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ASSESSMENT OF SENSORIMOTOR REACTIONS PECULIARITIES DETECTED IN CERTIFIED TEST LABORATORY CENTER STAFF DURING THEIR OCCUPATIONAL ACTIVITIES

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Our research was performed on 90 people working at Voronezh Center for Hygiene and Epidemiology, a certified test laboratory center. Our research goal was to assess peculiarities of sensorimotor reactions detected in personnel of hygienic and epidemiologic laboratories as per simple visual-motor reaction parameters and complex visual-motor reaction. To examine visual-motor reactions, we applied EffectonStudio software, "Jaguar. Perception. Reactions. Research on precision and speed qualities and human working capacity" package, and Maslash and Jackson procedure supplemented with a mathematical model developed in Bechterev's Saint-Petersburg Scientific Research Psychoneurological Institute to assess occupational burnout risks. The paper dwells on how fatigue develops during a working week and on contributions made by each working day into overall fatigue experienced by personnel employed at a certified test laboratory center. We examined occupational burnout peculiarities detected in laboratory center workers as per emotional exhaustion parameters, depersonalization, and reduction in professional competences; we calculated integral burnout index for them. We reveled health risks for certified test laboratory center personnel which were caused by their emotional burnout and determined cause-and effect relations between the central nervous system functional state and emotional burnout. On the basis of the obtained data we made recommendations on prevention activities aimed at working conditions optimization and occupational burnout prophylaxis. Our research supplements and enlarges this knowledge sphere in occupational hygiene in terms of examining and preventing fatigue occurring in personnel at their workplaces.

Key words: *emotional exhaustion, occupational burnout, depersonalization, reduction in professional competences, visual-motor reaction, working conditions optimization.*

Work in laboratories is usually quite intense and it requires prophylaxis activities aimed at occupational morbidity prevention. Work tasks performed by a laboratory worker at any test center mostly involve the nervous system; artificial and natural stimuli which influence such worker's visual analyzer make his or her work worse thus making the motor reactions slow down [1–4]. When we performed our research, we focused on simple and complicated visual-motor reactions (SVMR and CVMR) in workers employed by a certified test laboratory center (CTLC) at Voronezh Regional Center for Hygiene and Epidemiology. SVMR and CVMR assessment determines responses from the central nervous system (CNS) [5, 6]. Examination of both simple and complicated visual motor reaction allows to reveal people with

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the strained CNS (excitation or inhibition) among laboratory center workers; such strain in the CNS leads to occupational burnout syndrome [7, 8]. There are several symptoms which can be considered health risks caused by occupational burnout development; they are 1) physical responses from a body (chronic fatigue and lower body immune state which lead to crises in occupational activities and body exhaustion); 2) social and behavioral signs which become apparent through discontent and attempts to "shift responsibility"; 3) psychoemotional symptoms which involve occupational motivation loss and a decrease in working capacities in laboratory center workers [7, 9, 10]. Determination of occupational burnout risks and timely prophylaxis will help to prevent diseases caused by nervous system overstrain which, in its turn, results from emotional one [10–12].

Our research goal was to assess sensorimotor reactions peculiarities in personnel of CLTC at Voronezh Regional Center for Hygiene and Epidemiology during their occupational activities.

Our research tasks were:

1. To examine sensorimotor reactions peculiarities in laboratory center personnel..
2. To determine occupational burnout risks as a factor influencing personnel's health depending on their occupational activities.
3. To detect cause-and-effect relations between the CNS functional state and occupational burnout in CLTC workers.
4. To work out prophylaxis measures aimed at lowering health risks via occupational burnout prevention and improving working conditions for the center personnel.

Our research object was personnel employed by the CLTC at Voronezh Regional Center for Hygiene and Epidemiology which has 11 laboratories in its structure. We examined 90 workers aged from 23 to 65.

Data and methods. To perform our research, we divided all the workers into two groups as per their occupational activities: a hygienic profile group and an epidemiologic profile group. Hygienic profile laboratories included: prophylaxis toxicology laboratory (PTL), physical-chemical examinations laboratory (PCEL), nutrition hygiene laboratory (NHL), air control laboratory (ACL), communal hygiene laboratory (CHL), laboratory for control over physical factors (LCPF), and radiation laboratory (RL). Epidemiologic profile laboratories were bacteriological laboratory (BL), extremely dangerous infections laboratory (EDIL), virology laboratory (VL), and parasitological laboratory (PL).

To predict working capacity of laboratory personnel, we assessed their CHS functional state, or simple and complicated visual-motor reactions [4]. We detected regularities in visual-motor reactions dynamics via analyzing changes in reactions time (RT):

$$RT = Tnn + Tnp + TM,$$

where *RT* is a reaction time; *Tnn* is sensory-perceptive process time; *Tnp* is time for assessing and making a decision, and *TM* is a motor response time [5, 13].

We applied certified software developed by EffectonStudio, "Jaguar. Perception. Reactions. Research on precision and speed qualities and human working capacity" package. It allowed us to determine an average reaction time which en examined worker spent when he or she had to react to a known simple visual analyzer stimulus. An examined worker had to press a computer button when an element on a screen changed its color. When we examined complicated visual-motor reactions, we measured which average reaction time it took an examined worker to react to a

complicated visual analyzer stimulus: he or she had to press a button only when a definite color appeared on a PC screen. Each action was measured in milliseconds. We allowed for the overall time it took examined workers to pass each test and a number of errors made by an examined worker during tests. Workers had to abandon their usual occupational activities for 5 minutes only to take part in our research. We performed our research on workdays and it helped us to determine fatigue dynamics as per weekdays and a contribution made by each working day into workers' fatigue.

To assess occupational burnout syndrome risks, we chose a procedure developed by Maslach and Jackson, edited by Vodopyanova, and added with a mathematical model developed in Bechterev's Saint-Petersburg Scientific Research Psychoneurological Institute [14]. Questioning blanks were developed in accordance with procedures for occupational burnout diagnostics. It took workers as little time as 3 minutes to fill in the blanks. They were offered 22 questions related with their work tasks. Answers varied from "never" (0 scores) to "every day" (6 scores). Scores sum was calculated basing on the obtained results for the following sub-factors: emotional exhaustion (EE), depersonalization (DP), and reduction in professional competence (RPC). Emotional exhaustion results from lower emotional tonus with apparent affective psyche instability. It becomes apparent not only through workers becoming "fed up" with their occupational activities, but also with them feeling themselves unsatisfied with their life in general. This parameter directly influences relations in a work team. Depersonalization is detachment from all the events which happen around. It frequently becomes apparent through cynicism and "occupational labeling" in a team when one workers "label" others. Reduction in professional competence is a parameter which shows how a respondent sees him- or herself as a professional. When it decreases, a worker becomes unsatisfied with his or her work tasks and processes, and their occupational motivation also goes down.

Owing to the mathematical model developed in Bechterev's Saint-Petersburg Scientific Research Psychoneurological Institute which was a perfect supplement to the applied procedure, we calculated integral burnout index (IBI) [14]:

$$IBI = \sqrt{(EE-EE(x)/54)^2+(DP-DP(x)/30)^2+(1-RPC(x)/48)^2/3},$$

where EE=0, DP=0 and RPC=48 are ideal burnout syndrome parameters as per Maslach and Jackson test, and EE(x), DP(x) and RPC(x) are an examined worker's parameters as per corresponding Maslach and Jackson test scales. The result varies from 0 to 1, where 0 means there is no occupational burnout, and 1 means maximum occupational burnout.

Basing on integral burnout index, we determined health risks for laboratory personnel employed by a Rospotrebnadzor' organization. IBI value from 0 to 0.6 meant acceptable risk, but if IBI was higher than 0.6, it meant risk was unacceptable.

We calculated correlations in certified Microsoft Office Excel.

Results and discussion. Time of simple and complicated visual-motor reactions, time needed to pass each test, as well as a number of errors in examined workers' reactions varied depending on a laboratory profile. Average time of a simple visual-motor reaction in hygienic laboratories amounted to 483±24 msec, while it was equal to 457±23 msec in epidemiologic ones. Average CVMR time was also dif-

ferent: it amounted to 484±24 msec in hygienic laboratories, and to 445±22 msec in epidemiologic ones. Averaged number of wrong reactions occurred more frequently in hygienic laboratories: 1.5±0.1:1.4±0.1. We compared average time needed to pass a test and revealed that workers with hygienic profile spent 1 second longer time than workers from epidemiologic laboratories (Table).

SVMR and CVMR time taken in working week dynamics was also different depending on a laboratory profile.

Maximum SVMR time in epidemiologic laboratories was detected on Monday. Maximum working capacity was detected ion Thursday (445±22 msec), and fatigue occurred by Friday.

A different situation was observed in hygienic laboratories where fatigue grew by the middle of a week.

Thus, on Wednesday SVMR time amounted to 520±26 msec in hygienic laboratories, while on the same day it was 460±23 msec in epidemiologic ones. The parameter came to the same level by Friday in both groups and amounted to 514±26 msec , which proves that fatigue occurred at the end of a working week. (Figure 1).

The CNS functional state in workers from different laboratories of CLTC at Voronezh Regional Center for Hygiene and Epidemiology

Parameters	Hygienic laboratories	Epidemiologic laboratories
Simple visual motor reaction		
Average SVMR value	483 ± 24 msec	457 ± 23 msec
Time needed to pass a test	51 ± 3 sec	50 ± 3 sec
Complicated visual motor reaction		
Average CVMR value	484 ± 24 msec	445 ± 22 msec
Time needed to pass a test	157 ± 8 sec	156 ± 8 sec
Wrong reactions number	1,5 ± 0,1	1,4 ± 0,1

A difference between time of a simple visual motor reaction and a complicated one is known as "central delay" which is divided into two stages: processing of information on a stimulus in the CNS and making a decision on how to react to this or that stimulus. Both these stages significantly depend on the CNS functional state. Our examination of complicated visual motor reaction time also revealed discrepancies between different laboratories.

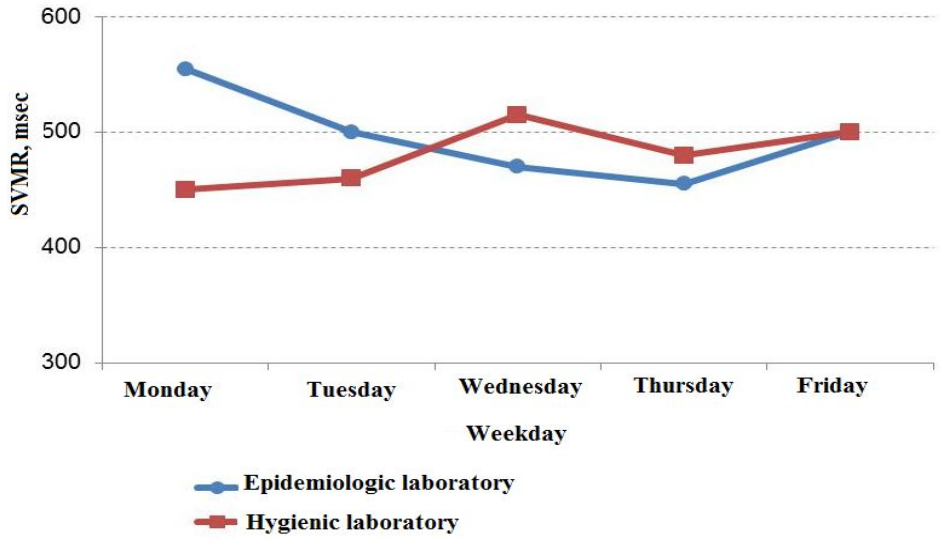

Figure 1. SVMR parameters in a working week dynamics

Thus, the greatest CVMR times were detected on Monday and Friday in epidemiologic laboratories: 528±26 msec and 524±26 msec correspondingly, but as for hygienic laboratories, their greatest times, 520±26 msec and 479±24 msec, were detected on Wednesday and Friday. The highest CNS functional parameter was equal to 431±21 msec and was detected on Wednesday in epidemiologic laboratories. As for hygienic laboratories, this parameter had its highest value on Thursday, after a drop on Wednesday, and amounted to 449±22 msec. In means that fatigue occurs at the beginning of a working week due to weaker nervous processes in the brain cortex. A formed excitation focus here is a dominant which determines whether a worker is ready to perform his or her working tasks and maintains a body functional state with consequent protective inhibition occurrence. In future it can cause the nervous system exhaustion and stress evolvement [15, 16]. Constant stress leads to a body exhaustion and emotional burnout which consequently causes occupational burnout development [7, 14].

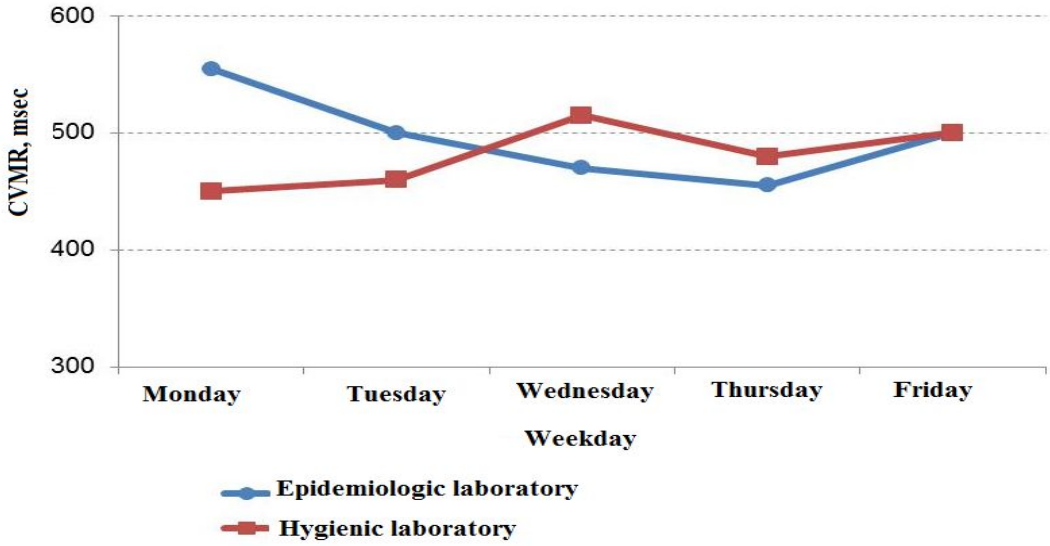

Figure 2. CVMR parameters in a working week dynamics

The obtained data prove that fatigue and increased strain in the CNS can occur not only by the end of a working week, but on other days too. A contribution made by Wednesday into fatigue evolving in hygienic laboratories personnel amounted to 21.5%.

We analyzed the results obtained with Maslach and Jackson procedure edited by Vodopyanova, and added with a mathematical model developed in Bechterev's Saint-Petersburg Scientific Research Psychoneurological Institute, and revealed that occupational burnout occurred both in hygienic and epidemiologic profile laboratories. Emotional exhaustion was detected in 16% respondents from the laboratory center in general. Increased cynicism level which evidenced depersonalization was detected in more than a half CLTC workers (58% respondents). Reduction in professional competence was observed in 27 people (30% workers).

We calculated a correlation coefficient for SVMR and CVMR speed and integral burnout index (IBI) and obtained the following results: $r=0.71$ and $r=0.70$ correspondingly, which proves there is a strong cause-and-effect relation with statistic error probability being less than 5% ($p< 0.05$).

Conclusions. Personnel working in hygienic laboratories undergo greater emotional stress during a working week than those working in epidemiologic ones. A contribution made by Wednesday into fatigue evolving in workers from both laboratory groups amounts to 21 %.

Occupational burnout risk is acceptable both in hygienic and epidemiologic laboratories; however, integral burnout index was higher in hygienic laboratories than in epidemiologic ones which means workers in these laboratories run higher occupational risks.

Correlation coefficients calculated for SVMR and CVMR speed and integral burnout index (IBI) amounted to r=0.71 and r=0.70 correspondingly which means there is a strong cause-and-effect relation between them ($p< 0.05$).

To reduce occupational burnout risks, we developed a set of prophylaxis activities which includes:

– lower workloads in hygienic laboratories on Monday and Tuesday and more correct distribution of workloads during a working week;

– change of tasks which a worker has to perform in order to reduce a number of the same actions during a working week;

– optimization of time a worker has to spend doing his or her work via computerization and automation of routine tasks in the certified laboratory test center;

– improvement of sanitary-hygienic and psychophysiological conditions for workers employed at the certified laboratory test center.

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