

# Pain symptoms of the spine and work ergonomics of people in south-eastern Poland

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## Abstract

**Introduction.** Pain disorders of the spine are the most common causes of appointments with physiotherapists. It has been estimated that nine out of ten adults at least once in their lifetime experience spine pains and five out of ten working people have this kind of ailments a minimum once a year.

**Objective.** The evaluation of the occurrence of spine pains in people who are professionally active with regards to obeying the rules of work ergonomics.

**Material and methods.** The research group has been composed of 100 people professionally active from south-eastern Poland. Their ages have been from 20 to 50 years (average age has been 35 years). In the research the authors' own survey and VAS scale have been used on which the surveyed person has marked the intensity of pain experience in the area of the spine.

**Results.** Greater pain in the spine has been experienced by people who have never obeyed the rules of, among others, manual lifting and/or carrying the maximum load, lifting and carrying heavy objects, in their work. The lowest degree of pain has been experienced by those who obeyed the above-mentioned rules.

**Conclusions.** Assuming the incorrect body posture during the everyday activities and disobeying the rules of ergonomics resulting from lack of knowledge are crucial factors in the occurrence of spine pains. People who disobey rules of ergonomics experienced spine pain to a higher degree.

## Key words

spine, pain, VAS scale, work load ergonomics, rest ergonomics

## INTRODUCTION

Pain is one of the most common ailment for a human which is the alarm sign for the existing threat to health [1, 2]. So-called muscular-skeletal pains are sensations of receptor character, their source being connective-tissue sheaths surrounding muscles, fasciae, tendons and aponeuroses. Muscles are rich in nerves that is why the always occurring feature of irritation is pain [3]. Pain sensations accompanying disorders of the movement apparatus belong to the most common problems of present-day population.

The least beneficial factor affecting the skeletal-muscular system is the sedentary lifestyle which causes that the muscles more often undergo constant static load due to which they are in the state of long-lasting increased tension. Frequent changes of position during standing or sitting is one of the ways to deal with this relative immobility. Even minimal movements allow the muscles stressed so far to rest by moving the tension to other muscle groups [4].

Another important factor influencing the appearance of pain sensations of the movement organs is disregarding basic rules of ergonomics. Assuming incorrect body posture during work, long lasting sitting or standing, the wrong way of bending and lifting heavy objects often lead to pains

in organs of movement and in time to the appearance of degenerative changes [5, 6]. Workers who are the most susceptible to them are those who throughout the most of the day repeat the same motion behavior remaining in one, often not physiological position of the body [7].

Among the results of limiting motion activity and disobeying the rules of work ergonomics, a special place is occupied by pain disorders of the spine observed among both men and women, all age groups and various populations. The degree of pain intensity can be so high that it often makes a person stop working and during everyday activity (sometimes even while sitting on a chair) it becomes very nagging. It has been estimated that the most commonly occurring pain – the lower back pain – is experienced by approximately 80% of people at least once in their lifetime and for many it becomes a life-long disease [8,9].

In the study has been analyzed the severity of pain assessed by subjective analogue scale VAS and the frequency of the occurrence of pain during the daily work with taking into account the place of employment, the character and respect the principles of work load ergonomics and rest ergonomics.

**Objective.** Assessment of the frequency of the occurrence of spine pain disorders in people professionally active with regard to obeying the rules of work ergonomics.

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## MATERIALS AND METHOD

The researched group consisted of 100 professionally active people (working full-time employed, dimension 40 hours per week). from the south-eastern Poland (50 people working in the Podkarpacie region and 50 people from the Malopolska region). The average age in the group was 35 years (from 20 to 50 years of age). 59 women (29 from Malopolska and 30 from Podkarpacie) and 41 men (21 from Malopolska and 20 from Podkarpacie) took part in the survey. In the study group there were included beginners (which work experience was minimum 1 year), as well as professional workers with many years of experience – maximum 32 years.

Due to the character of the work study group was divided into physical and intellectual work. Blue-collar workers constituted 25.3% of the group and mainly it included people working in agriculture, industry and building sector. White-collar workers constituted 74.8% of the group, (such as teachers, pedagogues) and 48,5% of these group were those who had intellectual work had typical sitting job (bankers, secretaries, directors of companies). The data about character of work are listed in Table 1.

Based on the analysis of education of the study group it was found that higher education possessed 76%, secondary education 19%, vocational education 4%, elementary education 1% of the study group. The inclusive criterion for the research was the age between 20 and 50 years, employment and the person's consent.

The analyzed factors which can affect on incidence of low back pain in the study group were: character of work, regularity of the trainings in occupational health and safety, proper care of the ergonomics of the workplace and compliance with safety rules by employer. In assessing the length of time in the workplace, there was established that both intellectual and manual employees complied with regulations about generally accepted principles of health and safety at workplace. In the research the authors' own survey questionnaire was used as well as the VAS pain scale on which the surveyed person marked the intensity of pain in the spinal area, where 0 was no pain at all and 10 was the maximum of pain.

The study was conducted among a random sample of employees in selected workplaces. In the study there has been used a simple random sample. In the research participated an active workers aged 20–50 years old, from Malopolska and Podkarpacie regions (South – East Poland). In order to verify the effectiveness of the questionnaire used in the research, the pilot study was conducted on the randomly selected group of five respondents from the Podkarpacie region.

During verification it was noted that all the questionnaires were filled in correctly i.e. in a way which allowed to enter data into the database of PASW/SPSS 17 statistical software. The maximum error of estimation for the trust level 0.05 and the size of trial was 9%. It means that the results obtained from the trial may differ from the make-up of the population up to the threshold of this value. The results of the research have been presented in the form of tables.

## RESULTS

The study's results are included in the tables form. In the **Table 1** and **2** there is an information about the character of work and the regularity of trainings in health and safety at work with consideration of place of residence.

**Table 1.** Characteristic of work and place of residence of the study group

		Region		Total	
		Małopolska	Podkarpacie		
		Character of work	Physical	N	21
%	8.2%			42.0%	25.3%
Intellectual	N		6	20	26
	%		40.8%	12.0%	26.3%
Intellectual and typically sedentary	N		23	25	48
	%		51.0%	46.0%	48.5%
Total	N	50	49	99	
	%	100.0%	100.0%	100.0%	

p=0.07

**Table 2.** Regularity of trainings in occupational health and safety in the workplace with consideration of the region

		Region		Total	
		Małopolska	Podkarpacie		
		Does your workplace hold regular occupational health and safety trainings?	Yes	N	37
%	74.0%			88.0%	81.0%
No	N		13	6	19
	%		26.0%	12.0%	19.0%
Total	N		50	50	100
	%		100.0%	100.0%	100.0%

p=0.07

The vast majority of respondents (81%) confirmed the regularity of trainings in occupational health and safety in their workplaces. The analysis of the answers from questionnaire with consideration of the region (Tab. 2) showed that, although the respondents from Podkarpacie region answered affirmatively more often (Podkarpacie region: 88%, Malopolska region: 74%), this relationship is not statistically significant.

Tables 3–7 contain information about the degree of pain (including area of the spine) and the correlation with the presence of the principles of ergonomics:

- obeying the rules of manual lifting and/or carrying acceptable load in a workplace
- obeying the rules during the way of bending
- obeying the rules of lifting and carrying heavy objects
- obeying the rule of moving large and heavy objects
- obeying the rules of ergonomics during housework

The number of the study group was 100 people, and therefore each calculated percentage is equal to the number "N" contained in the tables 3–7.

One-factor analysis of the variance showed that there are statistically significant relations (Table 3). Greater pain sensations are experienced by people who disobey the rules of manual lifting and/or carrying acceptable load in their workplace. The lowest degree of pain is felt by those who obey the above-mentioned rules.

One-factor analysis of the variance showed that there are statistically significant relations which inform that greater pains of consecutive spine parts are experienced by people who during an activity requiring bending perform the movement from bending (i.e., they bend the torso and not the knees) (Table 4).

**Table 3.** Pain ailments of consecutive segments of spine (sight-analogue VAS pain scale) in correlation with obeying the rules of manual lifting and/or carrying acceptable load in a workplace

Do you obey the rules of manual lifting and/or carrying acceptable load in your workplace?		To what degree do you experience spine pains? – the C part of the spine (0-means no pain at all, 10-means unbearable pain)			
		Average	1.6000	1.7200	2.6400
„yes”	<b>N</b>	<b>25</b>	<b>25</b>	<b>25</b>	<b>25</b>
	Standard deviation	1.91485	2.01080	2.56385	1.66244
	Minimum	.00	.00	.00	.00
	Maximum	6.00	6.00	8.00	4.67
	Average	2.9474	2.4211	4.7368	3.3684
„sometimes”	<b>N</b>	<b>19</b>	<b>19</b>	<b>19</b>	<b>19</b>
	Standard deviation	2.46021	2.71448	2.74554	2.26594
	Minimum	.00	.00	.00	.33
	Maximum	8.00	8.00	10.00	8.67
	Average	4.0714	2.9286	3.9286	3.6429
„rarely”	<b>N</b>	<b>14</b>	<b>14</b>	<b>14</b>	<b>14</b>
	Standard deviation	3.31580	2.64471	2.73058	2.11411
	Minimum	.00	.00	.00	.67
	Maximum	8.00	7.00	8.00	7.67
	Average	4.0000	6.3333	6.6667	5.6667
„never”	<b>N</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
	Standard deviation	4.00000	1.52753	2.51661	1.45297
	Minimum	.00	5.00	4.00	4.00
	Maximum	8.00	8.00	9.00	6.67
	Average	3.0000	1.5000	2.5000	2.3333
„not because my employer does not comply with these rules”	<b>N</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>4</b>
	Standard deviation	2.16025	3.00000	3.31662	2.58199
	Minimum	.00	.00	.00	.00
	Maximum	5.00	6.00	7.00	6.00
	Average	2.7429	1.8000	3.9143	2.8190
„lifting and / or moving heavy objects does not concern of my work”	<b>N</b>	<b>35</b>	<b>35</b>	<b>35</b>	<b>35</b>
	Standard deviation	2.68266	2.13927	2.68297	2.04579
	Minimum	.00	.00	.00	.00
	Maximum	10.00	6.00	9.00	7.67
	Average	2.7300	2.1800	3.7800	2.8967
Total	<b>N</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
	Standard deviation	2.64711	2.42204	2.77645	2.10962
	Minimum	.00	.00	.00	.00
	Maximum	10.00	8.00	10.00	8.67
	ANOVA test	p=0.10	p=0.02	p=0.05	p=0.02

**Table 4.** Pain ailments of consecutive parts of the spine (sight-analogue VAS pain scale) in correlation with way of bending

In step, accompanied by bending:		To what degree do you experience spine pains? – the C part of the spine (0-means no pain at all, 10-means unbearable pain)			
		Average	2.3860	1.7719	3.2632
„I do squat”	<b>N</b>	<b>57</b>	<b>57</b>	<b>57</b>	<b>57</b>
	The standard deviation	2.39609	2.09606	2.64255	1.85907
	Minimum	.00	.00	.00	.00
	Maximum	8.00	8.00	10.00	8.67
	Average	3.1860	2.7209	4.4651	3.4574
„I do slope”	<b>N/%</b>	<b>43</b>	<b>43</b>	<b>43</b>	<b>43</b>
	The standard deviation	2.91348	2.72838	2.83136	2.30599
	Minimum	.00	.00	.00	.00
	Maximum	10.00	8.00	9.00	7.67
	Average	2.7300	2.1800	3.7800	2.8967
Total	<b>N</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
	The standard deviation	2.64711	2.42204	2.77645	2.10962
	Minimum	.00	.00	.00	.00
	Maximum	10.00	8.00	10.00	8.67
	ANOVA test	p=0.14	p=0.05	p=0.03	p=0.02

There are statistically significant relations, which were indicated by one-factor analysis of ANOVA variance. Greater pains are experienced by those who rarely or never obey the rules of lifting and carrying heavy objects (Table 5).

Table 6 presents the correlation between pains of consecutive spine parts and obeying the rules of moving large and heavy objects. The researched people who perform the activity of moving large and heavy objects incorrectly experience greater pains in their spine (mean from all parts of the spine on VAS pain scale: 3.10).

Table 7 presents correlation between pains in consecutive spine parts and obeying the rules of ergonomics during housework. One-factor analysis of ANOVA test variance showed that there are statistically significant relations. People who during housework try to bend as little as possible experience less back pains in every part of the spine. The surveyed who declare that they are not aware what is good and what is harmful for their movement organs feel the greatest pains in every part of the spine.

**Table 5.** Pain ailments of consecutive spine parts (sight-analogue VAS pain scale) in correlation with obeying rules of lifting and carrying heavy objects

		To what degree do you experience spine pains? – the C part of the spine (0-means no pain at all, 10-means unbearable pain)	To what degree do you experience spine pains? – the Th part of the spine (0-means no pain at all, 10-means unbearable pain)	To what degree do you experience spine pains? – the L-5 part of the spine (0-means no pain at all, 10-means unbearable pain)	To what degree do you experience spine pains?
„yes”	When you lifting a heavy object do you remember about flexing the knees and carrying objects close to your body?				
	Average	1.9444	1.7778	3.0278	2.2500
	N	36	36	36	36
	The standard deviation	2.42539	2.26919	2.80292	2.03521
	Minimum	.00	.00	.00	.00
„some-times”	Maximum	8.00	8.00	10.00	8.67
	Average	2.7105	1.6842	3.5000	2.6316
	N	38	38	38	38
	The standard deviation	2.28873	2.18230	2.53356	1.76007
	Minimum	.00	.00	.00	.00
„rarely”	Maximum	8.00	7.00	9.00	7.67
	Average	4.3158	3.5789	5.5263	4.4737
	N	19	19	19	19
	The standard deviation	2.42791	2.41099	2.58990	1.89644
	Minimum	.00	.00	.00	.00
„never”	Maximum	8.00	7.00	9.00	6.33
	Average	2.5714	3.1429	4.4286	3.3810
	N	7	7	7	7
	The standard deviation	4.42934	3.18479	2.76026	2.87665
	Minimum	.00	.00	.00	.00
Total	Maximum	10.00	8.00	8.00	7.67
	Average	2.7300	2.1800	3.7800	2.8967
	N	100	100	100	100
	The standard deviation	2.64711	2.42204	2.77645	2.10962
	Minimum	.00	.00	.00	.00
ANOVA test	Maximum	10.00	8.00	10.00	8.67
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	Average	2.7300	2.1800	3.7800	2.8967
	N	100	100	100	100
ANOVA test	The standard deviation	2.64711	2.42204	2.77645	2.10962
	Minimum	.00	.00	.00	.00
	Maximum	10.00	8.00	10.00	8.67
	Average	2.7300	2.1800	3.7800	2.8967
	N	100	100	100	100
ANOVA test	The standard deviation	2.64711	2.42204	2.77645	2.10962
	Minimum	.00	.00	.00	.00
	Maximum	10.00	8.00	10.00	8.67
	Average	2.7300	2.1800	3.7800	2.8967
	N	100	100	100	100
ANOVA test	The standard deviation	2.64711	2.42204	2.77645	2.10962
	Minimum	.00	.00	.00	.00
	Maximum	10.00	8.00	10.00	8.67
	Average	2.7300	2.1800	3.7800	2.8967
	N	100	100	100	100
ANOVA test	The standard deviation	2.64711	2.42204	2.77645	2.10962
	Minimum	.00	.00	.00	.00
	Maximum	10.00	8.00	10.00	8.67
	Average	2.7300	2.1800	3.7800	2.8967
	N	100	100	100	100
ANOVA test	The standard deviation	2.64711	2.42204	2.77645	2.10962
	Minimum	.00	.00	.00	.00
	Maximum				

**Table 7.** Pain ailments of consecutive spine parts (sight-analogue VAS pain scale) in correlation with obeying the rules of ergonomics during housework

During working around the house:		To what degree do you experience spine pains? – the C part of the spine (0-means no pain at all, 10-means unbearable pain)	To what degree do you experience spine pains? – the Th part of the spine (0-means no pain at all, 10-means unbearable pain)	To what degree do you experience spine pains? – the L-S part of the spine (0-means no pain at all, 10-means unbearable pain)	To what degree do you experience spine pains?
„You try as minimum bend”	Average	1.6471	1.0000	2.8824	1.8431
	<b>N</b>	<b>17</b>	<b>17</b>	<b>17</b>	<b>17</b>
	The standard deviation	2.11959	1.58114	3.21874	1.75641
	Minimum	.00	.00	.00	.00
	Maximum	6.00	5.00	9.00	4.67
„You do not pay attention to my posture”	Average	2.9423	2.5000	3.5577	3.0000
	<b>N</b>	<b>52</b>	<b>52</b>	<b>52</b>	<b>52</b>
	The standard deviation	2.56227	2.59336	2.65989	2.13284
	Minimum	.00	.00	.00	.00
	Maximum	8.00	8.00	9.00	7.67
„You are not aware / conscious of what is good and what is harmful”	Average	3.9375	2.8750	5.6875	4.1667
	<b>N</b>	<b>16</b>	<b>16</b>	<b>16</b>	<b>16</b>
	The standard deviation	2.88603	2.24722	1.74045	1.69093
	Minimum	.00	.00	2.00	1.67
	Maximum	10.00	7.00	8.00	7.67
„You always try to relieve the spine such as free hand resting on knee”	Average	1.9333	1.6667	3.5333	2.3778
	<b>N</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>15</b>
	The standard deviation	2.76371	2.41030	2.87518	2.18896
	Minimum	.00	.00	.00	.00
	Maximum	8.00	8.00	10.00	8.67
Total	Average	2.7300	2.1800	3.7800	2.8967
	<b>N</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
	The standard deviation	2.64711	2.42204	2.77645	2.10962
	Minimum	.00	.00	.00	.00
	Maximum	10.00	8.00	10.00	8.67
ANOVA test		p=0.05	p=0.07	p=0.02	p=0.01

carrying and lifting. Similarly, among white-collar workers analyzed affects of ergonomics of work and rest on the incidence of pain.

Etiology of spine pain is not entirely clear yet. However, one of the significant causes has been assumed to be incorrect movement habits being closely related to the work we do and the environment in which we live [15]. Norwegian scientists Sterud T, Johannessen HA, Tynes T. made an effort to define factors influencing the occurrence of back pains in connection with the work environment. Conducting three-year-long observation of professionally active people they

confirmed that this problem more often concerns people performing the same multiple movements connected with, among others, constant sitting position or hard physical work or being highly exposed to vibrations [16].

In recent years a significant increase in, among others, the number of patients with dysfunction in the cervical part of the spine has been observed [17]. The so-called pain disorder of cervical spine rarely occurs as a single symptom. Accompanying symptoms are often back pain and muscle pains in the interscapular and cervical–occipital area, in the shoulder joint, head, mandible or ears, which additionally emphasizes the gravity of the problem. Yearly in Spain pain ailments of this area are experienced by 16.7% – 75.1% of population and in the lumbar area of the spine – by 22% – 65% [18]. In comparison in the Scandinavian countries this problem applies to approximately 14% of the surveyed and in Canada – 10% [19]. From the authors’ own research it may be concluded that pains in the cervical spine have been noted in 50% of the surveyed. It has been the most frequently reported by white collar employees working mainly in a sedentary position in front of a computer. The pain average in the VAS scale indicated by patients was 3.10 and in case of physical workers it was 2.68.

Similar conclusions were drawn by Lisiński P., Sklepowicz K. and Stryła W. who confirmed a high impact of sedentary work in front of the computer on pains mainly in the cervical spine [20]. Moreover, Kyusik Choi, Jae-Hyun Park, Hae-Kwan Cheng describe that pains in the muscular-skeletal system including the cervical spine more often occurred in people who used computer keyboards and mice during their work for minimum four hours a day [21].

Working at a computer requires concentration and precision which is connected with the necessity to immobilize the body and to maintain high static muscle tension. Assuming constant sedentary position for longer than 3 hours during work has been recognized as a risk factor of pains in muscular-skeletal system [22, 23].

Next disturbing data indicate the occurrence of lumbar-sacral spine pain in 49% up to even 70% of European and American population [24, 25]. The cause for sacral pains are postural loads resulting from assuming incorrect body posture i.e., remaining in long lasting sitting, standing or bending forward position or the incorrect way of lifting heavy objects. To a high degree this problem is connected with constant incorrect movement habits during work. The Report of the European Agency for Safety and Health at Work in Bilbao estimated that in the working population of the European Union 57% of workers are at risk of too high intensity of repeatable activities, 45% – loads resulting from lifting heavy objects, 34% – unfavorable psychosocial conditions of work environment (too high pace of work, wrong organization of the workplace) and approximately 67% – monotony [26].

D. Durmus and I. Ilhanli’s observations indicated that as a result of long lasting standing position 74.9% of 605 teachers state that they have pains in lower back and 47.9% in cervical spine [27]. Similar research on teachers in Hong Kong showed the most frequent ailments in lumbar-sacral spine in 59.3% of cases and in Brasil and Malesia in 41.1% and 40.4% respectively [28, 29, 30].

More frequent occurrence of sacral pains were also observed among people connected with doing jobs requiring hard physical work. The authors J. Zyznawska, B. Ćwiertnia

and R. Madetko revealed that in a group of 200 nurses and midwives back pains were reported by 92.9% and the first symptoms appeared on average before the age of 26 as a result of overload of the movement system [31]. Also Biggs et al. indicate more frequent sacral pains among young workers below 25 years of age. Newly employed workers are at the highest risk of this ailment because they lack sufficient knowledge on the rules of work ergonomics [2]. This assumption was confirmed by, among others, the observation of spine pains in 528 students of dentistry conducted by SA. Khan and KY Chew [32]. The research conducted in Iran in 2013 also shows that pains in the cervical spine in 69.2% of new office workers are mainly connected with the fact that these people worked less than one year [33].

Prevention of spine pains should include systematic exercises, free time spent in an active way and most importantly obeying the rules of ergonomics both in the workplace and outside.

## CONCLUSIONS

1. People who do not respect the basic principles of ergonomics more likely to experience back pain. The test group is also characterized by a higher degree of incidence of back pain.
2. Physical and white-collar workers who perform work in a sitting position, often do not follow the basic principles of ergonomics of work and rest compared to white collar workers who do not staying permanently in a sitting position.
3. In the Podkarpacie Province employers care of workplace ergonomics in a higher degree.
4. Not following by the generally accepted principles of occupational health and leisure in activities of daily living, as well as during time of work is an important factor predisposing to back pain.

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