Prevalence of Musculoskeletal Disorders, Assessment of Parameters of Muscle Tone and Health Status among Office Workers

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Abstract. Our way of life has changed considerably because of increased computer usage. Usually people do not think about links between computer work, fatigue and musculoskeletal disorders.
The aim of the study was to examine the prevalence of musculoskeletal pains, assess the musculoskeletal status and general health condition and to analyze associations between these indices. The methods of the study were based on a questionnaire, myometry and dynamometry. The most common musculoskeletal pains among office workers were neck pain (51.5%) and lower back pain (41.7%). Pains in the hands/wrists (34.5%), knees (29.9%) and elbows (14.6%) were less reported. The measurements of m. *trapezius* showed that the values of the tone were higher in the afternoon. Also, the most values of *m. erector spinae* were higher in the afternoon. The measurements of the grip strength showed a decrease in strength during the day.
The study confirmed the results of many earlier studies that the most common pains among office workers are neck and lower back pains. Office work is a burden especially for the *m. trapezius* and also for the *m. erector spinae*.

Key words: Office workers, musculoskeletal pains, health status, myometry, dynamometry

INTRODUCTION

The rapid development of information technology during the last decades has resulted in a number of changes in the work-life of people (Eltayeb et al., 2007). Regarding the development of technology, the share of physical labour has decreased and the share of mental work has increased. Due to this fact, the number of computer users has noticeably increased as well. In most of the European countries more than half of the working population are computer workers, millions of people are using computer several hours each day (Europan Agency for Safety and Health at Work, 2008). In relation to the use of computers, frequent occurrence of musculoskeletal disorders can be noticed. Several publications have shown that computer work increases the risk of musculoskeletal disorders and according to studies, musculoskeletal pain occurs usually in the neck and in the lower back (Klussmann et al., 2008; Hush et al., 2005; Woods, 2005; Janwantanakul et al., 2008). The assessment of the musculoskeletal status by myometry has not been used much so far but this method has become more popular.

The aim of the study was to examine prevalence of musculoskeletal disorders, parameters of muscle tone and burnout among office workers.

METHODS

The research has been carried out within the framework of the international work and health survey 'Cultural and Psychosocial Influences on Disability' in the participation of 19 countries. The target group was formed by office workers from the University of Tartu and Estonian University of Life Sciences (n=415), whose work involves monotony, forced positions and repetitive movements. The selection criteria for the research participants were following: 1) the length of computer use per working day was to be at least 4 hours; 2) the age of research participants was to be 20...59 years; 3) the length of employment in the present position was to be at least 12 months. The employees who met those criteria formed a sample group.

For the analysis of the results, a questionnaire ('International survey of work and health') has been developed by the University of Southampton based on an international validated questionnaire which has been translated and supplemented by the research authors (Tuomi et al., 1994). The questionnaire consisted of seven parts (76 questions), which involved information about the employee (7), information about his/her current work (9), aches and pains (25), other people`s pain (4), views of the causes and prevention of pain (3), about the general health of the employee (6) and feelings concerning work and colleagues (22). This article does not include the results of the last part of the questionnaire. The questionnaire provided a survey on the employee and the work, on the occurrence of pain in lower back, neck, shoulders, elbows, hands/wrists and knees, on the general health and work ability and on signs of burnout. The questionnaire allowed yes/no answers to the questions about the distribution of pains, and moreover, specification of the exact part of the body and assessment of the duration of pains. An estimation of how much other health problems have distressed or bothered the respondent was possible to make on a 5-point scale (0 – not at all; 1 – a little bit; 2 – moderately; 3 – quite a bit; 4 – extremely).

Myometer 'MYOTON-3' was used to diagnose the functional state of the skeletal muscles of office workers. Myometer is a hand held device developed at the University of Tartu. Myoton exerts a local impact on the biological tissue by means of a brief mechanical impulse. The impact force is small enough so that it does not cause changes in the biological tissue or neurological reactions. The tissue responds to the mechanical impact with damping oscillation which is registered by an acceleration sensor located on the measuring tip of the device. Microprocessor saves and analyzes the signal and outputs the parameters of tone (frequency of the oscillation Hz), elasticity (logaritmic decrement of damping of the oscillation), and stiffness (N m^{-1}) of the tissue. The results are transfered to a computer; the data is stored and can be visualized as reports, normative measures and graphical evaluations. Muscle performing the movement (agonist) stretches out the antagonist muscle, the speed and ease of the movement is directly related to the stiffness of the antagonist muscle – muscles with higher stiffness require more force for stretching, leading to less economical movement. Muscle elasticity describes the conditions for increasing the frequency of movements and blood supply during the effort. A more

elastic muscle releases itself more quickly from the tension of the previous contraction – providing better conditions for the blood supply during the effort. The condition for recovery during the period between training (or work effort) is described by muscle tone, increased tone (associated with muscle pain and decreased performance) – worsened conditions for blood flow (Müomeetria Ltd., 2007; Vain, 2006).

Two of the most heavily loaded muscles of the office workers were measured (*musculus trapezius* and *musculus erector spinae)*. The measurements were conducted twice a day – at the beginning and at the end of working day. Ten repetitive measurements were carried out in every point of measurement.

In addition to muscular strain, hand grip strength was measured with hand dynamometer. Hand grip strength was also measured on both hands at the beginning and at the end of the working day.

The basis for the precondition was that half of the surveyed workers experience musculoskeletal disorders in the neck and lower back area and half of them experience no disorders. Altogether 18 office workers consented to participate in the measuring – 9 employees from the University of Tartu and 9 employees from Estonian University of Life Sciences.

For statistical data processing the computing programme SPSS.13 for Windows was applied. The arithmetic mean and standard deviation (*SD*) were calculated. For ascertaining connections between characteristics, Spearman rank correlation analysis (r – correlation coefficient) was applied, differences between groups were tested with χ^2 –statistic and Student's t-test. Difference $p<0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

As a result of a survey conducted in October and November 2008, 243 question forms were returned (response rate 58%), among which 204 office workers who met the selection criteria formed the sample group. 137 of them were from the University of Tartu and 67 from Estonian University of Life Sciences, 31 of them were male and 173 of them were female. The average age was 40.3 (*SD* 10.0) years. The length of employment of approximately two thirds of the respondents (61.4%) was more than five years, of one third (31.4%) up to five years and of a minority (7.2%) less than a year. The mean number of working hours per week was 40.3 (*SD* 5.0) hours. 14% of office workers worked up to 70 hours per week. According to the new labour contract the working time should not be more than 48 hours per week to 7 days period relating to four months period (Töölepinguseadus, 2009). The mean length of computer work per day was 6.6 (*SD* 1.5) hours.

Among all respondents, 80.4% had had musculoskeletal pain in different parts of the body during the last 12 months. Half of all workers (51.5%) reported pain in neck and a little less than half (41.7%) of workers reported pain in lower back. About one-third reported pain in hand/wrist (34.5%), in shoulders (30%), in knees (29.9%) and a small portion of workers reported pain in elbows (14.6%). Shoulder, elbow, hand/wrist and knee pain was studied both in the right and the left limb as well as in both sides of the body, although this presented no statistical differences.

As most employees (91.2%) were right-handed, pains showed a tendency to occur more frequently in the right shoulder and hand area. As for knee pain, both sides of the body were equal. The duration of pain, characterized in Fig. 1, lasted in the case of more than one third of the employees for 1...6 days and in the case of as many employees for 1...4 weeks. Pain lasting for 1...12 months occurred less. More than a quarter of the employees have experienced pain in the neck and knees for longer period of time, slightly less in shoulder, elbow and lower back.

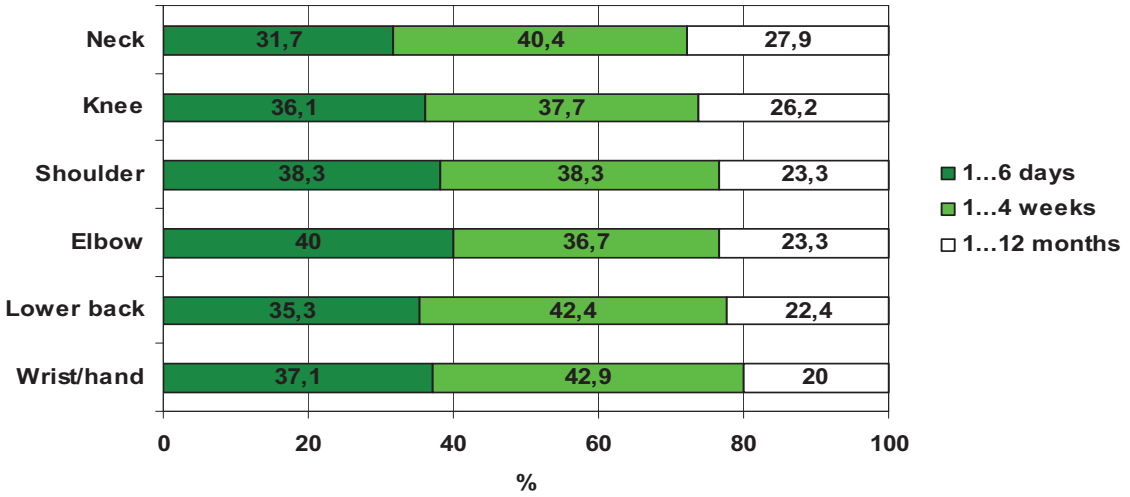

Fig. 1. Musculoskeletal pain duration in different body parts within the last 12 months.

In earlier studies, most of the attention was on the upper limb disorders (Klussmann et al., 2008). Many studies include both upper limb disorders and also upper and lower back pain and headaches (Janwantanakul et al., 2008; Woods, 2005). Pain in knees and other lower limbs (Janwantanakul et al., 2008; Woods, 2005) are examined less because these pains are not directly connected with computer work. The comparison of different studies (Table 1) shows a resemblance between the results. Pains in the neck and lower back were most frequent in all countries, followed by pain in hand/wrist or in shoulders, then pain in knees and pain in elbows. The results of studying Estonian office workers are similar to results from Germany, a bit lower than results from England and higher than results from Thailand.

Table 1. The prevalence of musculoskeletal disorders among office workers during the last 12 months in different countries (% of repondents) (Klussmann et al., 2008; Woods, 2005; Janwantanakul et al., 2008)

Part of the body	Estonia	Germany	England	Thailand
Lower back	42%	-	54%	34%
Neck	52%	55%	58%	42%
Shoulder	30%	38%	37%	16%
Elbow	15%	15%	8%	5%
Hand/wrist	35%	21%	51%	20%
Knee	30%	-	14%	12%

During the last month, the tendency of musculoskeletal pain occurrence has been the same as during the last 12 months. During the last month, the majority of pains occurred in neck (32.4%) and lower back (23.5%). Fewer pains occurred in wrist/hand (20.6%), shoulder area (19.6%), knee (17.6%) and elbow (8.8%). In shoulder and arm area, pain occurred more often on the right-hand side of the body; however, regarding to knee pain, both sides were equal. In approximately two thirds of the employees who had had pains during the last month, the duration of pains had been 1...6 days (Fig. 2). Longer lasting pain was rarer among office workers (pain which lasted more than 2 weeks occurred in about a quarter of the cases in the shoulder area, lower back and neck).

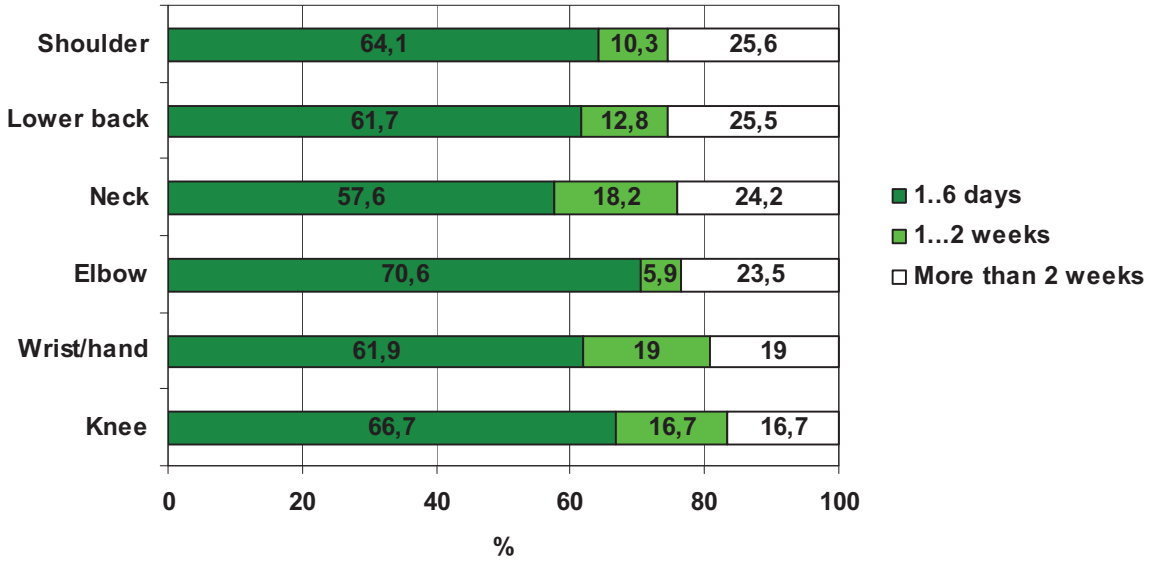

Fig. 2. Musculoskeletal pain duration in different body parts within the last month.

Musculoskeletal pains did not stop the employees from going to work (89.5%) (Fig. 3) and if they did, most sick leaves were taken due to lower back (10.6%) and neck (8.6%) pain. Although more than half of the office workers were convinced that musculoskeletal pain was caused by their work, their sick leave, however, resulted from other ailments (54%) (Fig. 3). This allows us to conclude that people continue going to work with musculoskeletal pains and do not pay much attention to them. This conclusion is further confirmed by the fact that although the vast majority was of the opinion that neglecting musculoskeletal pains may cause chronic disorders, nevertheless more than half of the office workers did not consult a doctor, a medic or an alternative doctor.

Considering other general health related complaints, office workers (% respondents) mostly suffered from overall faintness and dizziness (52%) and numbness or twinges in parts of the body (42.1%). Hot and cold spells (38%), muscle weakness (33.5%), pains in heart and chest (33%), nausea or upset stomach (32.9%) and shortness of breath (28.9%) occurred to a lesser extent.

The overall health assessment of half of the workers (50.5%) was rather high, of 36.8% average, of 6.4% very high, of 5.9% rather low and of 0.5% low.

Musculoskeletal pains, except for shoulder pains, were related to other health complaints (p=0.0001...0.001; r=0.3). Lower back pains affected health ($p \leq 0.0001$; r=–0.4), however, pains in other parts of the body did not. Employees experiencing lower back and neck pains, were more aware of other people's lower back ($p \leq 0.0001$; r=0.3) and neck pains (p=0.001; r=0.2).

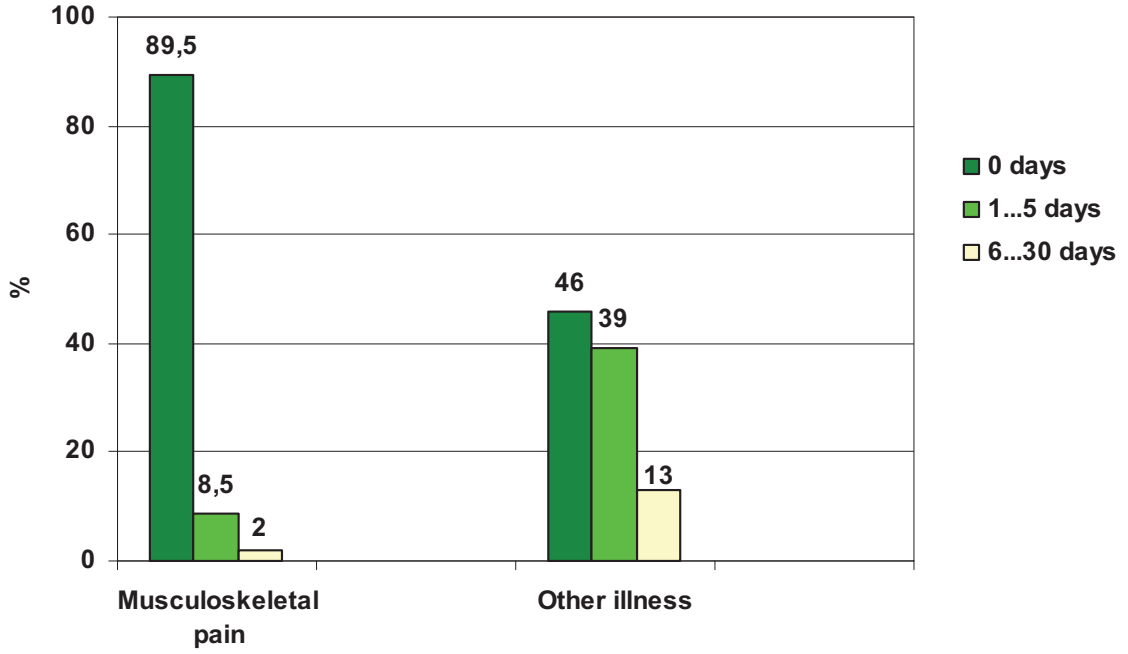

Fig. 3. Sick leave duration in case of musculoskeletal pains and other illnesses.

Measurement result values of muscle tone parameters varied from individual to individual when measured both at the beginning and end of the working day (Table 2). Statistically significant difference could be noticed between the morning and evening measurement values only in case of *musculus erector spinae* elasticity (95% *CI*: 0.1496...0.0007; p=0.052). In most cases the measured parameter value showed the tendency to be higher in the evening than in the morning. So we can conclude that computer work burdens neck and lower back area.

According to the sex, age and body mass index of the individual concerned, the software of the appliance enabled us to establish individual norms for muscles both in the right and left side of the body of the examined persons. Meeting the norms in case of *musculus trapezius* tone parameter values was insignificant (0...33%). *Musculus trapezius* tone, for instance, failed to meet the norms in any of the measurings. *Musculus erector spinae* tone parameter values met the norms in more cases (27...50%).

In office workers with no musculoskeletal disorders *musculus trapezius* tone parameter values were lower and *musculus erector spinae* tone parameter values were higher than in those employees who had musculoskeletal disorders. This was contrary to the expected results, thus concluding that lower back disorders should not be underestimated by office workers who have no muscoloskeletal disorders.

Table 2. Mean measuring results of skeletal muscle tone parameters at the beginning and end of working day and their difference

Muscle	Parameter	Morning	Evening	Difference %
M. trapezius right	Tone Hz	15.78 (*SD* 1.98)	15.98 (*SD* 2.09)	1.25
	Elasticity	1.17 (*SD* 0.24)	1.18 (*SD* 0.22)	0.85
	Stiffness N m^{-1}	272.21 (*SD* 41.74)	275.06 (*SD* 38.81)	1.04
M. trapezius left	Tone Hz	16.41 (*SD* 2.44)	16.78 (*SD* 2.62)	2.21
	Elasticity	1.19 (*SD* 0.21)	1.24 (*SD* 0.17)	4.03
	Stiffness N m^{-1}	283.04 (*SD* 44.57)	284.44 (*SD* 46.18)	0.49
Erector s. right	Tone Hz	15.33 (*SD* 2.38)	16.37 (*SD* 2.77)	6.35
	Elasticity	1.29 (*SD* 0.28)	1.32 (*SD* 0.28)	2.27
	Stiffness N m^{-1}	325.15 (*SD* 60.14)	332.09 (*SD* 85.26)	2.09
Erector s. left	Tone Hz	16.73 (*SD* 3.07)	16.96 (*SD* 3.22)	1.36
	Elasticity	1.37 (*SD* 0.19)	1.44 (*SD* 0.20)	4.86*
	Stiffness N m^{-1}	330.61 (*SD* 60.27)	320.48 (*SD* 76.74)	– 3.06

* statistically significant difference ($p<0.05$)

The value of measuring results of hand muscle strength was higher at the beginning of the working day than at the end (Table 3). Hand grip strength decreased after the working day both in the right and in the left hand. The arithmetic means of parameters measured in the morning and in the evening were statistically significantly different (95% *CI*: –37.5044...–12.6356, $p=0.001$ right hand, 95% *CI*: –22.0608... –0.8293, $p=0.036$ left hand). The hand of office workers, who were displaying musculoskeletal disorders in wrist/hand, grew more tired than the hand of office workers who did not display such kind of disorders.

Table 3. Mean muscle strength at beginning and end of working day and differences in measuring results

Hand	Morning N	Evening N	Difference %	p
Right	196.75 (*SD* 50.19)	189.66 (*SD* 49.91)	–11.30	0.001
Left	221.82 (*SD* 51.71)	201.11 (*SD* 48.91)	–5.69	0.036

CONCLUSIONS

The majority of all respondents reported musculoskeletal pains in different parts of the body during the last 12 months. In different parts of the body, most pains during the last 12 months and during the last month occurred in the neck and in the lower back. These were followed by pain in wrist/hand, shoulder, knee and elbow. As for other general health complaints, office workers displayed mostly

overall faintness, dizziness, and numbness or twinges in different parts of the body. Hot and cold spells, muscle weakness, pains in heart and chest, nausea or stomach disorders and shortness of breath occurred less. Despite of occurrence of musculoskeletal disorders and other health complaints, general health assessment of half of the employees was rather high. Most musculoskeletal pains were associated with other health related complaints. Lower back pain affected the overall estimation of health. Other people's pains were more noticed.

Other health related complaints affected work attendance significantly more than musculoskeletal pain. Among most of the office workers musculoskeletal pain did not cause to miss a single working day, while other diseases caused more than half of office workers to be absent from work. Office workers did not go to see the doctor because of musculoskletal pains, thus concluding that the severity of musculoskeletal disorders are underestimated and the disorders are not associated with the specificity of computer work.

The possibility of lower back pains should not be underestimated by office workers who had not had muscoloskeletal disorders, because especially their *musculus erector spinae* tone parameter values were higher than those of the employees who had had musculoskeletal disorders. The hands of office workers, who were displaying musculoskeletal disorders in wrist/hand, grew more tired than the hands of office workers who did not display such kind of disorders.

According to the results of the study, the workstations of office workers should be designed ergonomically – the position of chair and table must be proper and shoulder/upper limbs must be in neutral position. More knowledge about the reasons of musculoskeletal disorders in computer work must be passed on to office workers.

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