

## REVIEW PAPER

# ASSESSMENT OF IMPACT OF THE COMPUTER WORK STATION ON THE RISK OF MUSCULOSKELETAL SYSTEM DISEASES IN BANKING SECTOR EMPLOYEES

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## Abstract

*Diseases of the musculoskeletal system have a significant impact on the presence of an increasingly large group of employees on the labor market, on their mobility and efficiency. This study was aimed at assessing the impact of computer work stations on the risk of musculoskeletal system diseases (MSDs) in banking sector employees. Material and methods: Subject group consisted of 71 banking sector employees who worked in front of the computer for more than 7 hours per day. Purposive sampling was used, in accordance with the non-probability sampling technique. Author's own survey was used. Results: Pain in the lumbar spine (90.63%;  $\chi^2=3.94$ ;  $df=1$ ;  $p=0.047$ ) and discomfort in the hand area (10.2%;  $\chi^2=4.89$ ;  $df=1$ ;  $p=0.02$ ) were statistically more common in banking sector employees in small towns. In those locations, computer work stations were less frequently equipped with a footstool and wrist pads (25.0%;  $\chi^2=30.84$ ;  $df=1$ ;  $p=0.0001$ ), office equipment was more commonly situated in a way which did not require change of body position (78.13%;  $\chi^2=5.89$ ;  $df=1$ ;  $p=0.02$ ), and employees worked with a twisted torso*

(59.38%;  $\text{Chi}^2=8.28$ ;  $\text{df}=1$ ;  $p=0.004$ ). Banking sector employees in larger cities participated in ergonomics trainings more often (89.74%;  $\text{Chi}^2=33.51$ ;  $\text{df}=1$ ;  $p=0.0001$ ); they also displayed deeper knowledge of ergonomics (87.18%;  $\text{Chi}^2=4.68$ ;  $\text{df}=1$ ;  $p=0.03$ ). Lack of desk with adjustable height was accompanied significantly more often (24.14%) by wrist pain ( $\text{Chi}^2=3.9086$ ;  $\text{df}=1$ ;  $p=0.04$ ). Similarly, twisted position of the torso while sitting down was related to frequent incidence of numb legs (37.93%), compared to proportion of those sitting down in a non-forced position (9.52%;  $\text{Chi}^2=8.04$ ;  $\text{df}=1$ ;  $p=0.004$ ). Conclusions: Correct ergonomics of the computer work station help prevent diseases of the musculoskeletal system. Trainings for employees, prevention programs and promoting healthy work habits are key factors in reducing the incidence of musculoskeletal symptoms.

**Key words:** *musculoskeletal system, work station, computer, banking, ergonomics, health risk*

## **Introduction**

In recent years the computer has become a wide-spread work tool. Technological advances and software development resulted in introducing computers in new fields which so far had been computer-free. There has been an increase of computer work stations not only in offices, but also in corporate finance departments, as well as in the banking, insurance, IT, accounting, commerce, and science sectors. More and more people from various market sectors spend long work hours in front of computers. Meanwhile, the Polish Labor Code states that working for more than 4 hours per day in front of a computer constitutes ‘particularly arduous working conditions’ (Minister of Labor and Social Policy, 1998). This classification is well-grounded: ignoring negative aspects of working with a computer leads to significant health consequences for the workers.

Kowalska and Bugajska (2009) carried out an analysis of office work and identified negative health consequences in persons working in front of computers. Among the most commonly reported problems were: musculoskeletal system disorders (MSDs), peripheral nervous system diseases, as well as eye diseases and psychosocial stress.

Bendíková (2014) proved that sedentary position translates into long-term immobilized spine, which results in a spinal overload, causing increased pressure of vertebrae, as well as static load on torso and back muscles. This leads to incorrect spine curvature, which in turn results in pain and degenerative changes. According to research conducted in 27 EU member states, as many as 22% of employees face musculoskeletal system disorders.

MSDs significantly impact mobility and efficiency of employees in many various sectors. It affects both individuals and teams, lowering productivity and quality of work, and – consequently – financial results and competitiveness advantage of enterprises. Results show that in 2010 MSDs and carpal tunnel syndrome caused 26 million days of absence from work (Zheltoukhova, Bevan & Reich, 2011). These numbers justify an urgent need to treat MSDs as one of top priorities of national health care in the coming years (Raciborski, Władysiuk, Bebrysz, & Samoliński, 2013; Malińska, 2013). This problem will increase not only due to lack of healthy practices and low health awareness of employees, but also due to aging of Polish employees, who – with time – will experience natural morphological, metabolic and operational changes in their skeletal muscles (with various intensity in men and women) (Bartuzi, 2012). To complete this worrying panorama, one should also add high BMI (Bugajska, Jędryka-Góral, Gasik, & Żołnierczyk-Zreda, 2011), life style deprived of physical activity (Bendíková, Šmída, & Rozim, 2014; Nowak, 2011), smoking, alcohol and diseases such as diabetes, hypothyroidism and rheumatoid arthritis (Bugajska, Jędryka-Góral, Gasik R, & Żołnierczyk-Zreda, 2011).

For sedentary work, it is absolutely vital to provide an ergonomic work station, proper organization of work and to familiarize employees with arduous conditions of work, their consequences and methods of preventing them. Proper attention must be paid to providing adequately equipped work stations: tables or desks with appropriate measurements, chairs, footstools, wrist rests or document holders. Elements of the computer work station must be also ergonomically placed, while employee should take breaks to reduce the static load (Mieszkowska, Bugajska, & Wolska, 2008; Tokarski, 2011). Among other factors that trigger disorders of the musculoskeletal system, categorized as psychosocial factors, are: working under pressure, low satisfaction from work and insufficient social support. Stańczak et al. (2014) stated that working at computer stations in the banking sector is particularly stressful compared to other sectors, and requires further research into related health problems (Stańczak, Mościcka-Teske, & Merez-Kot, 2014).

*Research objectives and questions.* The aim of the study was to assess the impact of computer work station ergonomics on the incidence of musculoskeletal system pain among banking sector employees.

The study aimed to answer the following question:

1. How often do MSDs affect banking sector employees working in front of computers in various-sized cities and towns?
2. Do ergonomic work stations and trainings result in reduced MSDs?

3. Which socio-demographic, health and ergonomic factors in this study are related to the incidence of musculoskeletal system pain?

### Material and methods

The study was conducted in various branches of the same bank in the “Zachodniopomorskie” and “Mazowieckie” Voivodships in large cities and small towns. The study encompassed 71 employees working in front of computers. Subjects were selected by non-probability sampling. There were 71 employees in the subject group; 83.1% of them were women and 16.9% were men. Number of working hours in front of the computer exceeded 7 hours daily. Participation in the study was voluntary. Subjects were aged 25 – 60. Average age was 39 years (SD±6.42). Majority of subjects (64.79%) were university-educated. None of subjects had vocational education. Subjects worked in their roles from 1 to 30+ years. Subjects were divided into 5 groups, based on years of work in their current role and years of work in the bank. The largest groups were computer operators working in their role up to 4 years. Characteristics of the subjects are presented in Tab.1.

**Table 1**

Sociodemographic characteristics of the respondents

Demographic variable	Respondents (N=71)	
	n	%
Sex		
women	59	83.10
men	12	16.90
Education		
secondary	13	18.31
bachelor's degree	12	16.90
master's degree	46	64.79
Work experience in the position [years]		
≤ 4	47	66.20
> 4 ≤ 10	8	11.27
> 10 ≤ 20	7	9.86
> 20 ≤ 30	5	7.04
> 30	4	5.63
Work experience in the bank [years]		
≤ 4	43	60.56
> 4 ≤ 10	6	8.45
> 10 ≤ 20	9	12.68
> 20 ≤ 30	6	8.45
> 30	7	9.86

The study was conducted in two stages. In stage I, interviews with bank directors were conducted. Stage II included a printed 2-part survey

based on author's questionnaire. Part I included questions related to descriptive data, such as socioeconomic and demographic aspects, as well as role and work experience. Part II included questions related to MSDs, self-assessment of one's health and computer work station ergonomics. Bank employees completed anonymous surveys. These were placed in individual envelopes, which were then put into collective envelopes.

Surveys were analyzed statistically with Statistica 10.0. Distribution of responses and significance of differences was identified with Chi-squared test. Statistically significant result were those with  $p < 0.05$ . Relations between pain and risk factor incidence were described with agglomerative analysis, using non-standard Euclidean distance.

## Results

Subjects were divided into two groups based on their work location. Group A included computer operators working in bank branches in a large city, while group B – in town branches.

Subjects most commonly reported lumbar spine pain – 80.28%. Other common issues were cervical spine pain (77.46%) and back pain (30.99%). Leg numbness was identified in 21.00% of subjects, while every fifth employee reported hand or wrist pain (Tab. 2).

**Table 2**

Diseases of the musculoskeletal system in computer users in the banking sector

Incidence of musculoskeletal system symptoms	Group A (N=39)		Group B (N=32)		Total (N=71)		Chi <sup>2</sup> Pearson	p
	n	%	n	%	n	%		
back pain	11	28.21	11	34.38	22	30.99	0.313	0.58
cervical spine pain/ neck stiffness	29	74.36	26	81.25	55	77.46	0.479	0.49
lumbar spine pain	28	71.79	29	90.63	57	80.28	3.937	0.04*
pain/stiffness in the hand or wrist area	4	10.25	10	3.12	14	19.72	4.894	0.02*
leg numbness	6	15.38	9	28.12	15	21.12	1.712	0.19

\*  $p < 0.05$

SMDs had greater incidence among computer operators working in the bank office in a small town than those working in a large city. Statistical significance was observed in terms of MSDs related to lumbar spine pain and hand pain. Other differences were not statistically significant. When asked about dangerous physical factors that influence their MSDs, every 1 in 4 subject confirmed their existence. Proportion of confirmations was

higher among small town branches (31.25%), as compared to 20.51% in large city branches (Tab. 3).

**Table 3**

Assessment of work conditions and basic requirements in terms of equipment of the computer work station

Question	Group A (N=39)		Group B (N=32)		Total (N=71)		Chi <sup>2</sup> Pearson	p
	n	%	n	%	n	%		
Incidence of risky physical factors leading to musculoskeletal symptoms	8	20.51	10	31.25	18	25.35	1.07	0.301
Assessment of one's workstation in terms of ergonomics	31	79.49	18	56.25	49	69.01	2.531	0.111
Presence of footstool and wrist pads	35	89.74	8	25.00	43	60.56	30.848	0.0001**
Adjustable desk height	7	17.95	6	18.75	13	18.30	0.007	0.931
Screen position of the desk leading to glare effect	7	17.95	6	18.75	13	18.30	0.007	0.931
Twisted torso while sitting down	10	25.64	19	59.38	29	40.84	8.278	0.004**
Presence of chair/armchair with regulated height, depth and armrests	39	100.00	30	93.75	69	97.18	2.508	0.115
Location/distance from the office equipment without change in body position	22	56.41	25	78.13	47	66.27	5.8991	0.0151*

\* p<0.05; \*\* p<0.01

The observed differences were not statistically significant. Large city branch employees were more positive about ergonomics of their work stations (79.49%), whereas 56.25% of small town employees believed their work place was ergonomic. There were statistically significant differences in terms of work station equipment in footstools and wrist rests (p=0.0001), position of office equipment which does not require change of body position (p=0.015) and working while sitting with twisted torso (p=0.004).

One of the elements that shape awareness of impact of the work conditions on health is employees' knowledge about ergonomics of computer work stations. Ergonomics encompasses requirements for computer chairs, tables, computer screen and keyboard placements, as well as additional equipment, such as document holders, foot stools and wrist rests. Such knowledge is gained by employees during 'ergonomics at work'

trainings and potentially they can use it in practice to modify their work conditions, which was analyzed herein (Tab. 4).

**Table 4**

Preventive activities aimed at work-related musculoskeletal symptoms

Question	Group A (N=39)		Group B (N=32)		Total (N=71)		chi2	p
	n	%	n	%	n	%		
A meeting about work ergonomics at computer work stations	35	89.74	7	21.87	42	59.15	33.509	0.0001**
Knowledge about ergonomics at computer work stations	34	87.18	21	65.63	55	77.41	4.678	0.031*
Effective and comfortable rest during break at work	16	41.03	9	28.13	25	35.21	1.282	0.257

\* p<0.05; \*\* p<0.01

Questions answered by the subjects were related to participation in trainings and assessment of their knowledge on ergonomics and active breaks at work. Over half of subjects (59.15%) participated in ergonomics trainings. There were statistically significant differences between large cities and small towns (89.74% vs 21.87%). Banking sector employees in larger cities displayed deeper knowledge of ergonomics. These differences were statistically significant, similarly to participation in ergonomics trainings. Although over 40% of employees from Group A engaged in effective rest during breaks at work, in Group B the proportion was only slightly lower – 28.13% (Tab. 5).

**Table 5**

Participation in physical activity and BMI of respondents

Question	Group A (N=39)		Group B (N=32)		Total (N=71)		chi <sup>2</sup>	p
	n	%	n	%	n	%		
Physical activity in respondents' free time	32	82.05	16	50.00	48	67.60	8.2451	0.004**
BMI [body mass in kg/(height in m) <sup>2</sup> ]								
underweight	1	2.56	0	0.00	1	1.41	4.9887	0.172
normal body weight	29	74.36	17	53.13	46	64.79		
overweight	6	15.38	10	31.25	16	22.54		
obesity	3	7.69	5	15.62	8	11.26		

\* p<0.05; \*\* p<0.01

One of conditions of good state of the musculoskeletal system is maintaining correct body posture and physical activity. The obtained results were analyzed in terms of physical activity and BMI. It was found that

82.05% of computer operators from Group A reported physical activity in their free time, while in Group B it was 50.00% of subjects. The difference between groups was statistically significant. Group A had better BMI than Group B. More computer operators from large cities had corrected BMI and there were fewer overweight and obese subjects in that group.

The study was aimed at answering the following questions: Do ergonomic work stations and trainings result in reduced MSDs? Based on work station ergonomics assessment (ergonomic vs non-ergonomic), an analysis of incidence of diseases among bank employees was conducted (Tab. 6).

**Table 6**

Diseases of the musculoskeletal system in computer users in the banking sector versus work station ergonomics

Type of musculoskeletal system symptoms	Work station ergonomics						Chi <sup>2</sup> Pearson	p
	Ergonomic (N=22)		Non-ergonomic (N=49)		Total (N=71)			
	n	%	n	%	n	%		
back pain	7	31.82	15	30.61	22	30.99	0.0103	0.919
cervical spine pain/ neck stiffness	16	72.73	39	79.59	55	77.46	0.4098	0.522
lumbar spine pain	18	81.82	39	79.59	57	80.28	0.0475	0.827
pain/stiffness in the hand or wrist area	5	22.73	9	18.37	14	19.72	0.1823	0.669
leg numbness	2	9.09	13	26.53	15	21.13	2.7712	0.096+

+ statistical significance at the level of  $p < 0.1$

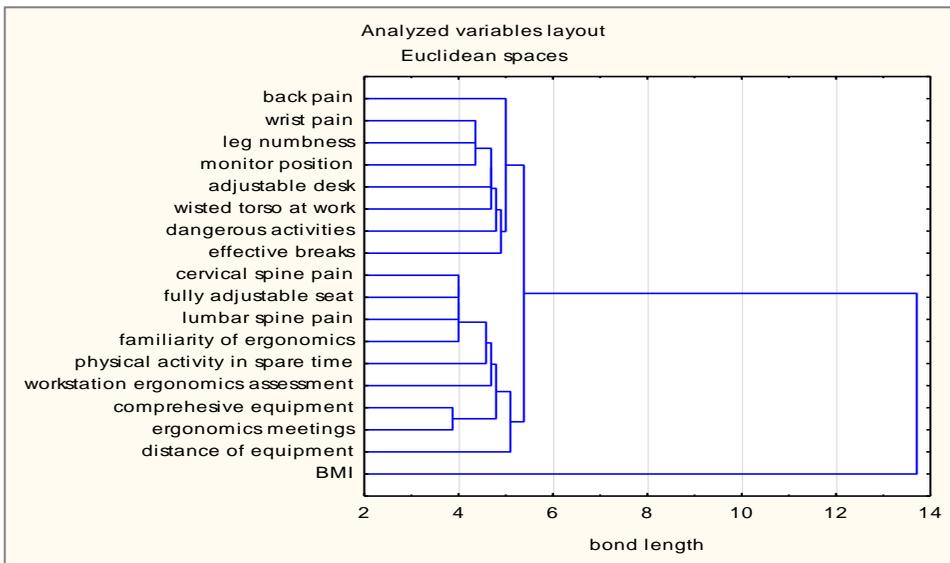
The presented data did not give grounds to believe that workplace ergonomics assessment made by employees correlated with incidence of pain disorders of the motor system. It was also determined that there were no statistically significant differences in declarations of pain incidence made by subjects – only leg numbness was significant in terms of statistical trend. Paradoxically, this problem was faced more often by employees who assessed their work station ergonomics positively.

Due to the subjectivity of employees' assessments, the researcher also checked whether an objective factor – work station equipment – was related to pain incidence. It was found that lack of desk with adjustable height correlated with significantly more frequent wrist problems (24.14%). Employees with adjustable desks did not suffer from this problem; statistically significant difference ( $\text{Chi}^2=3.908$ ;  $\text{df}=1$ ;  $p=0.048$ ). Similarly, twisted torso while sitting correlated with leg numbness (37.93%), compared to 9.52% among those working in natural positions. Difference in

response distribution was statistically significant ( $\text{Chi}^2=8.038$ ;  $\text{df}=1$ ;  $p=0.004$ ).

The study was aimed at determining which of the analyzed factors were related to pain problems. To illustrate it, a description with Euclidean distances was conducted, as presented in Figure 1.

Preliminary analysis excluded the size of the city – distance of this variable from pain problems was the greatest and prevented clear presentation of the data. Based on the Euclidean distances of physical distances between variables placed in a multidimensional space, it may be stated that back, wrist and leg pain were mostly related to body position at work and access to individually adjustable desk; less significance was observed in terms of dangerous factors at work and preventive function of effective breaks at work. Cervical and lumbar spine pain, being a separate group of problems, correlated with full adjustment of chair at work and knowledge on ergonomics. Such elements as comprehensive and ergonomic equipment were closely related to ergonomics trainings. However, their correlation with pain problems was weak (Fig. 1).



**Figure 1.** Relations between pain incidence and risk factors

## Discussion

Research results presented in this paper indicate that over 80% of subjects faced lumbar spine pain. Cervical spine pain was experienced by 77% of subjects, back pain was reported by 31%, leg numbness – by 21%, while hand and wrist pain – by less than 20%. Reporting rate of

musculoskeletal system pain by the employees is relatively high, although computer operators still don't report their problems to a satisfactory extent. Preventive exam results of computer operators from Poznań, Poland (n=198) in the last 20 years showed a minimal reporting rate of motor system pain related to working in front of LCD monitors. In 1992 – 1996 it amounted to 60%, in 2010 – 2011 only 5%, while in 2012-2014 – 7.7% (Romankow, 2015).

Such low numbers contradict global research results, which suggest that pain among computer operators is common. Sillanpaa et al. showed that 63% of the analyzed computer operators reported neck pain, while 16% suffered from hand pain (Sillanpaa, Huikko, Nyberg, Kivi, Laippala, & Uitti, 2003). German employees (n=1065) suffered from neck pain (55% of subjects), hand and wrist pain (21%) (Klussmann, Gebhardt, Liebers, & Rieger, 2008). Study on Swedish call center operators who worked in front of computers (n=1183) showed that 75% of subjects reported musculoskeletal system pain (Norman, Floderus, Hagman, Toomingas, & Tornqvist, 2008). Research conducted in the UK (n=869) proved that 34% of subjects reported neck pain, while 35% – wrist joint pain (Devereux, Vlachonikolis & Buckle, 2002). Cross-sectional study of high- and low-level knowledge workers who worked in front of computers (n=6191) showed that 45.7% and 56% (respectively) experienced pain and numbness of neck (Korpinen, Pääkkönen & Gobba, 2012).

Results obtained in author's own study suggested that proper work conditions as well as correct position of computer work station elements are available to employees in large city branches, rather than in small towns. Worryingly, only 25% of computer work stations in the small town branch met the requirements for ergonomic work station, i.e. footstools and wrist rests. Placement of work station elements and employee's adjusting themselves to the station by working in twisted position was also very troubling. Incidence of MSDs was significantly higher among small town employees than those from large cities. The study revealed significant differences in terms of computer work station equipment between city/town branches. In small towns, bank offices occupied old buildings which were adapted to suit bank's needs many years before. Meanwhile, in the large city branches, the employees had much greater comfort of work. They had better opportunities to equip their work stations, the rooms tended to be newer and in many cases buildings had been adapted from scratch. It was confirmed by study results, which showed statistically significant differences in existence of dangerous physical factors that influence bank employees' MSDs. Most common mistakes in small town branches were: lack of footstools and wrist

rests, and the most common complaints were related to twisted torso position.

The study clearly indicates that uncomfortable conditions may be reduced and even eliminated by providing ergonomic work stations and proper work environment (Tint, Traumann, Pille, Tuulik-Leisi, & Tuulik, 2012). Bugajska et al. (2011), basing on Washington State Department of Labour & Industries materials, presented periods of various activities in unnatural body positions; by exceeding these times, employees expose themselves to moderate or high risk of overload disorders. Among physical risk factors was keyboard usage: used for 4 hours daily, it constitutes a moderate risk, while used for more than 7 hours per day – a high risk.

Bartuzi et al.'s study results were also interesting. They analyzed computer operators (n=53) and found that MSDs stem inter alia from insufficient awareness of computer ergonomics among employees (Bartuzi & Kamińska, 2010). It was further confirmed by results of study reported in this paper, which indicated that employees with lower awareness of ergonomics and sources of pain experienced pain statistically more often. On the other hand, employees who rested effectively during breaks at work declared statistically lower incidence of leg numbness. It was also related to distance between office equipment without the need to change body position. These observations were confirmed by many papers on importance of breaks at work (Mahmud, Kenny, & Heard, 2011; Rehman, Khan, Khan, & Surti, 2014) and stretching exercises (Mahmud, Fatimah-Bahari, & Zainudin, 2014).

Study results also confirmed beneficial effect of physical activity on reducing musculoskeletal pain incidence. Individuals taking physical exercise in their free time tended to have corrected BMI – these were mostly large city employees. Employers in large cities have opportunity to use appropriate infrastructure, hire gyms or provide fitness / swimming passes.

## **Conclusions**

The presented results give grounds to the following conclusions:

Proper ergonomics of computer work stations helps prevent musculoskeletal pain.

In terms of musculoskeletal pain prevention at work, healthy life style, physical activity in free time and correct BMI play a significant role.

Trainings and prevention programs to raise awareness of employees and promote health work habits play a crucial role in reducing incidence of MSDs.

Education activities should be supported and an appropriate incentive (procedure) system needs to be implemented in order to develop

more effective methods of reducing the risk of chronic musculoskeletal pain among computer operators in the banking sector.

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