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Ocena zmian przeciążeniowych kręgosłupa lędźwiowego pracowników o siedzącym charakterze pracy

Assessment of overload changes in the lumbar spine of employees with sedentary nature of work

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Streszczenie

Cel pracy. Celem badań było określenie zmian przeciążeniowych odcinka lędźwiowego kręgosłupa występujących u kobiet i mężczyzn pracujących w pozycji siedzącej oraz określenie jednostki czasu związanej z nasileniem dyskomfortu.

Statyczna pozycja ciała przyjmowana przez długi czas, powoduje powstawanie zmian przeciążeniowych odcinka lędźwiowego kręgosłupa. Poza zawodowymi czynnikami ryzyka, również sedenteryjny tryb życia lub prace domowe wykonywane przy niedbałej pozycji ciała, mają niebywały wpływ na zmiany degeneracyjne krążków międzykręgowych.

Materiał i Metodyka. Badania ankietowe przeprowadzono wśród 62 pracowników biurowych wybranej korporacji. Materiał badawczy stanowiło 29 kobiet oraz 33 mężczyzn w przedziale wiekowym 23-61 lat, którzy doświadczali epizodów bólowych lędźwiowego odcinka kręgosłupa. Ankieta była oparta na części podmiotowej karty badań metody McKenziego, uzupełniona o część antropometryczną.

Wyniki. Na ból odcinka lędźwiowego uskarża się 84% wszystkich ankietowanych, przy czym objawy somatyczne różnią się płciowo. Ponadto odnotowano współwystępowanie dyskomfortu bólowego w odcinku szyjnym i lędźwiowym kręgosłupa. Nasilenie dolegliwości wzrasta nie tylko proporcjonalnie do wieku ankietowanych ale również podczas codziennych obowiązków zawodowych.

Wnioski. Praca siedząca, pomimo doniesień na temat powstawania zmian przeciążeniowych, w dalszym ciągu przysparza bóle pleców. Dyskomfort odcinka szyjnego i lędźwiowego kręgosłupa świadczy o zjawisku kompensacji. Niedbała pozycja siedząca jest przyczyną szybszego pojawiania się zmian przeciążeniowych i związanych z tym dolegliwości bólowych.

Słowa kluczowe:

kręgosłup, bóle kręgosłupa, układ mięśniowo-szkieletowy, ergonomia pracy; ryzyko zawodowe

Abstract

Objective. The objective of the study was to specify the lumbar spine overload changes in women and men working in a sitting position and to establish when the feeling of discomfort intensifies.

Static position for a long periods of time leads to lumbar spine overload changes. Apart from professional risk factors, sedentary lifestyle also has a tremendous impact on degenerative changes in intervertebral discs.

Material and Methodology. A survey was conducted among 62 office employees, 29 women and 33 men aged 23-61, from a selected corporation, who experienced lumbar pain episodes. The survey was based on the subjective part of the McKenzie method test supplemented with an anthropometric part.

Results. Lumbar pain was reported by 84% percent of the subjects, with the somatic symptoms gender-differentiated and co-occurrence of neck and lumbar pain/discomfort. The pain intensified proportionately to the subjects' age and when performing professional duties.

Conclusion. Although there are reports on the development of overload changes, sedentary work continues to cause back pain. Cervical and lumbar discomfort is indicative of compensation. An inappropriate sitting position is the reason for accelerated development of overload changes and the related pain.

Key words:

spine, low back pain, musculoskeletal system, work ergonomics, occupational risk

Introduction

Back pain still constitutes a serious social and economic problem. Latest scientific research suggests that lumbar pain is reaching epidemic proportions. According to the World Health Organisation, such pain affects 80% of population at various life stages and constitutes the most frequent reason for a decrease in physical efficiency, which is one of the main reasons for absence at work [1-4]. The pain may occur as a result of an injury or overloading, i.e. performing repeated movements over a long period of time, as a result of which physical endurance or functional performance of muscles, bones and joints is exceeded [5].

According to epidemiological research, there are three main classes of risk factors of developing back pain syndrome. These include individual and lifestyle-related factors, physical and biomechanical factors as well as psychosocial factors. Examples of the biomechanical factors include: lifting heavy objects, hard work, incorrect body position, exposition to vibrations, driving a car, leaning forward, sitting, twisting the torso [6]. Biomechanical factors contribute to the occurrence of a back pain syndrome episode as well as persistence and exacerbation of symptoms. Various scientific studies suggest that aggravation of pain is closely connected to bent trunk positions, i.e. sitting, standing up from the seated position, leaning forward and driving a car. Patients reported alleviation of the symptoms while walking and performing a physical activity which requires a hyperextended position. According to epidemiological data, there is a high frequency of the occurrence of lumbar pain in blue-collar workers. Current research presents the issue of spine pain syndromes in white-collar employees working at computer desks [7-9]. The type of work performed in today's office environment involves sitting for long periods of time, which is related to a lack of knowledge on the pathobiomechanism of the development of lumbar spine overload changes.

According to the Multi-centre National Population Health Examination Survey (WOBASZ), 55% of Polish women and 49% of Polish men prefer a sedentary lifestyle with either no or incidental physical activity. To compare with, the percentage of people who prefer a sedentary lifestyle in Finland is 10.5%. The result was similar in Germany, i.e. 11.6%; in Russia and Hungary the percentage was 27.3 and 43.4 respectively [10].

In prophylaxis and work ergonomics, a specific way of sitting is recommended to prevent and reduce potential back pain. An inappropriate body position with the trunk bent has a negative impact on the spine structures, which is why the recommended seated position is a position with lordotic curvature of the lumbar spine and a position with slight bending of the lumbar spine [11]. Research confirms that assuming a particular body position, using armrests and personalised location of peripherals translates into employees' increased work comfort [12].

Lumbar spine ailments usually affect men more often than women. The higher proportion men is due to not only

a higher level of mechanical load, but also gender-specific factors which are still subject to research. The lumbar spine pain syndrome is an ailment which concerns a significant part of the society and usually occurs in middle-aged individuals, i.e. at the peak of their professional efficiency. Back pain symptoms usually occur at the end of the third decade of life, i.e. at the age of about 40. Sharp pain in the lumbar area or sciatic neuralgia are often not related to a particular external reason [7].

Back pain episodes are not identical. The course of the disease differs from patient to patient, which is due to individual predispositions, including persistence of symptoms, their gravity and functional impairment. Given the development of musculoskeletal disorders, back pain syndromes become the reason for chronic disability, especially in middle-aged patients in the period of their highest productivity [7]. It can be concluded that a between a half and three fourths of adults will experience the so-called "low back pain" at some point in their lives. Research on general population suggests that 40% of the subjects experienced at least one lumbosacral (L-S) pain episode at least once a year, while 15-20% experienced such pain all the time. Similar statistics are included in overviews and studies in various countries around the world. These statistics suggest that as few as 10-20% of people did not experience such back pains. The stereotypical image of natural, short and self-limiting course of back pain syndrome is not consistent with the latest scientific findings. It should be emphasised, however, that the majority of severe pain episodes end quickly and spontaneously [13].

Office work involves remaining in the seated position for long periods of time. Therefore, an employee is exposed to lumbar spine overload changes. In spite of the development of work ergonomics, the musculoskeletal overload disease still constitutes a large problem.

Objective

The objective of this paper is to establish the correlation between the intensity, frequency and location of lumbar spine pain in people of different genders working at computer desks and their office work seniority as well as the number of hours spent in the seated position.

Material and methods

The research group comprised 62 professionally active individuals. The subjects included 29 women and 33 men aged 23-61, all of whom complained of lumbar pain. The eligibility criteria for participation in the study were the following: similar episodes of pain in the lumbosacral spine, buttocks or thighs experienced in the past and symptoms which varied during the day and with passage of time. People who underwent a surgery, a fracture or with neoplastic changes in the spine did not qualify. The research group included employees of a corporation who work in a sedentary position in front of their computers. Table 1 presents characteristics of the studied groups.

All the employees perform their professional duties in the seated position. Following the assessment of their workstations, it was observed that the employees assumed sitting positions which were conducive to overloading, moreover office chairs and peripherals were not adjusted. The individuals assumed a static seated position and performed infrequent twists of the trunk and leaned forward. They rested their forearms on their desks, instead of chair armrests. The employees participated in organised trainings on work ergonomics.

The employees included in the study answered a number of questions concerning back pain. The survey was created on the basis of the McKenzie MDT self-test. It was divided into three parts; the first concerned anthropometric data, the second referred to lumbar pain and the last part concerned cervical pain and its co-occurrence with lumbar pain. Information on the location, type and intensity (VAS scale) of pain was collected and instances of pain were characterised in detail. The subjects indicated the frequency and location of pain and the correlation between the pain and specific body positions. Information on the number of years doing computer work and adherence to the rules of ergonomics was also provided. The employees provided information on ways of spending their free time as well. The survey was conducted in person, at the respondent's place of work.

Table 1. Characteristics of the research material

Variable	Women n = 29 $\bar{x} \pm SD$ (Me; Q1÷Q3)	Men n = 33 $\bar{x} \pm SD$ (Me; Q1÷Q3)	p value
Age [years]	35,4 ± 7,26 (35; 30 ÷ 39)	37,1 ± 9,41 (36; 30 ÷ 40)	0,6670
Height [cm]	168,3 ± 5,75 (168; 164 ÷ 173)	180 ± 6,65 (180; 176 ÷ 184)	< 0,0001
Weight [kg]	64,8 ± 11,8 (62; 54 ÷ 75)	80,8 ± 9,36 (82; 74 ÷ 87)	< 0,0001
BMI [kg/m ²]	22,8 ± 3,9 (22; 19,5 ÷ 26)	24,9 ± 2,77 (24,7; 23,2 ÷ 26,8)	0,0059
Staż pracy [lata] work experience [years]	7,6 ± 6,1 (6; 1 ÷ 12)	8,1 ± 6,3 (6; 2 ÷ 13)	< 0,0001

Results

In the course of the study, it was established that 54 out of 62 of the surveyed individuals reported lumbosacral pain. Among them, 28.1% experienced pain several times a month, 23.4% several times a week and 18.7% several times a year and as many as 17.2% every day.

Local pain in the lumbosacral area was reported by 40.6% of all the subjects (54.8% women and 45.5% men). Pain radiating from the lumbar spine to the buttock and thigh was

reported by 21.8% women and men. What is significant and characteristic of spine pain syndromes is their occurrence in the past. As many as 68.7% of the research group (22 women and 22 men) reported they had experienced pain incidents.

Physical activities performed by the subjects outside work included housework (78%) and cycling (74%), which they performed several times a week (57.8%). Few subjects (12%) performed additional physical activities every day.

Slightly more than 60% confirmed compliance with the rules of ergonomics at work (54.8% women and 66.66% men). However, as many as 84.37% of the respondents, slightly more men than women, reported lumbar pain during work. Cervical pain was reported by 59.37% of the subjects (58.06% women, 60.60% men). Simultaneous lumbar pain and cervical pain was reported by 17.18% of the respondents.

The frequency of pain also differed depending on the gender (Fig. 1). Women (32.25%) experienced pain several times a month, whereas men (27.27%) experienced pain on a daily basis.

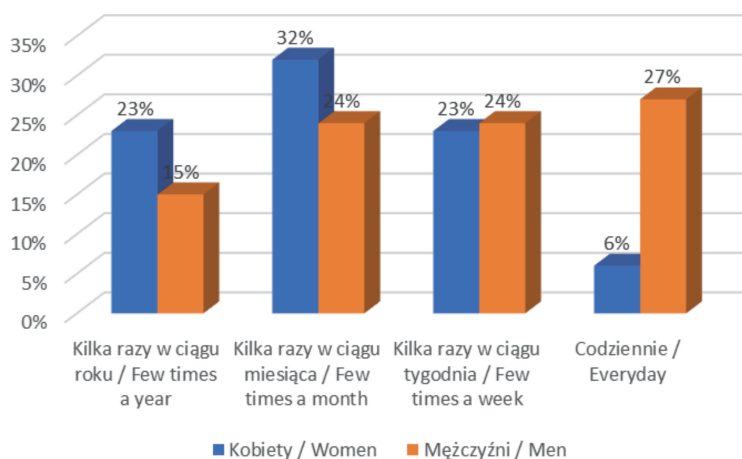


Fig. 1. Frequency of lumbar pain

Figure 2 presents the location of pain accompanying lumbar pain in all the subjects. Lumbosacral pain was the most frequent, while pain limited to the area of the buttocks was the least frequent.

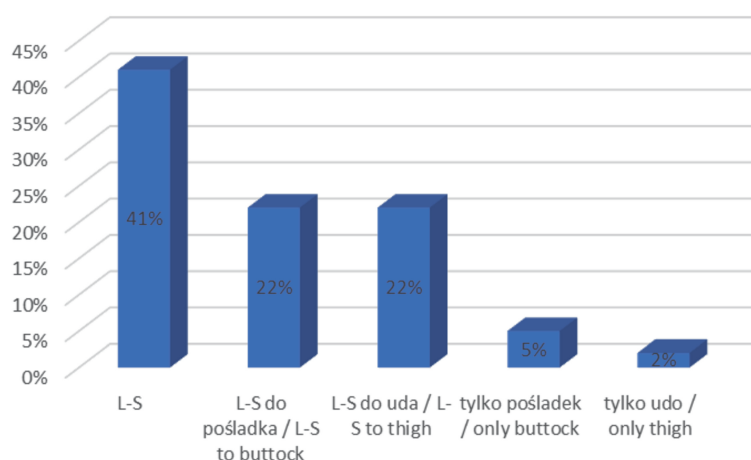


Fig. 2. Location of pain symptoms accompanying lumbar pain in all the subjects

Figure 3 presents the differences in location of lumbar pain depending on the gender. The lumbosacral spine was the most frequent location of pain reported by women. In men, apart from local pain, radiating pain to the buttocks or thighs also occurred.

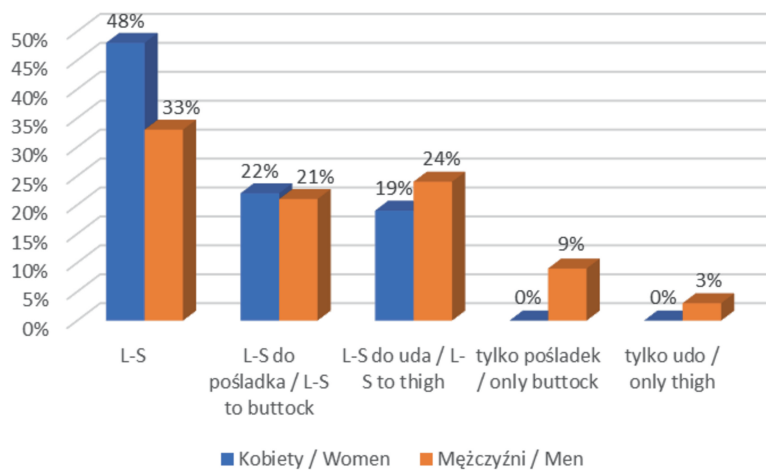


Fig. 3. Percentage distribution of lumbar pain reported by women and men

Figure 4 presents pain accompanying cervical pain. Local pain and pain radiating to the shoulder were the most frequently reported locations of pain accompanying cervical pain in all the subjects.

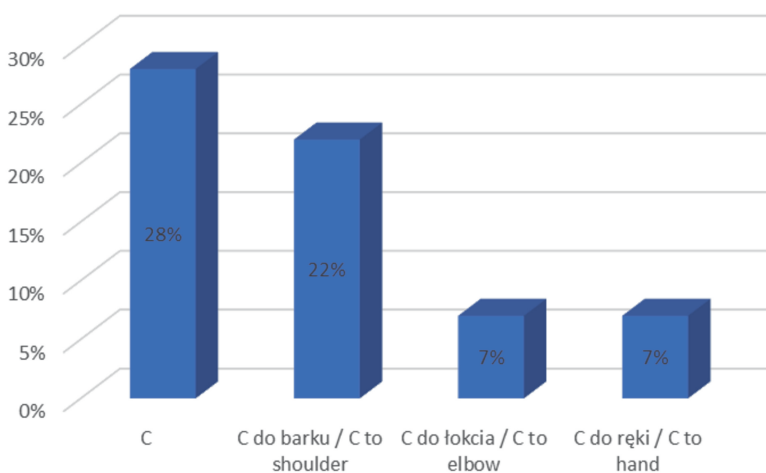


Fig. 4. Location of pain symptoms accompanying cervical pain in all the subjects

Figure 5 presents gender differences in terms of the location of pain accompanying cervical pain. Pain in the cervical spine area and pain in the cervical spine area radiating to the shoulder were the most frequent locations of pain reported by men. The dominant type of pain in women was local pain and pain radiating to the elbow and arm.

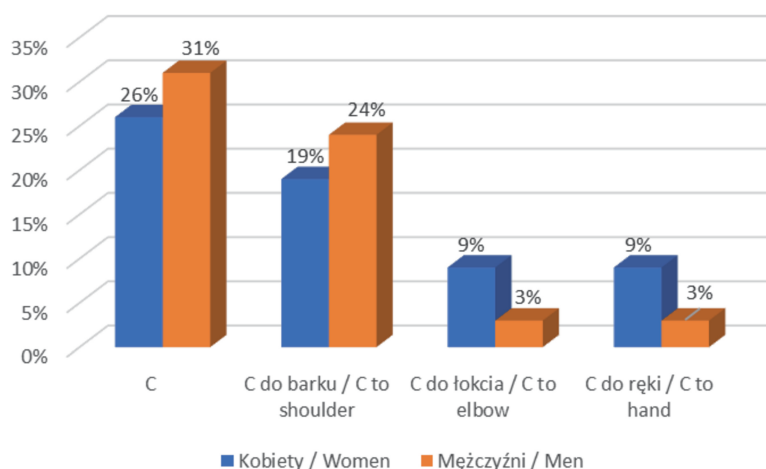
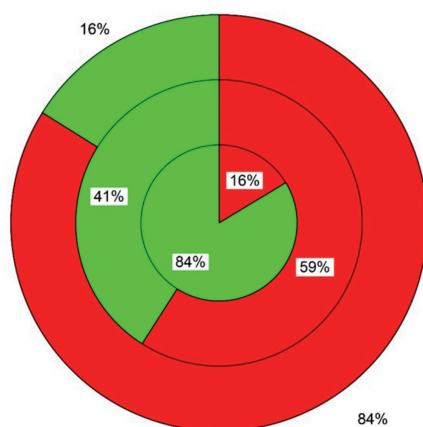


Fig. 5. Percentage distribution of cervical pain reported by women and men.

The pie chart (Fig. 6) presents percentage values of the occurrence of pain in various sections of the spine. As many as 84% of the respondents reported lumbar pain and 59% reported pain originating in the cervical spine. Pain originating both in the cervical spine and the lumbar spine was reported by 16% of the respondents.



The occurrence of back pain
outer circle: lumbar spine
middle circle: cervical spine
internal circle: co-occurrence of pain in the cervical and lumbar spine

Fig. 6. Occurrence of lumbar and cervical pain and their co-occurrence among employees with sedentary work.

Figure 7 presents the relationship between pain intensity in the three age groups. In the group of respondents up to the age of 30, 50% complained of pain whose intensity was 3-5. Respondents aged between 31 and 40 experienced pain whose intensity was 4-6. Respondents over the age of 40 usually marked 6 and 7 on the VAS scale. There was a statistically significant relation between the groups of respondents below 30 and above 40. The highest value among all the respondents was 8. The lowest value in the first group was 2, in the second group it was 1 and in the oldest group of employees the lowest value was 5 on the VAS scale.

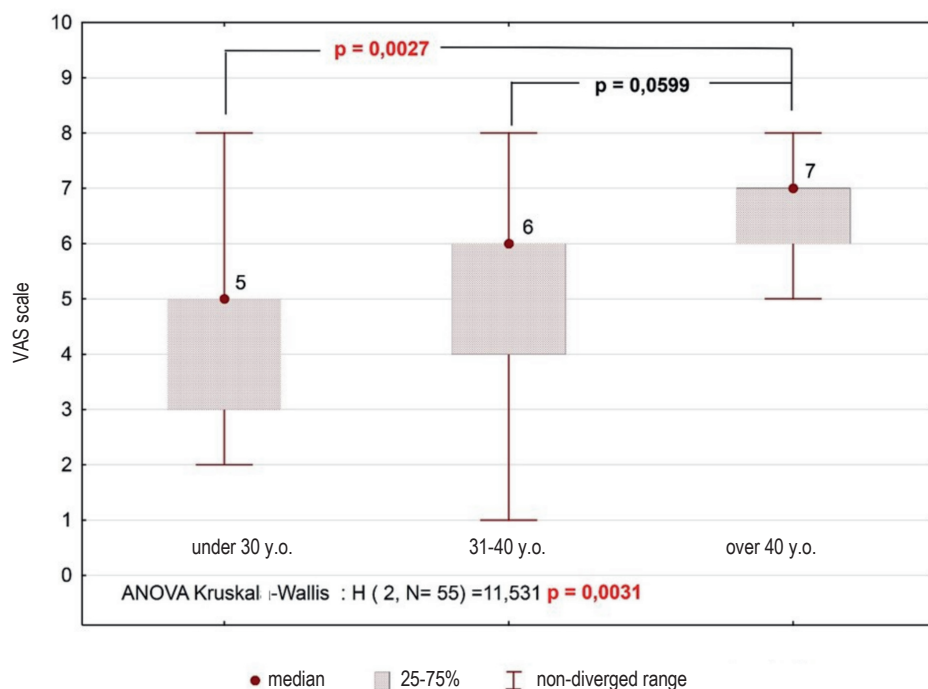


Fig. 7. Relationship between age and pain intensity in the three studied groups performing sedentary work

Figure 8 presents the relationship between work seniority (in years) and pain intensity with statistical dependence at $p = 0.0008$. The intensity of pain increased together with the increase in the number of years spent working at a computer desk. Single individuals reported pain of intensity of 2-8 (VAS scale) as early as after one year at work. The pain intensity after 10 years at work was 5-8 (VAS scale).

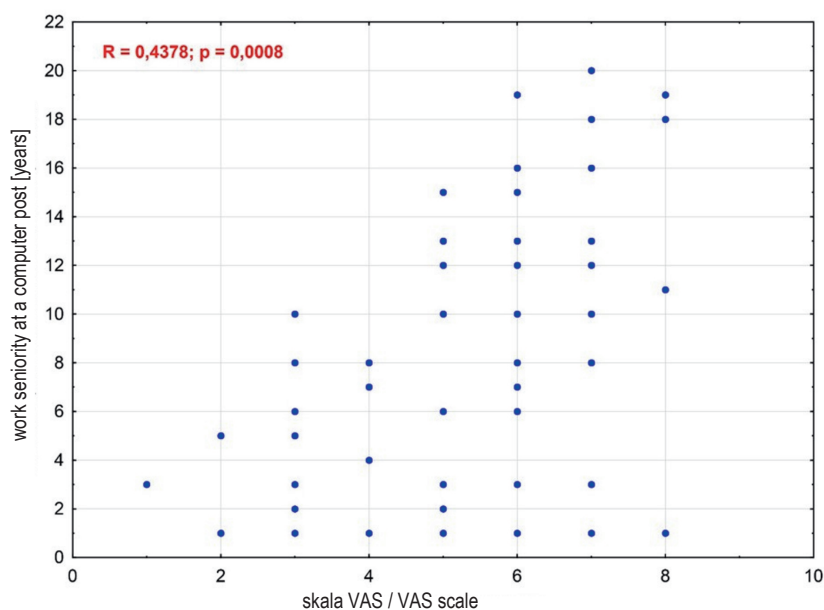


Fig. 8. Relationship between work seniority [years] and pain intensity [VAS] in office employees

Another issue is the occurrence of pain when performing work (Fig. 9). Statistically significant relation ($p = 0.0017$). The highest concentration of pain was between the 4th and 6th hour of work. It is then that the respondents reported pain of 3-8 points in terms of intensity (VAS scale) most frequently. Single individuals reported strong pain, i.e. over 5 on the VAS scale, as early as after one hour at work.

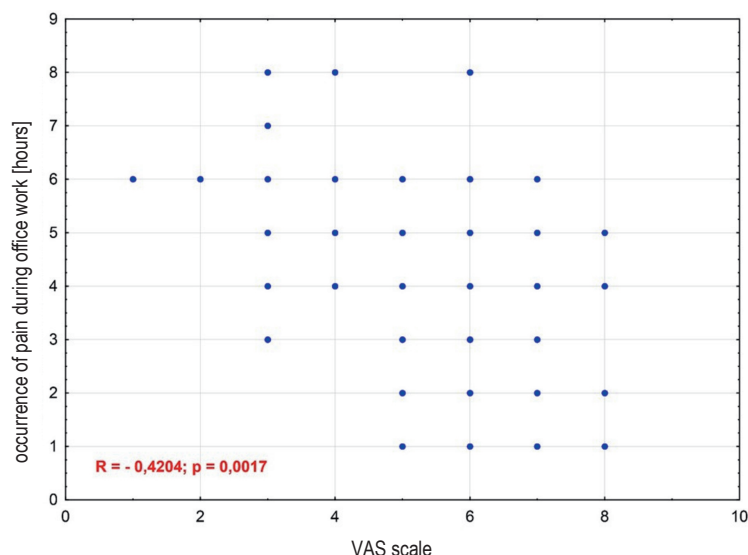


Fig. 9. Relationship between the occurrence of pain during work [hours] and pain intensity [VAS] in office employees

Discussion

Office or administrative work involves remaining in a static seated position for several hours a day. The perception of musculoskeletal pain in the employees of the selected corporation was studied with respect to gender. The study also referred to the number of years spent working at a computer desk, which is related to the intensification of pain sensations.

Cervical spine and low back were the locations of pain most frequently reported by office employees. Shoulder and knee pain was not reported nearly as frequently [14]. Research by Black et al. consequently indicates that people who have a tendency to stoop, sit with the head protracted or assume a non-ergonomic body position are prone to upper and low back pain while working [15]. Out of the 312 office employees studied, as many as 45.5% reported cervical pain. It was also observed that – as in the case of the above study – people over 30 are 2.61 times more likely to experience neck pain compared to younger employees [16]. It should be emphasised that co-existence of cervical pain and lumbar pain is related to the compensation mechanism which transfers loads according to the rules of biomechanics. Changing position while sitting entail changing the angles of lumbar lordosis, which undoubtedly leads to changes in the curvature of the cervical spine [17].

The ailments are related to the number of hours spent in the seated position. All-day observation of office employees allowed to establish that they were sitting with hunched back for at least 2.6% - 78.7% of the time at work. The subjects assumed a slouchy sitting position irrespective of the time of the day, however, the frequency was higher late in the morning and late in the afternoon than early in the morning [15]. The most frequent position among employees was a slouchy sitting position with kyphotic lumbar spine. According to the results of sEMG scans performed during office work, there were long periods of low or very low activity of the lumbar muscles [18]. Changes related to inactivity affect passive structures such as ligaments or intervertebral discs. This means that cyclical, long-term loading leads to the degeneration of flexible structures, which causes pain [19]. These data may be reflected in this study due to the fact that pain occurred most frequently after 4 hours of work.

Latest findings from 2016 show that people who have more breaks and often change position while sitting experience less pain related to the static seated position. The upright position and the forward inclined position are the most frequent among the seven seated positions. It was also noted that a perfect ergonomic position which could be maintained over longer periods of time does not exist. It was demonstrated that the seated position assumed by subjects with slight back pain during the day was more static than in the case of individuals without any discomfort whatsoever [20]. Loads on the spine related to slouching positions were studied by Wilke et al. It was proven that the pressure on intervertebral discs increased when subjects assumed a slouchy seated position with the trunk inclined forward on the sagittal plane, which accelerated the process of degeneration [21].

Differences in experiencing pain originating in the lumbar spine in women and men were analysed. Men complained of pain more often than women and pointed to a wider range of pain locations. A global study conducted in 2010 concerning occupational loads showed that men aged 35-55 constituted 62% of people with low back pain [22]. Easy paravertebral muscle fatigability associated with a higher pain intensity was observed in the male population. This was not observed in women [23]. Anthropometric measurements demonstrated an increased risk of lumbago in tall men (180 cm) and women over 170 cm, which may result from the tendency to lift weights with the end of the longer lever arm. A higher body mass index in men, as opposed to women, was also found to constitute a risk factor in prolapse of the intervertebral disc [24]. Biological tests, however, prove that women experience pain more often due to a lower pain threshold and tolerance to nociceptive stimuli than in men [25-26].

There is a correlation between pain intensity and the employee's work seniority and age. The group below the age of 30 reported pain of lowest intensity. Individuals over the age of 40 pointed to highest values on the VAS scale, which proves the pathobiomechanism of overload changes in the

lumbar spine. This is indicative of progressive pathological changes in the intervertebral disc in the lumbar spine, which translates into an increase in pain intensity. With age, it undergoes degeneration and dehydration. Incorrect positions of the body which overload the spine, repeated movements or incorrect carrying of objects accelerate degenerative processes in the intervertebral disc. Shear strengths lead to the protrusion of the disc and incorrect transfer of loads by the nucleus pulposus. In the last stage of degenerative changes, the intervertebral disc undergoes fibrosis, which limits the mobility of the spine and, therefore, reduces the pain [27- 28]. The lumbar spine pain syndrome is an ailment which concerns a significant part of the society and usually occurs in middle-aged individuals, i.e. at the peak of their professional efficiency. Research confirms that, at the earliest, back pain occurs at the end of the third decade of life, i.e. at the age of about 40 [7].

Given the high costs of diagnostics and treatment of musculoskeletal conditions, which affect mainly the lumbar spine, the efficiency of primary and secondary prophylaxis is analysed. Primary prophylaxis involves preventive interventions which prevent diseases in employees and whose aim is to alleviate pain; secondary prophylaxis involves non-specific exercise programmes and patient education on returning to work after a disease. Clinical scientists agree that ensuring quick preventive interventions is the most effective method of preventing the development of chronic diseases. Research confirms high effectiveness of prophylaxis based on the decrease in general costs related to employees taking sick leaves, specialist medical consultations and analgesics [29- 30].

This study shows that over 60% of the respondents follow work ergonomics rules. However, as many as 87% of all the respondents reported lumbar pain and 59% reported cervical pain. Therefore, in the selected group of office employees, ergonomic guidelines did not contribute to a reduction of the ailments. However, Pillastrini proved that personalised and detailed instructions in terms of ergonomics of the seated position reduce the occurrence of low back pain [31]. Apart from trying to find the perfect seated position, researchers are trying to introduce an alternative way of working. One of the proposals was made at the beginning of 2017 and its aim is to reduce the time spent in the static seated position by combining a desk with a bike [32]. A standing workplace or a treadmill were also applied in order to limit pathogenic body positions [33].

Authors present various possibilities with numerous advantages. Implementation of new office work standards should be considered. Such standards should not constitute an additional financial burden for the company and should be available for each employee, irrespective of the way they perform their professional duties and what the loads involved are.

Conclusions

Pain located primarily in the area of the lumbar spine, in the area of the cervical spine and simultaneous occurrence of lumbar and cervical pain was observed in employees performing their professional duties in the seated position.

The location and frequency of spine pain is gender-differentiated, with men being the dominant group.

In spite of theoretical knowledge of the scientific community concerning the pathobiomechanism of the occurrence of spine overload changes, the recurrence of pain episodes still remains an issue, which may be indicative of the lack of awareness and knowledge among society in general.

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