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Occupational and non-occupational risk factors for neck and lower back pain among computer workers: a cross-sectional study

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ABSTRACT

Objectives. The aim of this study was to identify major determinants for neck and lower back pain (LBP) among office workers of different ages. *Methods*. Computer workers ($N = 2000$) responded to a questionnaire on demographics, musculoskeletal disorders (MSDs), lifestyle characteristics, ergonomics of computer work and psychosocial and physical job characteristics. *Results*. Over 48% of respondents complained of MSDs last year, in particular neck pain and LBP. The results of logistic regression analysis revealed that prolonged computer time (odds ratio [*OR*] 1.92) and increased job demands (*OR* 1.06) were likely to increase the risk of neck pain, while social support (*OR* 0.96) and the use of seat-plate height adjustment (*OR* 0.64) would help to reduce the risk. Risk factors for LBP included smoking more than 14 cigarettes a day (*OR* 2.21), long hours spent working with a computer (*OR* 1.94), increased physical exertion at work (*OR* 1.29), increased work demands (*OR* 1.03) and older age (*OR* 1.03). *Conclusions*. The most effective way to eliminate MSD hazards in the workplace is to develop health programmes aimed at advocating healthy lifestyle behaviours and raising workers' awareness of workstation ergonomics and work organization**,** especially for women and older workers.

KEYWORDS
musculoskeletal disorders; spinal pain syndrome; lower back pain; neck pain; computer workers; ergonomics of computer work

1. Introduction

According to Eurostat [1] data, more than 20 million EU workers complain of occupational ill-health; with the most frequently reported form being musculoskeletal disorders (MSDs). In Poland, MSDs are the second most common cause of complete inability to work and one of the main causes of the highest number of sick-leave days [2,3]. According to numerous epidemiological data, spinal pain syndrome is the most common form of MSDs, with lower back pain (LBP) and neck pain representing the largest percentage of MSD cases [1,4]. According to the Central Statistical Office [5], almost 20% of Poles reported health issues and chronic diseases over the past year, including LBP (20% of women and 23% of men) and neck pain (14.7% of women and 13.5% of men). In addition, MSDs accounted for 15.7% of all occupational diseases in Poland in 2019 (11.4% chronic diseases of the peripheral nervous system, 4.3% chronic diseases of the locomotor system) [6].

LBP and neck pain are considered to be indirectly work-related MSDs. Occupational factors influencing the risk of the occurrence of MSDs include heavy physical work (such as lifting and carrying loads), exposure to general vibration and assuming a forced and static body position, e.g., working in front of a computer screen [7]. The highest count of workers suffering from MSDs is observed in the age group 25–65 years, with the highest incidence seen in those aged 35–45 years [7–10]. In turn, the risk factors contributing to the development of non-work-related MSDs include older age, female gender, body weight, social and economic situation, and an inappropriate lifestyle [11].

The aim of this cross-sectional study was to identify the most significant determinants for neck pain and LBP among office workers. In addition, the study attempted to investigate the MSD risk factors in men and women depending on age.

2. Methods

This cross-sectional study was a field survey with the sampling based on quota and target group selection. The quota was determined by age (groups 20–25, 30–35, 40–45, 50–55 and 60+ years) of office workers spending a minimum of 4 h a day in front of a computer screen. It was decided to use this kind of selection because random selection would be significantly difficult due to demographic reasons, especially among workers aged 60+ years.

The survey was anonymous and voluntary. The survey booklet consisted of four different parts related to MSD symptoms as well as to occupational and non-occupational factors determining these variables.

To assess MSDs, the Nordic musculoskeletal questionnaire (NMQ) was used [12]. The respondents were asked to provide information on the occurrence of MSD symptoms over the period of the last 12 months within nine areas of MSD, including the neck, shoulder, upper back, lower back, wrist/hand, elbows, hips/thighs, knees and ankles.

For the assessment of psychosocial and physical work demands, the job content questionnaire was used [13]. The questionnaire consists of 27 items on a 5-point Likert scale divided into four subscales: Social Support, Job Demands, Skill, Decision Latitude and physical job demands. The Decision Latitude and Skill Discretion subscales constituted the control dimensions.

As part of the study, worker lifestyle was investigated using a specially designed survey. The survey contains general questions (about age, education, total number of years worked and number of years in the current job, position held, body mass index [BMI]) and questions about lifestyle, including self-assessment of health, diet, smoking and alcohol consumption.

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Assessment of the working conditions and computer ergonomics was based on the authors' own questionnaire developed on the basis of the ergonomics checklist [14]. Among the questions asked were years worked with the computer, average daily computer screen time at work and ergonomics of the workstation (e.g., table and workspace), monitor (e.g., position of the monitor, viewing distance), chair (height adjustment and inclination of the seat and backrest, presence of five castor wheels and adjustable armrest) and keyboard (its placement, positioning of forearms and wrists when typing).

2.1. Statistical analysis

Statistical analysis was performed with SPSS version 10.0. The assessment of the relationship between variables determining the risk of MSDs was based on statistical tests. These were selected on the basis of the risk factors under analysis and the nature of the variables. The statistical tools included the Pearson correlation coefficient and maximum likelihood method selected to examine the relationship between the analysed variables, and the Mann–Whitney test and Kruskal–Wallis *H* test to determine statistically significant differences between variables. Logistic regression analysis was used to examine the strongest predictors of MSDs among office workers. For the purpose of the statistical analysis, respondents were considered together and also separately for subgroups divided by age and gender. $\alpha = 0.05$ was chosen as a significance level for the analysis.

Table 1. Socio-demographic characteristics.

		Descriptive statistics				
Socio-demographic characteristic	Group	*N*	*M*	Minimum	Maximum	*SD*
Age (years)	20–25	397	23.6	20	25	1.5
	30–35	402	32.5	30	35	1.8
	40–45	401	42.4	40	45	1.7
	50–55	400	52.4	50	55	1.8
	≥ 60	400	61.7	60	71	1.6
	Total	2000	42.5	20	71	13.7
Total number ofyears worked	Female	993	18.6	0.1	46.0	12.7
	Male	994	18.7	0.2	45.0	12.3
	Total	1987	18.6	0.1	46.0	12.5
Total number ofyears worked in the current position	Female	989	10.0*	0.1	41.2	9.0
	Male	979	8.2*	0.1	36.0	6.8
	Total	1968	9.1	0.1	41.2	8.0
Number of years worked with a computer	Female	995	10.6	0.1	40.0	7.2
	Male	986	11.0	0.2	35.0	7.1
	Total	1981	10.8	0.1	40.0	7.1
Number of hours worked per week	Female	996	40.9	20.0	68.0	5.1
	Male	995	41.1	20.0	80.0	5.7
	Total	1991	41.0	20.0	80.0	5.4
Body mass index (BMI)	Female	979	23.8*	14.4	39.6	3.4
	Male	978	25.3*	15.3	48.9	3.3
	Total	1957	24.6	14.4	48.9	3.5

*Statistically significant differences between the surveyed men and women ($p \le 0.05$).

3. Results

3.1. Study group

The study covered a group of 2000 office workers (1000 women and 1000 men) with an average age of 42.5 years (*SD* 13.7). The average number of years worked in total was 18.6 years (*SD* 12.5) and the average number of years worked with a computer was 11 years (*SD* 7.1) (Table 1). Women were found to have a statistically significantly longer average number of years working in their current position and to spend significantly more time working in front of a computer screen than men ($p \le 0.05$). In contrast, men were found to have a statistically significantly better education and significantly more often held a managerial position compared to women ($p \le 0.05$). A significantly higher percentage of overweight and obese people was also observed in men (Table 2).

3.2. Discussion of the results

The research shows that over 48% of respondents complained of MSDs in the last year. The most frequent complaint reported was neck pain (17.05%) and LBP (16.8%) (Figure 1). The study found statistically significant differences ($p \le 0.05$) between men and women in the frequency of reported cervical vertebrae discomfort (22.4% of women, 11.7% of men) and back pain (19.5% of women, 14.1% of men).

In an attempt to determine predictors of neck pain among occupational and non-occupational factors, based on logistic regression it was found that the increase of MSD risk was associated with intensive computer use (over 40 h weekly) (odds ratio [*OR*] 1.92, 95% confidence interval [CI] [1.03, 3.57]) and high work demands (*OR* 1.06, 95% CI [1.03, 1.10]). In contrast, social support (*OR* 0.96, 95% CI [0.94, 0.98]) and a chair with adjustable height of the seat plate (*OR* 0.64, 95% CI [0.46, 0.88]) would reduce the risk of neck pain. Furthermore, age and gender were found to be significant yet independent risk factors for this ill-health. In turn, the risk factors for LBP were associated with smoking more than 14 cigarettes a day (*OR* 2.21, 95% CI [1.38, 3.53]), spending long hours working with a computer (over 40 h weekly) (*OR* 1.94, 95% CI [1.03, 3.63]), increased physical exertion at work (*OR* 1.29, 95% CI [1.10, 1.51]) and increased work demands (*OR* 1.04, 95% CI [1.01, 1.08]). On the other hand, it was found that using a footrest (*OR* 0.72, 95% CI [0.52, 0.98]) as well as a stable chair with five castor wheels (*OR* 0.48) reduced the occurrence of developing LBP (Table 3).

The analysis of the results shows that the following factors had a statistically significant influence on the risk of developing neck pain in women: working at a computer over 40 h weekly (*OR* 2.73, 95% CI [1.25, 6.01]), psychosocial and physical work demands (physical exertion at work *OR* 1.27, 95% CI [1.01, 1.59]; work demands *OR* 1.05, 95% CI [1.00, 1.09]) as well as support from superiors (*OR* 0.95, 95% CI [1.92, 0.98]) and colleagues (*OR* 0.91, 95% CI [0.83, 0.99]). The following variables were identified as predictors of LBP in women: overweight and obesity (*OR* 1.51, 95% CI [0.29, 2.61]), physical exertion at work (*OR* 1.37, 95% CI [1.09, 1.71]), support from superiors (*OR* 0.95, 95% CI [0.92, 0.98]), age (*OR* 1.02, 95% CI [0.00, 0.06]), stable chair (equipped with five castor wheels) (*OR* 0.52, 95% CI [0.33, 0.81]) and a chair ensuring a comfortable body position (*OR* 0.54, 95% CI [0.34, 0.85]) (Table 4).

The results reveal that the increased risk of neck pain in men was associated with high work demands (*OR* 1.07, 95% CI [1.02, 1.12]), while the lack of a chair equipped with seat height

Table 2. Age structure, position, education and body mass index (BMI) of men and women.

	Gender					
	Female		Male		Total	
Characteristic of study group	*n*	%	*n*	%	*n*	%
Age (years)						
20–25	199	19.9	198	19.8	397	19.9
30–35	201	20.1	201	20.1	402	20.1
40–45	200	20.0	201	20.1	401	20.1
50–55	200	20.0	200	20.0	400	20.0
≥ 60	200	20.0	200	20.0	400	20.0
Position						
Regular	849*	84.9	777	77.7	1626	81.3
Managerial	151	15.1	223*	22.3	374	18.7
Education						
Vocational	47*	4.8	25	2.5	72	3.6
Secondary	506	51.2	492	50.1	998	49.9
Higher	435	44.0	466*	47.4	901	45.1
Years worked in front of a computer						
< 5	327	32.9	273	32.9	600	30.0
5–10	201	20.2	272	20.2	473	23.7
10–20	386	38.8	355	38.8	741	37.1
≥ 20	81	8.1	86	8.1	167	8.4
Number of hours spent at work in front of a computer per day						
< 20	75	7.5	167*	16.8	242	12.1
20–40	891*	89.5	794	79.9	1685	84.3
40–60	30	3.0	33	3.3	62	3.1
BMI						
18.5–24.9	664	67.8	492	50.3	1114	55.7
25.0–29.9	268	27.4	411	42.0	679	34.0
≥ 30.0	47	4.8	75	7.7	122	6.1

*Statistically significant differences between the surveyed men and women ($p \leq 0.05$).

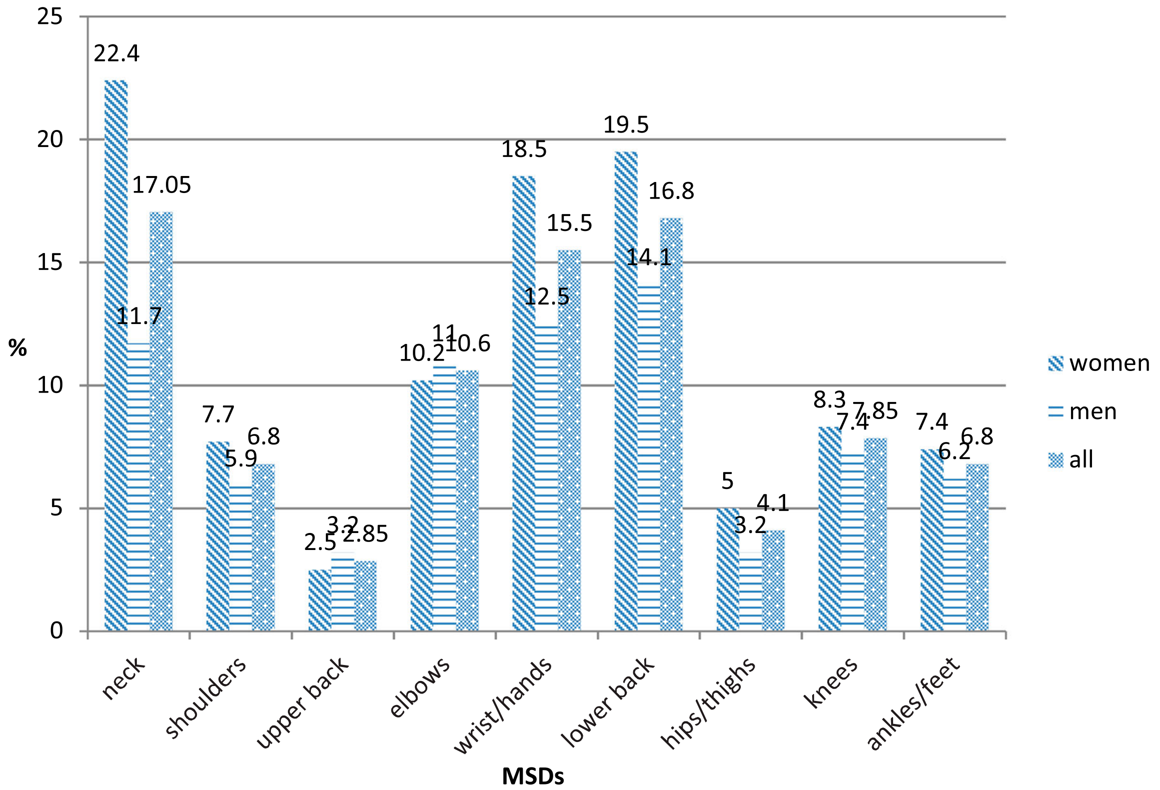

Figure 1. Musculoskeletal disorders (MSDs) in particular parts of the body (%) over the last 12 months. *Statistically significant differences between the surveyed men and women ($p \leq 0.05$).

Table 3. Results of logistic regression for all of the respondents determining the prevalence of neck pain and lower back pain (LBP) over the last 12 months.

		Logistic regression model	
Risk factor	Univariate analysis, *p*	OR	95% CI
Neck pain			
Gender	0.00	0.51	[0.39, 0.67]
Work demands	0.00	1.06	[1.03, 1.10]
Social support	0.00	0.96	[0.94, 0.98]
Time worked in front of a computer screen at work (> 40 h weekly)	0.04	1.92	[1.03, 3.57]
Seat-plate height adjustment	0.01	0.64	[0.46, 0.88]
LBP			
Age	0.00	1.03	[1.02, 1.04]
Gender	0.00	0.66	[0.51, 0.87]
Work demands	0.01	1.04	[1.01, 1.08]
Physical exertion	0.00	1.29	[1.10, 1.51]
Smoking more than 14 cigarettes a day	0.00	2.21	[1.38, 3.53]
Time worked in front of a computer at work (> 40 h weekly)	0.04	1.94	[1.03, 3.63]
Stable chair (equipped with five castor wheels)	0.00	0.48	[0.36, 0.65]
Using a footrest	0.04	0.72	[0.52, 0.98]

Note: CI, confidence interval; *OR*, odds ratio.

Table 4. Results of logistic regression for women determining the prevalence of neck pain and lower back pain (LBP) over the last 12 months.

		Logistic regression model	
Risk factor	Univariate analysis, *p*	OR	95% CI
Neck pain			
Work demands	0.03	1.05	[1.00, 1.09]
Support from colleagues	0.05	0.91	[0.83, 0.99]
Support from superiors	0.00	0.95	[0.92, 0.98]
Physical exertion	0.04	1.27	[1.01, 1.59]
Time worked in front of a computer screen at work (> 40 h weekly)	0.01	2.73	[1.25, 6.01]
LBP			
Age (years)	0.00	1.02	[0.00, 0.06]
BMI (overweight and obesity)[a]	0.03	1.51	[0.29, 2.61]
Support from superiors	0.01	0.95	[0.92, 0.98]
Physical exertion at work	0.01	1.37	[1.09, 1.71]
Stable chair (equipped with five castor wheels)	0.00	0.52	[0.33, 0.81]
Chair ensuring comfortable body position (dimensions, shape of seat and back support)	0.00	0.54	[0.34, 0.85]

[a]Overweight, 25.0–29.9; obese, $\geq$ 30.0.
Note: CI, confidence interval; *OR*, odds ratio.

adjustment was likely to reduce the risk of neck symptoms (*OR* 0.60, 95% CI [0.37, 0.99]). In turn, the risk of LBP was determined by age (*OR* 1.02, 95% CI [1.00, 1.04]), work demands (*OR* 1.06, 95% CI [1.01, 1.11]), smoking more than 14 cigarettes a day (*OR* 2.78, 95% CI [1.59, 4.84]), not using a footrest and the lack of a stable chair (equipped with five castor wheels) (Table 5).

The highest incidence of MSD cases was observed among those aged 50–55 and $\geq$ 60 years, with less incidence in persons in other age groups ($p \leq 0.05$). The predictors of neck pain in office workers aged 60+ years were associated with smoking (*OR* 1.54, 95% CI [1.09, 2.1]), high work demands (*OR* 1.12, 95% CI [1.05, 1.19]) and gender (*OR* 0.49, 95% CI [0.29, 0.85]). LBP, in turn, was found to be associated with a low level of support from colleagues (*OR* 0.77, 95% CI [0.65, 0.92]) and from superiors (*OR* 1.09, 95% CI [1.03, 1.14]) and a chair without adjustable armrests (*OR* 0.47, 95% CI [0.25, 0.87]). Furthermore, the study found that the variables that statistically significantly influenced the risk of developing neck pain in people aged 50–55 years included, among others, prolonged work using a computer (*OR* 4.54, 95% CI [1.13, 8.16]) as well as overweight and obesity (*OR* 2.56, 95% CI [1.36, 4.85]), while the risk of lower back problems was associated with work with a computer at home (*OR* 4.08, 95% CI [1.23, 3.49]) and high work demands (*OR* 1.08, 95% CI [1.02, 1.14]).

In the group of youngest workers (aged 20-25 years), the study found that predictive factors of neck pain were associated with increased physical exertion at work (*OR* 2.63, 95% CI [1.55, 4.45]), the inability to adjust armrests (*OR* 0.39) and a lack of computer chair back support (*OR* 0.10, 95% CI [0.01, 1.00]). However, the low level of support from superiors (*OR* 0.82, 95% CI [0.71, 0.93]), the lack of a footrest (*OR* 0.02, 95% CI [0.07, 0.78]) and a low level of unstable job (*OR* 0.01, 95% CI [0.59, 0.94]) were found to reduce the risk of LBP.

As regards workers aged 30–35 years, it is worth noting that a link was identified between the risk of occupational neck pain and working with a laptop more 6 h a day (*OR* 2.54, 95% CI [1.07, 6.01]) while LBP was found to be attributable to long hours spent working with a computer (*OR* 4.7, 95% CI [1.49, 4.79]) and a low level of support from superiors (*OR* 0.92, 95% CI [0.85, 0.99]).

The data analysis also revealed that factors determining the risk of MSDs in workers aged 40–45 years were mainly related to the working conditions and computer ergonomics. Moreover, the study showed that an ability to adjust the armrests (*OR* 0.45, 95% CI [0.24, 0.82]) and to support the wrists on the armrests and/or the table top (*OR* 0.40, 95% CI [0.20, 0.80]) would reduce the risk of neck pain. On the other hand, it was noted that breaking up longer periods of sitting (*OR* 0.48, 95% CI [0.26, 0.88]) and the use of a stable chair (equipped with five castor wheels) reduced the risk of LBP (*OR* 0.31, 95% CI [0.16, 0.61]) (Table 6).

Table 5. Results of logistic regression for men determining the prevalence of neck pain and lower back pain (LBP) over the last 12 months.

		Logistic regression model	
Risk factor	Univariate analysis, *p*	OR	95% CI
Neck pain			
Work demands	0.00	1.07	[1.02, 1.12]
Seat plate height adjustment	0.05	0.60	[0.37, 0.99]
LBP			
Age (years)	0.00	1.02	[1.00, 1.04]
Work demands	0.01	1.06	[1.01, 1.11]
Smoking more than 14 cigarettes a day	0.00	2.78	[1.59, 4.84]
Stable chair with five castor wheels	0.00	0.50	[0.33, 0.76]
Using a footrest	0.04	0.60	[0.38, 0.98]

Note: CI, confidence interval; *OR*, odds ratio.

Table 6. Results of logistic regression for all groups of different ages determining the prevalence of neck pain and lower back pain (LBP) over the last 12 months.

			Logistic regression model	
Age of subjects (years)	Risk factor	Univariate analysis, *p*	OR	95% CI
Neck pain				
20–25	Physical exertion at work	0.00	2.63	[1.55, 4.45]
	Back support adjustment	0.05	0.10	[0.01, 1.00]
	Armrest adjustment	0.03	0.39	[0.16, 0.93]
30–35	Social support	0.03	0.94	[0.89, 1.00]
	Working on a laptop for more than 6 h per day	0.03	2.54	[1.07, 6.01]
	Seat-plate height adjustment	0.03	0.48	[0.25, 0.92]
40–45	Wrists based on armrests and/or table top	0.01	0.40	[0.20, 0.80]
	Armrest adjustment	0.01	0.45	[0.24, 0.82]
50–55	Gender	0.00	0.29	[0.14, 0.56]
	Overweight and obesity	0.00	2.56	[1.36, 4.85]
	Support from colleagues	0.00	0.72	[0.61, 0.86]
	Time worked in front of a computer screen at work (> 40 h weekly)	0.03	4.54	[1.13, 8.16]
60+	Gender	0.01	0.49	[0.29, 0.85]
	Work demands	0.00	1.12	[1.05, 1.19]
	Smoking	0.01	1.54	[1.09, 2.1]
LBP				
20–25	Support from superiors	0.00	0.82	[0.71, 0.93]
	Use of footrest	0.02	0.23	[0.07, 0.78]
	Unstable job	0.01	0.74	[0.59, 0.94]
30–35	Support from superiors	0.03	0.92	[0.85, 0.99]
	Time worked in front of a computer screen at work (> 40 h weekly)	0.01	4.69	[1.49, 4.79]
	Presence of armrests	0.01	0.40	[0.20, 0.82]
40–45	Restbreaksduringwork	0.02	0.48	[0.26, 0,88]
	Stable chair with five castor wheels	0.00	0.31	[0.16, 0.61]
50–55	Gender	0.01	0.50	[0.29, 0.85]
	Work demands	0.01	1.08	[1.02, 1.14]
	Time spent working in front of a computer screen at home	0.02	4.08	[1.23, 3.49]
60+	Support from colleagues	0.00	0.77	[0.65, 0.92]
	Support from superiors	0.00	1.09	[1.03, 1.14]
	Adjustment of armrests	0.02	0.47	[0.25, 0.87]

Note: CI, confidence interval; *OR*, odds ratio.

4. Discussion

This study examined cross-sectional associations between neck pain and LBP in a large sample of computer workers. Discomfort of the lumbosacral and cervical spine remains a common medical condition in the working population, a fact which is also confirmed by the results of our study. The prevalence of this form of ill-health is also confirmed in reports by many other authors [15–21]. Moreover, the results of our research as well as findings from many other studies show that women are statistically significantly more likely than men to report neck and lower back problems [18,21–26]. Similar data are also presented by Statistics Poland (GUS), according to which 10.5 million reported have suffered from work-related health problems in the last year and almost 21% of them were bone, joint or muscle problems that mainly affect the back and neck [5].

The statistically significant difference in neck pain and LBP was found to depend on the age of the respondents. Those in the age groups 50–55 and 60+ years statistically significantly more often tended to report symptoms than younger workers. This may be related to, among others, changes in the muscular system resulting from ageing of the body. With age, changes occur in anatomical and functional properties of skeletal muscles. The same applies to the way and frequency of stimulating muscles to work. The age-related changes include a loss of skeletal muscle mass, also referred to as sarcopenia, and the associated reduction in muscle contraction strength as well as changes in muscle fibre contractile properties and muscle innervation [27,28]. Similar research results were obtained by Ricco et al. [19], who examined MSDs among 1032 Italian computer operators (about 64% women). The analysis of these data identified the neck (38.1%) and lower back (29.1%) as the most frequently affected body parts. A statistically significant higher percentage of complaints was observed in the age group 50+ years [19]. In turn, Spyropoulos et al.'s [29] research shows that a higher risk of LBP was observed in people over 45 years of age. The aim of their study was to assess the prevalence of LBP in a group of 648 office workers and to examine the impact of working conditions combined with computer ergonomics and psychosocial work demands on the incidence of LBP. Almost 76% of the participants of the study were women and their mean age was 44.5 years. The analysis of the findings indicates that 61.6% of the respondents complained of LBP and that ill-health occurrence was significantly determined by age, gender, BMI and the working conditions and computer ergonomics. Among the latter, the following had a special impact: body distance from a computer screen, body position when working with the computer, sitting time in front of a computer exceeding 6 h a day, job satisfaction and repetitive work [29]. Likewise, the results of our study demonstrate that the conditions of working with the computer are significant determinants for predicting MSD occurrence. Spending a typical 40-h working week or longer sitting in front of a computer screen doubled the risk of neck problems in women, while in men the risk of this form of ill-health was increased by the absence of a chair with adjustable height of the seat plate. The study showed that the reduction of exposure of both men and women to the risk of LBP was associated with an ergonomic and stable chair equipped with five castor wheels. Additionally, the risk of LBP in women was reduced by the use of a chair whose dimensions and shape of the seat and back support would provide a comfortable position, while in men this occurred by using a footrest. The relationship between working conditions and computer ergonomics at work and the incidence of MSDs can also be observed in the results of other studies [18,20,24,26,30–34]. Ricco et al. [19] not only identify the negative impact of long periods of time spent in front of a computer screen, but also point to the impact of workstation set-up and equipment set-up on MSDs. Findings of their study demonstrate that persons using an ergonomic desk, chair and footrest are less likely to complain of MSDs.

Based on the logistic regression analysis it can be concluded that psychosocial work demands, in particular increased work demand and a low level of social support, can put workers at risk for developing MSDs. The study reveals that an increase in work demands can contribute to the risk of neck pain (in men and women) and LBP (in men), whereas the increase in social support can be used as an effective approach in reducing the risks of MSD symptoms in women. These results seem to be consistent with reports of other researchers who indicate that MSDs can be associated with workplace factors that cause stress, such as psychosocial factors related to time pressure, lack of control over work performed, lack of support from colleagues and management as well as high work demands [13,35]. Furthermore, the results of the research presented in the document 'Musculoskeletal Disorders and the Workplace: Low Back and Upper Extremities' developed by the National Research Council indicate that psychosocial work demands, especially high job demands, low decision latitude and low social support, and few rest break opportunities could lead to development of MSDs [36,37]. Interestingly, while analysing our results separately for individual persons as a function of age, we observed that support from superiors tended to reduce the incidence of LBP in workers aged 30–35 years, while support from colleagues was likely to contribute to the reduction of the risk of neck pain in those aged 50–55 years and of LBP in a group of workers aged 60+ years. The results of our research reveal that too much physical exertion performed by women can increase the risk of LBP and neck pain. It should be noted, however, that the findings concerned physical exertion at work and not physical activity undertaken during free time. There exists ample literature data to suggest that improper doses of physical effort may increase the risk of MSDs. This may happen, e.g., as a result of too much force during the transfer of loads, but also during prolonged work using a computer when the muscles of the fingers are activated with a small force but a large number of repetitive movements are involved (when typing quickly on a computer keyboard) [38–41].

It is particularly interesting to note that overweight and obesity were found to be associated with increased incidence of lower back health issues in women, and neck pain in workers aged 50+ years. The negative impact of increased BMI was also reflected in findings from other studies. Sochocka et al. [20] report that academic teachers with a higher BMI have a greater severity of pain and a higher degree of disability, while according to Spyropoulos et al. [29] higher BMI in office workers translated into a higher incidence of LBP.

Interestingly, among the lifestyle elements affecting the occurrence of MSDs, tobacco smoking has been identified as one of the risk factors. Our data indicate that the risk of LBP in men is more than double if they smoke more than 14 cigarettes a day. There are many explanations for this phenomenon in the literature. Jaramillo et al. [41] explains that smoking cigarettes decreases bone mineral density causing vertebral compressions and back pain. In contrast, Japanese researchers have shown that nicotine can inhibit synthesis of the extracellular matrix and disc cell proliferation, and cause downregulation of collagen genes [42]. Knutsson et al. examined a large group of workers ($N = 331{,}941$) for a possible association between tobacco smoking and surgical intervention for lumbar spinal stenosis (LLS), and showed similar results to ours. The results of their study indicate that tobacco smoking is associated with an increased incidence of surgically treated LSS, especially among heavy smokers, who have a higher risk than moderate or former smokers [43]. The results are also consistent with previous reports indicating that cigarette smoking is associated with the occurrence of other spinal complaints, such as lumbar disc degeneration and LBP [44,45].

Prevention of MSDs should be focused on implementing comprehensive workplace health promotion programmes offering workers healthy lifestyle management advice as well as training and education on workstation ergonomics and work organization. The interventions addressing women should concern both the improvement of working conditions (physical and psychosocial) and the promotion of a healthy lifestyle, especially physical activity to prevent overweight and obesity. In turn, preventive programmes aimed at reducing the risk of neck pain and LBP in men should include promotion of a healthy lifestyle, reduction of psychosocial work demands as well as modification and improvement of workstations and work organization. As part of an MSD prevention strategy, workers should be provided with ergonomic support, involving the possibility of an individual conversation with an expert (so-called expert technical visit) about any irregularities related to the workstation ergonomics, familiarizing them with work techniques and the active use of breaks at work (especially micro breaks). Parallel to this type of intervention, spin-up educational activities such as workshops, training sessions, meetings, etc. should be held to promote knowledge of ergonomics, raise awareness of health consequences resulting from non-compliance with ergonomic principles at workstations and also to show ways of preventing MSD-related health issues, both in the workplace and during free time. Equally important is the ability to relieve stress at work. To this end, various types of events targeting workers, e.g., anti-stress training courses, training on interpersonal communication or time management, could prove very beneficial. As demonstrated by the results of our study, tobacco use prevention in the workplace calls for special attention. In the context of MSD symptoms, the topic is particularly important for men. These types of initiatives can be implemented in the form of anti-smoking workshops aimed at explaining all psychological, health and social aspects of smoking, how to quit smoking and how to cope with the desire to smoke after cessation.

Based on the study it can be concluded that older workers, over 50 years of age, both women and men, should be targeted as special recipients of a comprehensive preventive intervention programme focused on MSD risk factors in the workplace. In order to prevent those workers from MSD injury, it is advisable to implement measures that improve health and psychosocial work demands, in particular those that improve relationships with colleagues and superiors, and limit too high work demands. In addition, physical activity health promotion programmes should encourage physical activity, especially exercises combining stretching and strengthening of the lumbosacral and cervical spine. Such activities may include a number of initiatives, including: (a) co-financing of sports cards enabling the use of various types of sports and recreation facilities; (b) setting up a gym or special exercise room in the company; (c) organization of sporting tournaments; (d) promoting cycling as an ecological means of transport to and from work, (e) physical therapy consultations with the possibility of receiving individual recommendations on physical exercises both during breaks at works and at home.

5. Conclusions

From the presented data it transpires that the most important occupational risk factors for neck pain and LBP in computer workers are prolonged computer time, occupational stress and non-compliance with ergonomic principles at the workstation. On the other hand, non-occupational risk factors include lifestyle risk behaviours and older age.

Prevention of MSDs in the workplace should be focused on setting up comprehensive health programmes aimed at advocating healthy lifestyle behaviours and raising workers' awareness of workstation ergonomics and work organization, especially for women and older workers.

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Supplemental data and research materials

Supplemental data for this article can be accessed at < 10.1080/10803548.2021.1899650 >

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