

PHYSIOLOGICAL AND HYGIENIC CORRELATES OF TEACHERS' OCCUPATIONAL BURNOUT SYNDROME DEVELOPMENT

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ABSTRACT

The aim: To determine physiological and hygienic correlates of teachers' occupational burnout syndrome development in general secondary education institutions.

Materials and methods: The study involved 427 teachers of general secondary education institutions of Sumy region aged 21 to 71 years old, representing four pedagogical categories. During the study physiological, hygienic, psychological, mathematical and statistical research methods were used.

Results: A high level of occupational burnout was found in teachers of general secondary education institutions of the regional center (12,43%), which was mainly accompanied by the formed resistance symptom-complex (39,45%, $p < 0,01$). According to the correlation analysis, significant physiological-hygienic and psychological factors of occupational burnout formation were determined. They include: workload ($r = -0,32$, $p < 0,05$), lessons duration ($r = -0,32$, $p < 0,05$), using computer at work ($r = 0,36$, $p < 0,05$), workbook checking ($r = 0,41$, $p < 0,05$), extracurricular work ($r = 0,35$, $p < 0,05$), time spent on household chores on Sunday ($r = 0,36$, $p < 0,05$), time spent on conversations with parents ($r = 0,36$, $p < 0,05$), emotional state ($r = -0,35$, $p < 0,05$). Physiological markers are: sympathovagal balance ($r = 0,34$, $p < 0,05$), relative sympathetic activity ($r = 0,27$, $p < 0,05$), relative parasympathetic activity ($r = -0,32$, $p < 0,05$).

Conclusions: It has been found out that investigated physiological and socio-hygienic factors have "threshold" levels, the excess of which significantly affects teachers' occupational burnout. Predictably adverse effects have: workload for persons under 42 years, non-contact (more than 4 points) and hyper-reflective communication model (more than 5 points), time spent on household chores on Sunday (more than 3 hours), emotional state (less than 5 points), relative parasympathetic activity above 50%, sympathovagal balance above 1,3 relative units, autonomic regulation index below 6%.

KEY WORDS: occupational burnout, heart rate variability, teachers

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INTRODUCTION

Teachers' work in a complex system of psychosocial "human-human" relationships requires considerable psycho-emotional effort. Their occupational activity occurs under conditions of increasing information load, complicating curriculum and increasing teachers' responsibility for the result of their work [1-3].

Teaching, by its nature, assumes constant influence of psychophysiological loads, which cause such phenomena as overfatigue and overstrain, adversely affect the state of health and cause various psychosomatic diseases related to the protective compensatory mechanisms overstrain [4-9].

The issues of occupational burnout syndrome (OBS) impact on the teachers' functional state, importance of workload, qualification level in OBS formation and assessment of teachers' working conditions need further discussion [10, 11].

The analysis of scientific literature indicates constant scientific and practical interest in the problem of hygienic substantiation of the teacher's working conditions, determination of the physiological determinants of occupational burnout syndrome [12-15]. Further consideration needs the issue of determining occupational risk factors on the

basis of a comprehensive assessment of physiological responses of the teacher's body, which determines the relevance and novelty of this study.

THE AIM

To determine physiological and hygienic correlates of teachers' occupational burnout syndrome development in general secondary education institutions (GSEI).

MATERIALS AND METHODS

The study involved 427 teachers of general secondary education institutions of Sumy region aged 21 to 71 years old, representing four pedagogical categories. All the teachers were women. To achieve this goal, teachers were not assigned to age groups. Hygienic assessment of teachers' work conditions and nature included analysis of sanitary-hygienic conditions of the internal school environment and work intensity, teachers' professionally significant qualities in accordance with current regulations and "Hygienic classification of work by indices of hazard and danger of the work environment, severity and intensity

of the work process" (order of the Ministry of Health of Ukraine dated April 8, 2014 No. 248) [16].

To assess adaptive capacity of teachers' body we used the heart rate variability (HRV) assessment according to the system of rapid analysis "CardioSpectr" (JSC Solveig); registration of hemodynamics indices (heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), autonomic regulation index (ARI)). Occupational burnout syndrome was evaluated according to V. V. Boiko's methodology "Diagnostics of emotional burnout level" [17]. Subjective assessment of the functional state of the body was determined using the psychological test "Well-being, activity, mood" (WAM) [18]. The study was conducted in accordance with such principles as voluntariness, protection of human rights and freedoms, inviolability of physical and mental integrity, justice and equality, prior detailed information of volunteers about the essence of the study. Each subject of scientific research provided written consent for participation in the study and in the diagnostic measures according to the World Medical Association Declaration of Helsinki (2005).

Statistical analysis included calculation of primary indices, comparison of samples, correlation, variance analysis, calculation of threshold (critical) levels and relative risk of the current factors. Statistical analysis was performed on a personal computer using the standard statistical package STATISTICA 6.0.

RESULTS

Analysis of teachers' incidence with temporary disability according to the disability leaves has revealed its rate that constitutes 133,6 cases and 1173,4 days of incapacity for work per 100 employees with an average duration of one case of illness – 8,8 days. The maximum duration of an incapacity case is 9,7 days due to cases of osteochondrosis, injuries among teachers and complications of the disease.

The duration of teachers' temporary disability in the older age group by 31 % exceeds its duration for teachers up to 40 years. Such changes occur due to the development of chronic pathology, which causes a longer course of the disease.

The most common causes of diseases with temporary disability in teachers are respiratory diseases (65,5 %), as teaching is accompanied by a load on the vocal apparatus and non-compliance with the rules of phonation breathing. The structure of respiratory diseases is dominated by acute respiratory disorders (48,6 %), bronchitis (83,4 %), influenza (7,1 %), tracheitis (3,6 %), pneumonia (2,1 %) and pharyngitis (0,4 %). The second place due to temporary disability is occupied by diseases of the musculoskeletal system (10 % of cases), and among the nosological forms – osteochondrosis (44,1 %), traumatic injuries (35,3 %), arthritis (14,7 %) and periostitis (5,9 %). In addition, the third place in the structure of morbidity is occupied by diseases of the circulatory system (6,6 %), namely: hypertension (84,8 %), coronary heart disease (4,4 %), rheumatism (6,5 %) and vegetative-vascular dysfunction (4,4 %).

The results of the correlation analysis indicate a relation between adverse factors in working conditions and cases of temporary disability. Thus, the increase in phonation load during the working hour affects the temporary disability for diseases of the respiratory system ($r=0,3$; $p<0,05$), a decrease in motor activity – the musculoskeletal system diseases ($r=-0,37$; $p<0,05$), violation of the microclimate indicators in classrooms – increase in the number of teachers' complaints of headache ($r=-0,69$; $p<0,05$), malaise ($r=-0,33$; $p<0,05$), back pain ($r=-0,48$; $p<0,01$) and lack of appetite ($r=-0,4$; $p<0,05$). The frequency of violating artificial lighting correlates with the number of teachers' complaints of headache ($r=0,8$; $p<0,05$).

By the total point score, teachers generally have low levels of OBS ($54,2\pm 2,4\%$, $p<0,001$). It has been found out that the high level of OBS is 2 times higher among school teachers in the regional center ($12,43\pm 1,8\%$), compared to school teachers in the district centers ($6,5\pm 3,6\%$) and 3,5 times – school teachers in the rural area ($3,6\pm 3,5\%$, $p<0,05$). The high level of OBS is 1,4 times superior in teachers with 10 years of experience (16,2 %) to OBS indices in teachers with 10 to 20 years of experience (11,49 %) and 2 times superior to indices in teachers with 21 to 30 years of experience (8,25%, $p<0,05$).

The high OBS level is found 2 times more often in teachers working full time (12,35 %) and overtime (10,88 %) compared to teachers with a load of up to 10 hours (5,26%, $p<0,05$).

Analysis of OBS symptom-complexes mean values indicates higher values of resistance symptom-complex ($54,4\pm 2,6$ points) compared to symptom-complexes of tension and exhaustion in teachers with a load of 1,5 tariff rate ($36,7\pm 2,5$ points, $40,8\pm 2,3$ points respectively, $p<0,05$) (table I).

It should also be noted that for teachers working at 0,5 tariff rate, compared to other groups of workload, symptoms of tension ($21,5\pm 8,2$ points) and resistance stages are at the same level ($35,3\pm 10,4$ points). Exhaustion symptom-complex indices ($19,5\pm 6,8$ points) in teachers of this group are 16 points lower than in teachers with tariffload ($p<0,05$) and 21,3 points lower than in teachers with 1,5 tariff rates ($p<0,01$).

In the distribution of teachers with different OBS levels by pedagogical qualification it is determined that the high level of OBS is characteristic of teachers of the highest category (50 %), medium – the first category (42,9 %), low – the second category (33,3 %). Such OBS levels distribution among teachers of different pedagogical categories testifies to the impact of work intensity on teachers with high levels of occupational education, responsibility and duties.

The next task of determining the patterns of OBS formation and consequences of its development was to analyze the data of HRV in teachers with different OBS levels. When analyzing heart rate statistics, in teachers with high-level OBS was found a significant decrease in sympathetic-parasympathetic modulation (SDNN) by 64,7 % and parasympathetic activity (pNN50) by 69,7 % at the end of the working week ($p<0,05$).

For teachers with high OBS levels, the total power (TP) of the spectrum was 16,5 % higher at the end of the week,

Table I. Assessment of occupational burnout syndrome symptom-complexes in teachers with different weekly workload (M ± m, points)

Symptom-complexes	Groups by workload, hours		
	1	2	3
	< 10 n=19	10-18 n=170	≥ 19 n=239
Tension	21,5±8,2	33,7±4,4	36,7±2,5
Resistance	35,3±10,4	45,6±5	54,4±2,6***
Exhaustion	19,5±6,8**	35,5±4,5*	40,8±2,3

Notes:

1. * – p < 0,05 – reliable difference between 1 and 2 groups;
2. ** – p < 0,01 – reliable difference between 1 and 3 groups;
3. *** – p < 0,05 – reliable difference between OBS symptom-complexes.

compared to teachers with medium levels of OBS. Also, in this group of teachers, the sympathovagal index (LF/HF) was significantly higher by 56 % than similar indices in teachers with medium and by 59 % – with low OBS levels (p < 0,01).

Identical changes were recorded in indices of relative sympathetic (LFn) and parasympathetic activity (HFn), which are multidirectional in nature. Thus, at the end of the working week, the LFn indices in teachers with high OBS levels were higher than those in teachers with medium OBS levels by 9,6 % and low OBS levels by 16,1 %. Thus, a high level of OBS corresponds to the influence of the sympathetic nervous system in the regulation of heart rhythm and is accompanied by the tension of the regulatory systems of the body.

The variance analysis helped establish dependence of OBS level on the pedagogical experience, pedagogical qualification and weekly load. Moreover, determination of the contribution of these factors has made it possible to establish that proportion of the number of experience years in OBS formation is 7,2 % (p < 0,05), pedagogical category – 7,8 % (p < 0,05), and the weekly load – 11,9 % (p < 0,05). The level of critical values of such indicators as workload and length of service in determining thresholds for qualitative changes in OBS is 42 years (p < 0,01) and 21 years (p < 0,05), excess of which significantly reduces likelihood of OBS.

The correlation between occupational burnout syndrome and HRV is confirmed by correlation analysis, namely: an increase in occupational burnout and components of tension and resistance phases is accompanied by an increase in sympathovagal index, relative sympathetic activity (r = 0,34, r = 0,28, r = 0,35, p < 0,05, respectively) and an increase in relative parasympathetic activity (r = -0,32, r = -0,43, r = -0,35, p < 0,05, respectively).

The variance analysis helped establish that OBS is accompanied by a change in HRV. The share of this impact on the sympathovagal index is 20,5 %, the power of low frequency oscillations is 13,3 % and high frequency in normalized units is 13,3 % (p < 0,01).

There is a decrease in SBP (r = -0,22, r = -0,20, r = -0,33, r = -0,26, p < 0,05, respectively), HR (r = -0,27, r = -0,20, r = -0,29, r = -0,21, p < 0,05, respectively) and ARI (r = -0,20,

r = -0,20, r = -0,29, r = -0,21, p < 0,05, respectively) due to the symptoms of reducing occupational duties, emotional deficiency, resistance stage and general OBS. The symptoms of emotional and moral disorientation, emotional alienation, and the phase of resistance have an inverse relationship with the DBP indices (r = -0,26, r = -0,25, r = -0,20, p < 0,05, respectively).

Reduction of heart rate below 75 beats per minute (p < 0,01) and an autonomic regulation index below -6,5% (p < 0,05) are critical parameters, and this can testify to the teachers' OBS. In addition, the proportion of the impact of OBS on HR changes in teachers is 6 %, according to the data of variance analysis (p < 0,05).

DISCUSSION

As a result of the study, we have established the patterns of OBS formation in teachers of GSEIs with different occupational load and qualification level.

It should be noted that proportion of teachers with the medium level of OBS in GSEIs of the regional center is probably larger than that of other GSEIs (p < 0,05). The established pattern testifies to a significant contribution of the GSEI type to the OBS formation according to the territorial principle, since among teachers of the regional center there is a considerable share of cases of formed OBS (12,43±1,8 %) and OBS at the formation stage (37,6±2,6 %). Thus, it can be assumed that a higher pace of life, work in times of scarcity, competition of education institutions in the regional center influence OBS formation.

Assessment of different OBS symptom-complexes' manifestations in teachers with different weekly workload indicates, firstly: high manifestation of OBS among teachers with overtime weekly load; secondly, 41,2 % of them predominantly have signs of a resistance stage that is manifested by depersonalization and emotional alienation; thirdly, OBS symptom-complexes in teachers with normative load have the same meaning, which indicates the uniform manifestation of all OBS symptoms regardless of the symptom-complex. The established patterns testify to the negative contribution of a considerable weekly load to OBS formation.

Table II. Characteristics of the risk of teachers' occupational burnout

Indicator	Relative risk (R)	Share of contribution (%)
Workload	1,5	76,4
Emotional state	1,2	65,5
Non-contact model of behavior	1,3	81,8
Hyperreflective model of behavior	1,3	79,3
Household chores on the weekend	1,5	75,0
HR	1,5	74,6
ARI	1,3	78,1
Sympathovagal index (LF/HF)	1,5	80,0
Relative sympathetic activity (LFn)	1,1	62,5

The analysis of HRV data of teachers with different OBS levels has allowed to establish an increase in the role of sympathetic nervous system influence in autonomic regulation and regulatory systems tension in teachers with high OBS levels. There are no differences in the HRV in teachers with medium and low OBS levels during the week.

The results of the analysis of the HRV spectral characteristics in teachers with different OBS levels have allowed establishing prevalence of sympathetic impacts on the heart rate of teachers with high OBS levels at the end of the working week, indicating the stress response of the body to the load and transition to the central circuit of heart rate regulation.

As a result of obtained data, the peculiarities of OBS formation, depending on the type of institution and its territorial location, weekly workload, qualification level and consequences of the OBS influence on the heart rhythm, we can determine physiological, hygienic and psychological factors influencing OBS formation and physiological markers of OBS development.

The calculation of threshold HRV levels has allowed us to establish critical indices at which occur qualitative changes in the functional state of the cardiovascular system of teachers with formed OBS. Thus, the threshold value for the Baevsky stress index is 134,3 relative units, the excess of which may be a marker for the OBS. For the sympathovagal index, such a criterion is 1,3 relative units, for relative sympathetic activity – 48,5 %, for relative parasympathetic activity – 51,5 %.

Thus, changes of sympathetic index, high and low frequency oscillations in the normalized units can be a marker in the diagnostics of the degree of occupational burnout syndrome development.

In the OBS formation, among the organizational factors of occupational activity the leading are duration of additional elements, such as: work on a computer, checking workbooks, extracurricular work and work with parents. Moreover, the critical time, the excess of which leads to the OBS development, is 32 minutes of computer work ($p<0,05$), 80 minutes of notebook checking ($p<0,01$), 33,6 minutes of extracurricular work with children ($p<0,05$) and 42 minutes of communication with parents ($p<0,001$). In addition, among other elements of the teacher's day, thresholds for OBS development are reducing time of sports activities to 17 minutes ($p<0,05$), walking to 20,4

minutes and increasing by more than 3,2 hours duration of household chores on the last day off ($p<0,05$).

According to the variance analysis, among the additional elements of occupational activity in OBS formation 19,5 % belongs to amount of time to check workbooks ($p<0,01$) and 13,8 % – to work on a computer ($p<0,05$). Among other regime elements, which contribute to the OBS formation are household chores during the weekends – 9,2 % ($p<0,05$) and time spent watching TV – 10,4 % ($p<0,05$).

The relative risk of the occupational burnout development is determined by a number of physiological, regime and psychological components of teachers' occupational activity (Table II).

CONCLUSIONS

1. A high level of occupational burnout was found in school teachers of the regional center (12,43 %), which was mainly accompanied by the formed resistance symptom-complex (39,45 %, $p<0,01$).
2. Frequent causes of teachers' diseases with temporary disability are respiratory diseases (acute respiratory disorders, bronchitis, influenza, tracheitis, pneumonia and pharyngitis), as teaching is accompanied by a load on the vocal apparatus and non-compliance with the rules of phonation breathing.
3. With the help of the correlation analysis, probable biological and socio-psychological factors influencing the OBS formation and physiological markers of the OBS development are identified. They include workload, duration of lessons, computer work, checking workbooks, extracurricular activities, conversations with parents, and emotional state.
4. It is established that the studied biological and socio-hygienic factors have "threshold" levels, exceeding which significantly affects the teachers' occupational burnout. A number of important factors have a prognostic adverse effect: age (less than 42 years), non-contact and hyperreflective model of communication, negative emotional state, relative parasympathetic activity above 50 %, sympathovagal index above 1,3 relative units, heart rate below 75 points, ARI below -6 %.

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The Authors declare no conflict of interest

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