups. Upper part of the body included 8 individual parts (neck, shoulders, upper part of the back, lumbar part of the back, arms, elbows, forearms, wrists and hands) and lower part of the body which included 4 individual parts (hips, knees, lower legs, legs).

After completion of the questionnaire, data were generated from the software Google Forms (where they were collected) to the Microsoft Excel program where they were divided by individual body parts into individual sheets and then processed. The individual data obtained from the questionnaire were allocated serial numbers (according to the date the questionnaires were sent by respondents, from those sent earlier to those sent later; i.e., a

Key	Body part	Right	Left
1	Neck		
2	Shoulders		
3	Upper part of the back		
4	Lumbar part of the back		
5	Arms		
6	Elbows		
7	Forearms		
8	Wrists and hands		
9	Hips		
10	Knees		
11	Lower legs		
12	Legs		

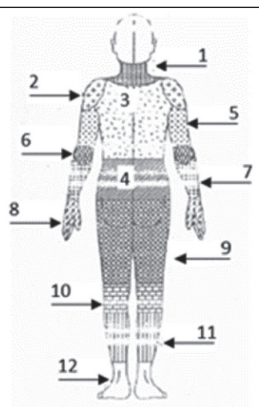


Fig. 1. Scheme for the assessment of muscle load (according to the NIPH National Reference Workplace for Labour Physiology and Psychology).

respondent who sent the filled questionnaire as the first one was allocated serial number 1 and a respondent who sent the filled questionnaire as the last one was given serial number 98). Questions in the first part of the questionnaire were processed each separately as answers to them differed.

The second part of the questionnaire included questions directly related to the fatigue of individual body parts in tree climbers. Answers were processed based on filtering individual areas concerning body parts, i.e., filters of numbers and text. Values of individual body parts were then summed up, recorded into tables and plotted into diagrams. Individual numbers of answers on the degree of fatigue to each body part were converted into percent and then rounded to one decimal. Values of these diagrams represent the percentage of answers to the degree of fatigue (none at all, mild, average, severe, excessive) felt by tree climbers in individual parts of their body.

As the tree climbers evaluated the degree of fatigue in the right and left body part separately, each degree of fatigue in the diagram shows these two body parts separately. Values of the degree of fatigue felt in individual body parts shown in the diagram do not need to be identical. In the specific evaluated body part, tree climbers could feel a different degree of fatigue on the left or right side.

The plotted diagrams (Fig. 2–4) contained ordinal data that were analysed, evaluated and characterized quantitatively based on descriptive statistics.

Furthermore, an analysis was performed based on a data set containing Pearson's correlation coefficients between the categories "number of hours per week" (1–9, 10–19, 20–29, 30–39, 40–50) and a set of variables representing individual body parts (Table 1). Number of hours per week represents the weekly number of hours that tree climbers work on tree care using rope techniques.

Standard thresholds for the Pearson correlation coefficient (r) were used to evaluate the strength of the relationship between the variables: a strong correlation was defined as $r \geq 0.50$, a moderate correlation as $0.30 \leq r < 0.50$, and a weak correlation as $r < 0.30$. A positive coefficient value indicates a positive relationship; that is to say, a higher number of hours is associated with a higher value of the monitored variable. Conversely, a negative value indicates an inverse relationship. The results were processed using software Statistica 14 by TIBCO.

RESULTS

Assessment of Fatigue in Individual Parts of the Body

The first body part in which the respondents evaluated the degree of fatigue or pain was the neck. Figure 2 indicates that nearly a half of respondents felt "none at all" fatigue or pain in this part of the body after performance of their work. At the same time, this was the only body part in which no respondent felt "excessive" fatigue or pain. Thus, Figure 2 shows that neck is the least stressed upper body part in tending trees by means of rope techniques.

Another body part in which the respondents evaluated fatigue or pain was the upper part of the back (Fig. 2). Results indicate that nearly 70% of respondents felt "none at all" or "mild" fatigue or pain, with "excessive" fatigue or pain on the right and left side of the upper back being reported only by one respondent. Compared with the other body parts in the upper part of the body, "severe" fatigue or pain represented the second lowest value.

The lumbar part of the back was another body part evaluated by the respondents. Results in Figure 2 indicate the highest "average" fatigue or pain of all other evaluated body parts. This answer was given by 35 respondents, which was by 3 respondents more as compared with "mild" fatigue or pain. "None at all" fatigue or pain was felt in the lumbar back by 20 tree climbers, and "excessive" fatigue or pain was reported only by 4 respondents.

Figure 3 shows results of the fatigue or pain in shoulders of tree climbers. Most respondents stated that they feel "mild" fatigue or pain in this part of the body and only 1% of addressed tree climbers stated to feel "excessive" fatigue or pain in this body part. It was specifically one respondent aged 36–40 years with no health problems, practice of 10 years, who spends approximately 30 hours a week tending trees with the use of rope technique.

In the category of feeling "severe" fatigue or pain in shoulders, 60% of respondents answered that they feel "severe" fatigue or pain identically on the left and right side. On the other hand, respondents who stated "severe" fatigue or pain in the right shoulder answered in 46.7% of cases that on their left shoulder they felt fatigue or pain lower than "severe".

Figure 3 presents answers of respondents concerning fatigue or pain in the arms. They show that respondents feel mostly "mild" fatigue or pain in arms. The "mild" fatigue or pain in their left

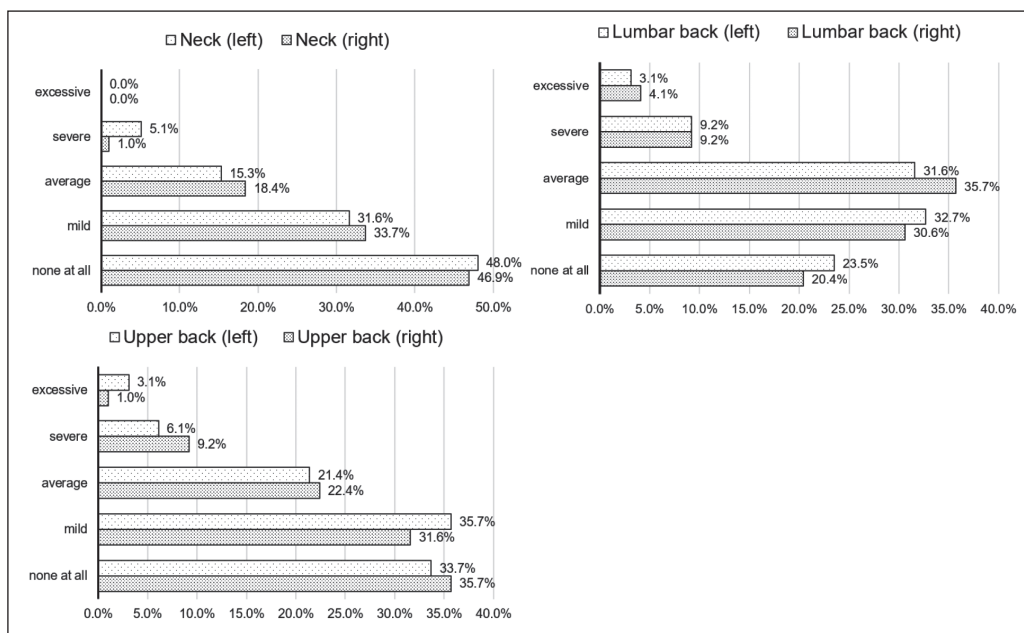


Fig. 2. Fatigue or pain in the back area of tree climbers after performing their work.

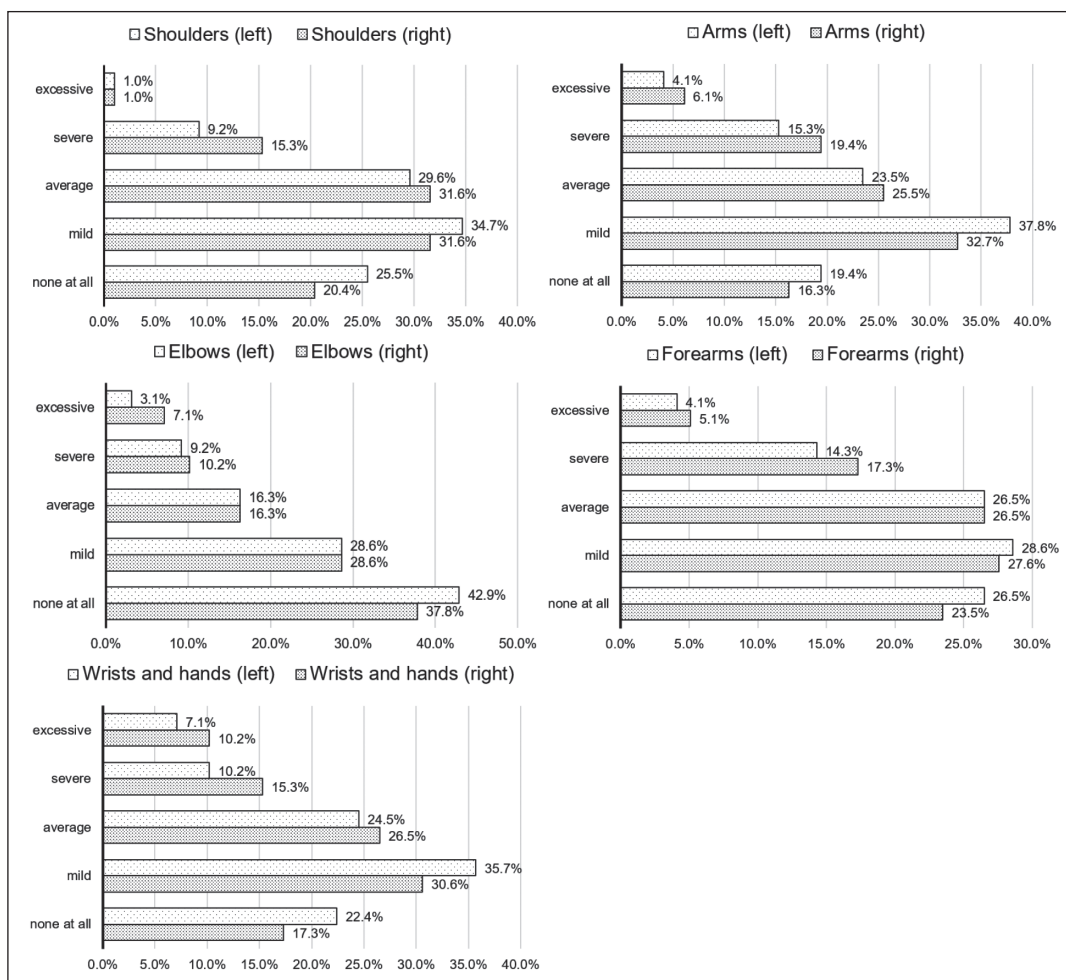


Fig. 3. Fatigue or pain in the upper body of tree climbers after performing their work.

arm as compared with the other body parts was reported by most tree climbers (37.8% of respondents). The “excessive” fatigue in this part of the body was felt by 6.1% of respondents with 50%

of them feeling “excessive” fatigue or pain in the right and left arm every time when they complete tree tending with the use of rope technique.

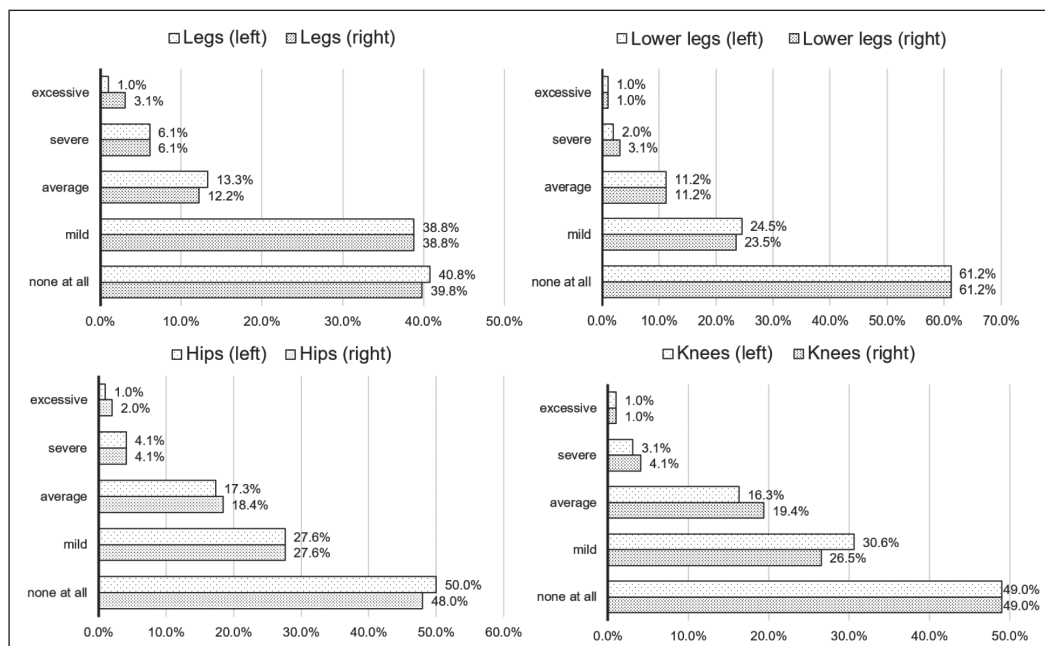


Fig. 4. Fatigue or pain in the lower body of tree climbers after performing their work.

Another body part evaluated by tree climbers were the elbows (Fig. 3). More than 66% of respondents agreed to feel “none at all” or “mild” fatigue or pain in this body part. On the other hand, “severe” or “excessive” fatigue or pain in at least one elbow was reported by 12.3% of tree climbers.

Fatigue or pain were also evaluated in the forearm of tree climbers after work (Fig. 3). As to this part of their body, respondents nearly agreed to feel “none at all”, “mild” or “average” fatigue or pain. One of these three options was marked by 81.6% of respondents. Thus, results indicate an average percentage for one of these three answers (26.6%). “Excessive” fatigue or pain in forearm after work in the tree with the use of rope technique reported only 5.1% of respondents.

The last part of the upper body evaluated in tree climbers after work was the area of wrists and hands (Fig. 3). “Excessive” fatigue or pain in this part of the body was felt by 17.3% of inquired tree climbers, with 41.2% of them feeling the “excessive” fatigue or pain on the right and left wrist and hand at the same time. The result makes the wrists and hands the most stressed body part in tree climbers using rope techniques. The results also indicate that evaluating this part of their body, the respondents most frequently stated to feel “mild” fatigue or pain in the left wrist and hand (35.7% of respondents).

The first part of the lower body evaluated by the respondents were the hips (Fig. 4). Nearly a half of the respondents ($n = 47$, 48%) agreed that they felt “none at all” fatigue or pain in the left and right hip. “Excessive” fatigue or pain in both hips was reported by only one of tree climbers after tending trees with the use of tree climbing techniques. The respondent with 2 years of practice was aged 31–35 years and spent approximately 15 hours per week by tending trees with the use of rope techniques.

Figure 4 shows the values of fatigue or pain felt by tree climbers in their knees. There was only one respondent who felt “excessive” fatigue or pain in his knees (it was the same respondent who felt “excessive” fatigue or pain also in both hips). This fact

makes the knees one of the two least stressed lower body parts. Nearly half of respondents reported “none at all” fatigue or pain in this part of their body.

The surveyed tree climbers reported lower legs as the least stressed body part in tending trees with the use of rope techniques. There were more than 84% of them (Fig. 4) agreeing with the fact as they felt “none at all” or just “mild” fatigue or pain in this part of their body; 4.1% of tree climbers reported to feel “severe” or “excessive” fatigue or pain in the forearm. The feeling of “average” fatigue or pain in lower legs was reported by more than 21% of respondents.

The last part of body that was evaluated for fatigue or pain was the legs. This part of the body was considered by 38 respondents as “mild” in terms of fatigue or pain (Fig. 4); 39.8% of respondents felt “not at all” fatigue or pain in this part of their body, 6 respondents felt “severe” fatigue or pain in their legs after tending the trees with the use of rope techniques. One respondent reported to feel “excessive” fatigue or pain in his legs. It was the same respondent who felt “excessive” fatigue or pain also in the hips and knees.

Effect of Hours Worked on Fatigue in Individual Parts of Tree Climbers’ Bodies

In the back area of tree climbers after performing their work, the neck, upper back, and lumbar back areas were evaluated (Table 1). The neck area shows some of the most significant correlations in the entire sample. On both sides, there are moderately strong positive correlations in the lower to medium exposure range, indicating an increased incidence of difficulties with increasing load in this phase. Conversely, at the highest number of hours, there is a transition to significantly negative correlations, which may reflect adaptation mechanisms, selection effects, or changes in the nature of the work. Overall, the neck is among the segments with the most sensitive response to exposure duration.

Table 1. Results of Pearson correlation analysis

	Number of hours per week				
	1–9	10–19	20–29	30–39	40–50
Neck (right)	-0.23755	0.32212	-0.23489	-0.07761	-0.41833
Neck (left)	-0.22588	0.42053	-0.15727	0.07085	-0.41833
Shoulders (right)	-0.02636	-0.04627	-0.09191	-0.12246	0.14142
Shoulders (left)	0.07899	-0.02939	-0.12476	-0.16531	0.14142
Upper back (right)	-0.29055	-0.02837	-0.29461	-0.00948	0.25820
Upper back (left)	-0.12916	-0.07758	-0.29857	-0.00948	0.25820
Lumbar back (right)	-0.08976	-0.19220	-0.02914	-0.34457	-0.14142
Lumbar back (left)	-0.00274	-0.25131	-0.17134	-0.31037	0.00000
Arms (right)	-0.21064	0.03646	-0.39839	-0.29790	-0.65079
Arms (left)	-0.25824	0.11116	-0.41103	-0.23428	-0.49614
Elbows (right)	0.24988	0.34492	-0.35292	-0.24737	0.20080
Elbows (left)	0.25649	0.08863	-0.43798	-0.17710	0.20080
Forearms (right)	-0.33038	-0.16151	-0.48400	-0.15132	-0.13156
Forearms (left)	-0.34887	-0.24448	-0.41085	-0.12179	-0.05000
Wrists and hands (right)	-0.53974	0.23116	-0.30993	-0.00624	-0.17541
Wrists and hands (left)	-0.43843	0.18102	-0.37941	0.08749	-0.17541
Hips (right)	-0.42174	0.13718	-0.24818	-0.12039	-0.19365
Hips (left)	-0.40294	0.09537	-0.37740	-0.12039	-0.09129
Knees (right)	0.00496	0.10902	-0.02845	0.09821	-0.06202
Knees (left)	0.07029	0.03767	0.03057	0.09070	0.30000
Lower legs (right)	-0.37441	-0.16195	-0.11751	0.25001	-0.09129
Lower legs (left)	-0.35987	-0.16195	-0.12135	0.25001	-0.09129
Legs (right)	-0.11133	-0.23747	-0.13445	0.32813	-0.09129
Legs (left)	-0.01679	-0.21861	-0.21128	0.32813	-0.09129

The back, especially in the upper and lumbar regions, shows more systematic correlations than, for example, the shoulders. Both segments show moderately strong negative correlations in the highest exposure interval, indicating a lower incidence of difficulties in individuals with the longest workload. This finding may be related, for example, to changes in the work regime over time. At lower intervals, the correlations are weak and fluctuating, which supports the interpretation that the relationship between exposure duration and back pain is not linear and is influenced by a number of other factors.

Fatigue or pain in the upper body of tree climbers was also evaluated (Table 1). In the shoulder area, the correlations were mostly weak and inconsistent. The coefficient values were close to zero and their direction changed between individual intervals of hours. This indicates the absence of a stable linear relationship between the duration of exposure and the occurrence of difficulties in this area. The shoulders thus appear to be a segment where the influence of the number of hours of work is relatively small and probably overshadowed by other determinants, such as working position, type of load, or individual muscle condition. The arms show more pronounced negative correlations, especially in the higher intervals of the number of hours worked. This suggests that the reported incidence of problems in this area decreases with increasing exposure time. In the lower intervals, the correlations

are weak and inconsistent, which again supports the non-linear nature of the relationship. In the elbow area, the correlation coefficients show considerable variability, including alternating positive and negative values. There is no consistent trend here that would indicate a stable linear relationship between the number of hours and the occurrence of difficulties. This result suggests that elbow problems are likely to be more dependent on the specific type of physical activity than on the length of exposure itself. The forearms show predominantly negative correlations across intervals of hours, reaching moderate strength in some places. This pattern suggests that as the duration of exposure increases, the incidence of difficulties in this area tends to decrease. The interpretation is similar to that for the arms. The stability of the negative correlation is more pronounced here than in most other upper limbs. Mixed correlation relationships appear in the wrist and hand area. Negative correlations are evident at lower exposure intervals, while at medium intervals there is a transition to positive values. This suggests that difficulties in this area may increase at medium loads, but this trend reverses with long-term exposure. This nonlinear progression may reflect both the cumulative effect of the load and subsequent adaptation or change in work strategies.

The last part of the body to be evaluated was the lower body (Table 1). The hips show predominantly negative correlations,

especially in the lower and higher ranges of hours. This suggests that the occurrence of difficulties in this area does not tend to increase with the length of exposure, but rather the opposite. Slightly positive correlations in the middle ranges may signal a temporary increase in problems with increasing load, but this effect is neither stable nor strong. The knees are characterized by very weak correlations, often close to zero. The direction of the correlations varies between intervals, and no consistent trend is apparent. This result suggests that the number of hours alone does not have a significant linear relationship with the occurrence of difficulties in the knee area and that the nature of the physical load probably plays a key role. Weak negative correlations predominate in the lower leg area, with the exception of slightly positive values in the middle intervals. This indicates that problems in this area do not tend to increase systematically with the length of exposure. Again, the variability of the values supports the interpretation that factors other than the number of hours itself play a decisive role. In the feet, there is a slightly positive relationship in the middle interval of hours, while in the highest interval, the correlation again reverses to negative values. This pattern may indicate a temporary increase in difficulties at medium load and subsequent adaptation during long-term exposure. Overall, however, the correlations are weak and inconsistent.

DISCUSSION

Tree climbers perform most of their work activities in uncomfortable positions not only when physically working in the tree crown but also in ascending the tree crown and descending it. If they are not trained to observe correct working procedures or if the working rhythm is too high (14), the uncomfortable working posture is ever more affected by these factors, which directly affects MSD. Grzywiński et al. (15) inform that the high level of physiological working stress is associated with improper body positions, too. Kim et al. (16) agree with the statement and point out that inappropriate body posture has a negative impact on spine, and that correct body posture is considered a prerequisite of healthy life. Grzywiński et al. (17) add that the incidence of MSD symptoms represents a serious health problem. Malchaire et al. (18) point out that personal factors such as weight, height, dominant hand, age, smoking and drinking regimen do not play a direct role in the development of musculoskeletal symptoms.

The results of this study showed that out of 98 surveyed tree climbers, all felt at least some increased fatigue in all parts of their body. The reason may be the fact that tree climber often spends body movements to the sides to fulfil his work tasks such as pruning of distal subordinate branches. Another reason may also be that tree climbers move within the tree crown using lateral movement of their extremities or by swinging to the place on the branch (19, 20).

The research revealed that the most stressed part of the body of tree climbers working in trees with the use of rope technique is that of wrists and hands. There are several reasons for the fact. Tree climbers use rope systems among other things also for ascending into the tree crown. In this activity, they use legs and hands most. The engagement of hands requires great physical strength (21). Tree climbers also use the chainsaw in tending trees. Working with the chainsaw in the tree crown, they have to support the saw, keep

it in the desired cutting direction and handle it. All these activities put a continual load on the hands and wrists (22).

Abramuszkinová Pavlíková et al. (23) claim that the health and labour safety of arborists (tree climbers) are strongly affected by body posture, by using appropriate tree climbing techniques, tools and devices. The author of this study agrees with the statements. There are, for example, several options to get into the tree crown using a system of ropes. Tree climbers often adjust the climbing rope on tree from the ground using throwing ropes which facilitate rope adjustment in the primary support point (PSP) or in its vicinity from the ground. This increases effectiveness as the tree climber does not have to repeatedly tie the climbing rope on gradually higher places before reaching PSP (21). This method of installing the rope in the tree crown minimizes movements of both upper and lower limbs of tree climbers (as well as of the whole body), which may contribute to lower body fatigue and hence lower risk of MSD. Another method that can be used by tree climbers to get into the tree crown is single-rope technique. This technique allows easy ascending and descending movements on the rope, facilitating free vertical view (24). It is also a technique that does not require engagement of great physical strength, which may contribute to lower fatigue of individual body parts in tree climbers.

The work of tree climbers includes also movement in the tree crown to reach a certain place for tending a specific part of the tree. To facilitate the lateral movement to reach branches in the crown, J. Jepson (19) and S. Lilly (20) advise that tree climbers choose a suitable tie-in-point. TIP should be situated near the tree top and in the middle of the tree crown because walking and limb swings are easier when the angle that the tree climber rope makes with the vertical is small.

Another factor that may to help mitigate the risk of MSD and fatigue of individual body parts in tree climbers is the use of appropriate tools and equipment. Mirka et al. (25) point out importance of the size of handles used by tree climbers in their tools. Proper size can reduce the stress acting on the hand, wrist and shoulder. It will also minimize the risk of carpal tunnel syndrome and hand/wrist tendonitis (25).

A starting point for how to minimize problems associated with the risk of MSD is effective communication, training and an available system of risk reporting. Some research works evaluated safety risks in tree climbers. None of these studies, however, deals with the issue of fatigue felt in individual parts of the body of tree climbers tending trees with the use of rope techniques. Exactly this fact initiated the presented research which sets itself a goal to continue with this issue also in the future.

CONCLUSIONS

The evaluation of muscular stress in the body of tree climbers showed the area of the neck to be the only body part where no respondents felt “excessive” fatigue or pain. The neck was also the only part of the upper body in which more than 43% of tree climbers felt “none at all” fatigue or pain after performance of their work. The results indicate that neck is the least stressed part of the upper body when tending trees with the use of rope technique. The second lowest “excessive” feeling of fatigue or pain in the upper part of the body was reported in the area of the shoulders.

The lumbar part of the back was evaluated as an area with the greatest “average” fatigue or pain out of all classified body parts. The most stressed part in the body of tree climbers working in trees with the use of rope techniques was the area of wrists and hands. Nearly a half of respondents agreed to feel “none at all” fatigue or pain in their right and left hips. It was also found out that knees represent one of the least stressed parts of the lower body in tree climbers. The surveyed tree climbers reported lower legs as the least stressed part of their body in tending trees with the use of rope techniques.

The results of Pearson’s correlation analysis show that the relationship between the number of hours and the occurrence of musculoskeletal problems is weak, unstable, and nonlinear in most body segments. The neck, back, arms, and forearms show the most significant response to the length of exposure, with a frequent reversal of the correlation between lower and higher load intervals. In contrast, the lower limbs show predominantly weak and inconsistent relationships, suggesting that their load is more determined by the type of work than by the length of exposure itself. Tree climbers utilizing rope techniques are exposed to many ergonomic risks during tree care. This is why it would be very useful to continue in research studies and surveys drawing attention to the issue and aiming at recommendations for how to prevent the risks.

Conflicts of Interest

None declared

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