

INFLUENCE OF PROFESSIONAL STRESS ON TEMPORARY AND PERMANENT WORKING ABILITY OF EXPOSED WORKERS

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Occupational stress presents a health risk and affects working ability, leaving also a significant economic impact. Our aim was to examine the effect of the level of professional stress on temporary and permanent working disability in exposed workers. The study included 3527 workers of various professions, who in the period 2011 -2016 on the territory of South East Serbia did the same job for at least last five years, and who were referred by their chosen doctor to the Disability Commission for the assessment of their permanent making disability due to a work injury or illness. The number of lost working days in relation to the level of occupational stress at their workplaces (the Occupational Stress Index- score) was analyzed. There was an increase in the average number of lost working days in the subgroups of workers with higher levels of occupational stress. Additionally, the number of workers who were entitled to a disability pension increased in the subgroups of workers with a higher level of stress at work. The research implies that stress at the workplace significantly affects the temporary and permanent working ability of the exposed workers. *Acta Medica Medianae 2017;56(3):129-136.*

Key words: professional stress, occupational stress index, temporary working disability, permanent working disability, injury at work, workers' health

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Introduction

Stress at the workplace (1) presents a significant health risk (2-6) and affects the working ability of the exposed workers, which has also a significant economic impact, targeting not only the worker and his employer, but also the national economy (7-11). According to the literature data which examined the most frequently reported work-related health problems in Europe, stress was in the second place, and about half of European workers claimed that stress was common at their workplaces contributed almost to a half of all lost working days. The duration of work absenteeism related to professional stress tended to be longer compared with absenteeism resulting from

other causes (10). Additionally, stress at work can increase the rates of early retirement (10-12). The estimated enterprise and society costs due to work absenteeism and premature retirement because of complete and permanent loss of work ability are significant, and are estimated to be billions of dollars annually on a national level. For example, in the United States, they are estimated to be over 300 billion dollars annually (11).

Objective

This study aims to examine the effect of the level of professional stress on temporary and permanent working inability of the exposed workers.

Methodology

The study included workers engaged in various professions in the territory of South East Serbia, who in the period 2011-2016 did the same job for at least five preceding years, and who were prepared with their chosen medical doctors to go to the commission for premature retirement related to work disability ("Disability Commission") for South East Serbia, to assess their permanent working inability due to a work injury or illness. Data on the leading diagnoses for which they were

assessed by the Commission, and data on their eligibility to the right to a disability pension (i.e. the Commission confirmed the existence of permanent and total loss of working ability) were obtained from the Disability Commission registry. Data on the number of lost working days due to those diagnoses were collected from the workers' personal medical records and the average number of lost working days per worker during one year was calculated (the average of the last 5 years preceding the Disability Commission evaluation).

Only the workers who had the most frequent 11 diagnoses that could be related to professional stress were chosen for the study. Those leading diagnoses for the Disability Commission evaluation included: arterial hypertension, anxiety and depressive syndrome, insulin independent diabetes mellitus, cardiac arrhythmias, peptic ulcer gastrointestinal disease, cerebrovascular diseases, coronary heart disease, hyperthyroidism, injuries at work, insulin-dependent diabetes mellitus and skin diseases. In total, 3527 workers were included. In the course of the Disability Commission evaluation, they all filled a standardized questionnaire created by Belkić (2003) (13) for their subjective assessment of professional stress at their workplace, from which the total Occupational Stress Index (OSI) score at the workplace was calculated. Based on the level of stress at the workplace, all the workers were divided into seven subgroups: the total OSI score- 60 and below, 61-70, 71-80, 81-90, 91-100, 101-110, 111 and over. This paper analyzed the statistical significance of differences between the all 7 OSI-score subgroups in the number of lost working days and in the number of workers who were allowed to go to a disability pension. The examination also included the correlation between the total OSI score and the average number of lost working days per worker during one year, as well as the correlation between the total OSI score and the number of workers who earned the right to go to a disability pension. Survey results were analyzed by T test and correlation analysis was performed by calculating the Pearson correlation coefficient. Values of $p < 0.05$ were considered statistically significant.

Results

Out of the total number of workers included in this study, the largest proportion had hypertension (34.8%) and anxious-depressive syndrome (10.8%) as the leading diagnosis (Table 1).

When the whole group of subjects was divided into 7 subgroups according to the OSI score, it could be seen that each subgroup was represented by approximately the same number of subjects (Table 2).

The average number of lost working days for all workers in this study was 29.9 ± 6.9 days during one year. By analyzing the number of lost working days in relation to the level of stress at workplace

Table 1.: Sample structure

| Leading diagnosis for the Disability Commission processing | Number | % |
|--|--------|------|
| Arterial hypertension | 1226 | 34.8 |
| Anxiety and depressive syndrome | 380 | 10.7 |
| Insulin-dependent diabetes mellitus | 306 | 8.7 |
| Cardiac arrhythmias | 298 | 8.4 |
| Gastrointestinal peptic ulcer disease | 270 | 7.6 |
| Cerebrovascular disorders | 257 | 7.3 |
| Coronary heart disease | 223 | 6.3 |
| Hyperthyroidism | 162 | 4.6 |
| Injuries at work | 162 | 4.6 |
| Insulin-dependent diabetes mellitus | 139 | 3.9 |
| Skin diseases | 104 | 2.9 |
| Total | 3527 | 100 |

Table 2.: Distribution of study participants in relation to the overall level of the occupational stress (the OSI score)

| Subgroups in relation to the total OSI score | Study participants | |
|--|--------------------|------|
| | Number | % |
| 60 and bellow | 492 | 13.9 |
| 61 to 70 | 508 | 14.4 |
| 71 to 80 | 515 | 14.6 |
| 81 to 90 | 511 | 14.5 |
| 91 to 100 | 493 | 13.9 |
| 101 to 110 | 501 | 14.2 |
| 111 and over | 507 | 14.4 |
| Total | 3527 | 100 |

Table 3.: Number of lost working days per year in relation to the overall level of the occupational stress (the OSI score)

| Subgroups in relation to the total OSI score | Number of workers | Number of lost working days per year | |
|--|-------------------|--------------------------------------|-----|
| | | Mean | SD |
| 60 and bellow | 492 | 26.1 | 5.9 |
| 61 to 70 | 508 | 27.8 | 5.7 |
| 71 to 80 | 515 | 28.2 | 6.1 |
| 81 to 90 | 511 | 29.9 | 6.3 |
| 91 to 100 | 493 | 30.3 | 5.9 |
| 101 to 110 | 501 | 32.9 | 7.1 |
| 111 and over | 507 | 34.5 | 7.5 |
| Total | 3527 | 29.9 | 6.9 |

(the OSI score), it can be seen that there was an increase in the average number of lost working days in the subgroups with a higher level of stress at work (Table 3), and the differences between the

subgroups were statistically significant (Table 4).

The number of workers who were entitled to disability pension due to permanent and total loss of working ability increased in the subgroups with a higher level of stress at work (Table 5), and the

differences between the subgroups were statistically significant (Table 6).

The greatest number of lost working days was due to work injuries (98.8 ± 21.8 days per year), coronary heart disease (71.8 ± 17.2 days per

Table 4. :Statistical significance of differences in the number of lost working days per year among the subgroups (t- test)

| Subgroups in relation to total OSI score | Subgroups in relation to total OSI score | | | | | |
|--|--|-----------------------|------------------|-----------------------|-----------------|------------------|
| | 60 and bellow | 61 to 70 | 71 to 80 | 81 to 90 | 91 to 100 | 101 to 110 |
| 60 and bellow | | | | | | |
| 61 to 70 | t =4.74 p<0.01 | | | | | |
| 71 to 80 | t=6.65 p<0.01 | t=1.08 p>0.05(n.s) | | | | |
| 81 to 90 | t=9.95 p<0.01 | t=5.57 p<0.01 | t=4.39 p<0.01 | | | |
| 91 to 100 | t=11.27 p<0.01 | t=6.8 p<0.01 | t=5.55 p<0.01 | t=1.03 p>0.05(n.s) | | |
| 101 to 110 | t=16.42 p<0.01 | t=12.59 p<0.01 | t=11.3 p<0.01 | t=7.1 p<0.01 | t=6.2 p<0.01 | |
| 111 and over | t=19.68 p<0.01 | t=16.52 p<0.01 | t=14.6 p<0.01 | t=10.5 p<0.01 | t=9.7 p<0.01 | t=3.43 p<0.05 |

n.s – non-significant

Table 5.: Complete and permanent loss of working capacity in relation to the overall level of the occupational stress (the OSI score)

| Subgroups in relation to total OSI score | Number of workers | Number of workers with complete and permanent loss of working capacity | |
|--|-------------------|--|-----|
| | | Number | % |
| 60 and bellow | 492 | 5 | 1 |
| 61 to 70 | 508 | 10 | 1.9 |
| 71 to 80 | 515 | 15 | 2.9 |
| 81 to 90 | 511 | 20 | 3.9 |
| 91 to 100 | 493 | 21 | 4.3 |
| 101 to 110 | 501 | 30 | 5.9 |
| 111 and over | 507 | 35 | 6.9 |
| Total | 3527 | 136 | 3.9 |

Table 6. Statistical significance of differences among the subgroups in the number of workers with a complete and permanent loss of working capacity (t- test)

| Subgroups in relation to total OSI score | Subgroups in relation to total OSI score | | | | | |
|--|--|----------------------|----------------------|-----------------------|----------------------|----------------------|
| | 60 and bellow | 61 to 70 | 71 to 80 | 81 to 90 | 91 to 100 | 101 to 110 |
| 60 and bellow | | | | | | |
| 61 to 70 | t =1.2 p>0.05 (n.s) | | | | | |
| 71 to 80 | t=2.2 p<0.05 | t=1.0 p>0.05(n.s) | | | | |
| 81 to 90 | t=2.9 p<0.01 | t=1.8 p>0.05(n.s) | t=0.9 p>0.05(n.s) | | | |
| 91 to 100 | t=3.2 p<0.01 | t=2.1 p<0.05 | t=1.1 p>0.05(n.s) | t=0.3 p>0.05(n.s) | | |
| 101 to 110 | t=4.3 p<0.0001 | t=3.3 p<0.001 | t=2.4 p<0.05 | t=1.5 p>0.05 (n.s) | t=1.2 p>0.05(n.s) | |
| 111 and over | t=4.8 p<0.0001 | t=3.8 p<0.0001 | t=3.0 p<0.01 | t=2.1 p<0.05 | t=1.8 p>0.05(n.s) | t=0.6 p>0.05(n.s) |

n.s – non-significant

year) and cerebrovascular diseases (53.3 ± 7 , 8 days per year). The largest number of workers earned disability pension due to work injuries (61.8%) and cerebrovascular diseases (16.2%) (Table 7).

There was a statistically significant correlation between the number of lost working days per year and the level of professional stress in all examined diseases (Table 8).

Table 8. Correlation of the number of lost working days per year by type of disease and the overall level of the occupational stress (the OSI score)

| The leading diagnosis for the Disability Commission processing | Correlation coefficient | |
|--|-------------------------|-------------|
| | <i>r</i> | <i>p</i> |
| Arterial hypertension | 0.99 | $p < 0.001$ |
| Anxiety and depressive syndrome | 0.97 | $p < 0.001$ |
| Insulin-dependent diabetes mellitus | 0.93 | $p < 0.001$ |
| Cardiac arrhythmias | 0.97 | $p < 0.001$ |
| Gastrointestinal peptic ulcer disease | 0.95 | $p < 0.001$ |
| Cerebrovascular disorders | 0.98 | $p < 0.001$ |
| Coronary heart disease | 0.95 | $p < 0.001$ |
| Hyperthyroidism | 0.94 | $p < 0.001$ |
| Injuries at work | 0.99 | $p < 0.001$ |
| Insulin-dependent diabetes mellitus | 0.96 | $p < 0.001$ |
| Skin diseases | 0.94 | $p < 0.001$ |

r - Pearson's coefficient of the correlation analysis.

Discussion

The results of this study showed that occupational stress is an important factor which reduces the temporary and permanent work capacity in chronic diseases such as arterial hypertension, anxiety and depressive syndrome, insulin independent diabetes mellitus, cardiac arrhythmias, peptic ulcer gastrointestinal disease, cerebrovascular diseases, coronary heart disease, hyperthyroidism, injuries at work, insulin-dependent diabetes mellitus and skin diseases.

Many studies have shown a link between occupational stress and cardiovascular diseases. In a doctoral thesis, which examined the impact of stress on the temporary work disability in a group of health workers (14), a significant correlation was observed between the total OSI index including all the elements of professional stress and the development of disorders of cardiovascular system and duration of temporary and permanent work disability due to those diseases. In that study, it was found that specifically the conflicts at workplaces were related to the development of hypertension and its complications in the cardiovascular system. The influence of stress on a reduced work capacity of patients with hypertension could be interpreted by the effect of stress on the hyperactivity of the adrenergic nervous system and increased concentration of circulating catecholamines and adrenal steroids, increased activity of

the renin-angiotensin-aldosterone system, increased free radical production, impaired secretion of serotonin, and changes of vasopressin receptor under their influence (4). By similar mechanisms, professional stress affects the occurrence of heart arrhythmias (15, 16).

Many studies examined the role of psychosocial stress at work as a risk factor for the development of coronary heart disease and cerebrovascular stroke, chronic diseases which represent not only serious health problems, but also significant economic burdens (17-20). The analysis of 27 cohort studies performed in Europe, the United States and Japan with more than 600,000 men and women, showed that increased psychic stress at work, such as long working hours and increased burden and work-overload, were associated with a moderate increase in the risk of coronary heart disease and stroke. The risk for people exposed to these stressors was 10-40% higher than for those without such stressors (17). A meta-analysis of seven European prospective cohort studies (18), which studied the effect of different stressors and different lifestyles on development of coronary heart disease, confirmed that professional stress (job strain) in combination with unhealthy lifestyles (smoking, heavy drinking, physical inactivity and obesity) increased the risk of coronary heart disease.

The results of this study, which showed that stress at work was in a positive correlation with duration of work absenteeism in workers with diabetes, are in accordance with meta-analyses which confirmed the connection between stress at work and occurrence of type 2 diabetes (21-23). It was shown that people who were under a high level of pressure at work and who at the same time perceived little control over their work activities had about 45 percent higher risk of developing diabetes type 2 than those who had less stress at their workplace (21). Literature data demonstrated not only the association between stress and the occurrence of type 2 diabetes, but also the association between stress at work and the development of its complications related to the cardiovascular system, which additionally affected the working ability (24, 25). Some studies (21, 22) tried to explain the connection between stress at work and the occurrence of type 2 diabetes and its complications on the cardiovascular system by a direct impact of stress on the adrenergic nervous system hyperactivity and increased release of adrenal hormones (corticosteroids, adrenaline), which have per se the pro-diabetogenic action (22), while other studies (18-20) tried to explain the influence of stress on the formation of negative habits and lifestyles (sedentary style and obesity, smoking habit, insomnia, alcohol use, irregular glucose checking, irregular meals) which in turn potentiate the occurrence of these diseases and their complications. Literature data show that professional stressors disturbed the metabolism of glucose, blood pressure, lipid metabolism, coagulation factors and accelerated the process of atherosclerosis, increased the occurrence of complications in patients with arterial hypertension

associated with type 2 diabetes, and thus increased the duration of temporary working inability in these workers (18-22).

Psychological stress also impairs pancreatic function and leads to a faster progression of non-insulin-dependent to insulin-dependent type 2 diabetes mellitus (24, 25), while its role in the development of type 1 diabetes mellitus is still under debate (24, 26-30). However, it is well substantiated that psychological stress deteriorates glycaemic control in patients with type 1 (31, 32), which consequently leads to a faster development of diabetic complications (25, 27) and increases working inability (24).

This research has identified an association between stress and impairment of work ability in patients with anxiety and depressive syndrome. Similar results were obtained in a study (33) which examined the positive relationship between professional stress and occurrence of mental illness among secondary school teachers. That study also found that the intensity of job stress in teachers increased over time (33). There are studies which describe the effect of occupational stress on the development of depressive disorders (23, 34).

The results of this research showed that stress is a risk factor for the impairment of work ability in patients with gastrointestinal ulcer disease, which is similar to the results of a study that aimed to describe the risk of peptic ulcer in health-care workers compared to the general population (35). That research showed that nurses and other health workers had a higher risk of peptic ulcer disease compared to general population. Among all health care professionals, pharmacists had the lowest risk (35). Another study determined a significant effect of stress on the formation of peptic ulcer disease in taxi drivers (36). There are additional data on the effect of professional stress on the gastrointestinal tract (37).

This study showed a statistically significant association between stressful working conditions and reduction of temporary and permanent working capacity due to occupational injuries.

A study done by Li et al. (2004) (38) examined the effect of psychological stress on the occurrence of traffic accidents in car drivers and showed a significant correlation between them. A study by Sakurai et al. (2013) (39), which was controlled for demographic and professional factors, lifestyle and health status, showed that high demands and poor control at work were significantly associated with an increased risk of work injury. Nakata et al. (2006) (40) investigated the effect of stress on the risk of work injury in female workers in small and medium-sized manufacturing companies. It was found that the risk of injury at work was higher when there was less control at the workplace. In contrast, Murata et al. (2000) (41) showed that the impact of control at workplace on a work injury occurrence was not significant. A

study done by Kim et al. (2009) (42) in a group of Korean firefighters showed a significant correlation between high demands, poor interpersonal relationships and poor organization at work with the work injuries occurrence, while a poor control at work (opportunities for independent decision-making) showed no statistically significant association.

Many studies have examined the impact of longer working hours on the risk of diseases and injuries at work. Some studies have shown the evidence of a link between excessive working hours and increased risk of work injury in certain professions, including construction workers, nurses, anesthesiologists, veterinarians, truck drivers, firefighters and workers in nuclear power plants (43). In one of the studies which involved workers in the manufacturing factories in Hong Kong, an increased risk of serious work injuries among the workers who work more than 11.5 hours a day was shown (44). A study of 1.2 million German workers found a higher risk of fatal and non-fatal work injuries after the eight-hour work shift (45, 46). In a huge national survey performed in the United States (43), which included about 11 thousand Americans, after adjusting for age, gender, occupation, industry, and region, it was shown that working in jobs with overtime schedules was associated with a 61% higher risk compared with jobs without overtime work. Additionally, working at least 12 hours per day was associated with a 37% increased risk and working at least 60 hours per week was associated with a 23% increased risk for a work injury.

This study showed that the number of lost working days due to hyperthyroidism was in a positive correlation with the level of workplace stress. The most common causes of hyperthyroidism are Graves' disease, toxic multinodular goiter and autonomously functioning thyroid adenoma (47). Graves' disease, as the most common cause of hyperthyroidism, is under strong influence of stress, similar to other autoimmune diseases (48-52). Stress can directly trigger an autoimmune response (48, 49). Apart from that, stress increases the release of thyroid-stimulating hormone (TSH) and therefore stimulates the release of thyroid hormones (51, 53-55).

The results of this study showed a positive correlation between the level of workplace stress and number of lost working days related to skin diseases. Many studies investigated the role of stressful events in the development and exacerbation of some skin diseases, including psoriasis, alopecia areata, atopic dermatitis, non-atopic eczema, urticaria, pruritus, acne, vitiligo, hyperhidrosis, lichen planus and seborrheic dermatitis (56-63).

The results of this study also indicate that it would be advisable to develop and apply the measures for stress reduction at workplaces.

Indeed, some studies investigated and confirmed that various anti-stress interventions could mitigate the large financial losses due to work absenteeism (64-66).

Conclusion

This research indicates that stress at the workplace could significantly influence the temporary and permanent working inability of the exposed workers.

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UTICAJ PROFESIONALNOG STRESA NA PRIVREMENU NESPOSOBNOST ZA RAD IZLOŽENIH RADNIKA

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Stres na poslu predstavlja zdravstveni rizik koji utiče na radnu sposobnost i ima značajne ekonomske posledice. Cilj rada bio je da ispita uticaj nivoa stresa na poslu na privremenu i trajnu radnu nesposobnost izloženih radnika. U studiju je uključeno 3527 radnika različitih profesija, koji su u periodu 2011-2016. na području jugoistočne Srbije radili isti posao poslednjih pet godina i bili upućeni Invalidskoj komisiji od strane svojih izabranih doktora radi ocene trajne radne sposobnosti, zbog bolesti ili povrede. Analiziran je broj izgubljenih radnih dana u korelaciji sa stepenom stresa na njihovom poslu (Indeks profesionalnog stresa). Zapaža se povećanje srednje vrednosti broja izgubljenih radnih dana u podgrupama radnika sa većim nivoom stresa na poslu. Broj radnika koji je proglašen trajno nesposobnim za posao se povećava u podgrupama radnika sa većim nivoom stresa na poslu. Rezultati ovog istraživanja pokazuju da stres na poslu značajno utiče na privremenu i trajnu radnu sposobnost izloženih radnika. *Acta Medica Medianae* 2017;56(3):129-136.

Ključne reči: stres na poslu, indeks profesionalnog stresa, privremena nesposobnost za rad, trajna nesposobnost za rad, povrede na radu, zdravlje radnika