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CHARACTERISTICS OF THE DYNAMICS OF INDICATORS OF THE CENTRAL NERVOUS SYSTEM AND FUNCTIONS OF ATTENTION OF THE WORKERS OF SHOE PRODUCTION

***Azizova F.L. and Boltaboev U.A.**

Tashkent Medical Academy, Fergana branch of the Tashkent Medical Academy

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ABSTRACT

The aim: The study of changes in the functional state of the central nervous system, the stability of the function of attention occurring in the dynamics of the working day. **Material and methods:** Correction tables were used, chronoreflexometry was performed. A widely used technique for studying the conditioned-motor reaction of Ivanov-Smolensky with preliminary verbal instruction was used. The attention function was studied by using proof samples. Used tables with settled text, according to Whipple's formula, actual performance was calculated. **Results:** The results of research have shown the development of inhibitory processes in the central nervous system, leading to an increase in errors in differentiation, and at elevated air temperatures at workplaces, changes in simple and complex visual-motor response are more pronounced and significantly exceed the maximum permissible values of physiological changes. They also revealed the development of inhibitory processes in terms of simple and complex auditory-motor response, with more pronounced changes observed in those occupational groups where higher levels of noise at workplaces are recorded. When studying attention functions among working women, it has been established that the number of errors made increases, the actual performance decreases, the time spent on completing the assignment during the summer period of observations increases, where the quality of the corrective test deteriorates and the level of performance decreases, indicating a more pronounced production fatigue. **Conclusion:** Working conditions and the nature of work processes in workers causes the development of the predominance of inhibitory processes in the central nervous system, the development of inhibitory processes in terms of simple and complex auditory-motor response is revealed, the indicators characterizing the attention function of working women worsen, which indicates a more pronounced production fatigue.

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INTRODUCTION

The shoe industry is one of the largest branches of light industry. The main task of the shoe industry is to meet the needs of people in high-quality footwear and a diverse range. The modern footwear industry, which produces shoes of mass production, characterized by a fairly high level of introduction of new technologies, the pace of technological processes requires a constant concentration of central nervous system functions of [1,2]. Thus, significant neuro-emotional stress in the activities of various professions of shoe manufacturing, in combination with physical labor and production factors, create large loads on the central nervous system of [3, 4]. Materials on the study of health among workers of shoe production showed a high increase in the incidence associated with the impact of psycho-emotional stress present during the 8-hour working day while performing the basic functional duties of [5, 6, 7]. Scientific studies have shown that, for assessing the functional status of the central nervous system in certain professional groups, a number of different specially developed methods are determined, taking into account the indicators of the intensity of the labor process [8, 9]. In the manufacture of shoes, workers have increased eyestrain and attention, as well as the monotony of the movements of the hands and fingers, especially when using conveyors with a strictly defined work rhythm of [10].

****Corresponding author:*** **Azizova F.L.,**
Tashkent Medical Academy, Fergana branch of the Tashkent Medical Academy

Purpose of the study: The study of changes in the indicators of the functional state of the central nervous system, by determining the speed of visual and auditory-motor reactions, the stability of the attention function occurring in the dynamics of the working day.

MATERIALS AND METHODS

Taking into account the specifics of the work of the main professional groups of shoe production, where women constitute the main part, to assess changes in the central nervous system, the speed of visual and auditory-motor reactions and the stability of attention were determined using correction tables. Determining the speed of visual and auditory-motor reactions was carried out on a universal chronoreflexometer. A widely used technique for studying the conditioned-motor response of Ivanov-Smolensky with preliminary verbal instruction was used. The speed of a simple and consistent visual - and auditory-motor reactions was recorded; red and white light, a low and loud sound were used as a signal; differentiation to stimuli was developed by warning not to respond by pressing a button on white light and a loud sound. The studies were carried out according to the scheme: 10–12 positive signals were fed, 5 - complex, 5 - differential signals. The reaction rate (time from the moment when the conditioned stimulus was applied to the response) was noted in hundredths of a second (mls), taking into account both the correctness of the response to the differentiation signal and the rate of visual and auditory-motor responses to the positive stimulus following differentiation.

The attention function was studied by using proof samples. Used tables with settled text. The subject was asked to cross out a certain letter, taking into account the time of the task, the number of errors, and the actual performance was calculated using the Whipple formula. Results and its discussion. Conducted research among women shoe production showed results that differed significantly in the spring and summer periods in the tables below - 1, 2, 3, 4, 5, 6. Table 1 presents the materials obtained during the survey of harvesters in the spring and summer periods of observations. From the table it can be seen that in the spring period, the background to the operating speed of a simple visual-motor reaction corresponded to 307.1±0.12 mls, during the working day the reaction time increased to 328.5±0.15 mls ($p < 0.001$), which indicates a decrease in the rate of simple visual-motor reaction. In the summer period of observations, the nature of changes in the indices of a simple visual-motor reaction was similar to the data of the spring period of observations, but the degree of change was more significant. If at the optimum spring air temperature of workplaces, the time of a simple visual-motor reaction increased on average by 6.8%, then at elevated temperatures the decrease in the reaction rate corresponded to 35.7% (from 248.1±0.12 to 336.8±0.11 mls). According to the obtained materials, it was revealed that the time of the visual-motor reaction to a positive signal following the differentiation signal (complex or sequential visual-motor reaction) increased in the spring period at the beginning of work by 18.9 mls, by the end - by 8.3 mls , in the summer period - by 113.9 and 149.3 mls, respectively. This indicates the development of sequential braking due to production fatigue. In addition, from the beginning to the end of the shift, erroneous reactions to the differentiating stimulus increase: in spring, from 0.09±0.02 to 0.43±0.03, and in summer, from 0.03±0.01 to 0.46±0.03. Consequently, the working conditions and the nature of the work process of the procurers cause certain changes in the state of the central nervous system, which manifest themselves in lengthening time, in reducing the speed of a simple visual-motor reaction, which indicates the development of inhibitory processes in the central nervous system, in increasing erroneous reactions to the differentiation irritant and in the development of consistent inhibition.

Table 1. Changes in the visual-motor responseat harvesters in the spring and summer periods of observations, mls

№ п/п	Indicators of the visual-motor reaction (mls)	Atthebeginning work		Beforelunchbreak		Intheend work		Credibility
		n	M±m	n	M±m	n	M±m	$p<_{3-7}$
Springperiod								
1.	Simple	400	307.1±0.12	400	322.5±0.14	400	328.5±0.15	0.001
2.	Complex	200	326.0±0.11	200	369.7±0.18	200	427.1±0.13	0.001
3.	Errors (number)	200	0.09±0.02	200	0.22±0.02	200	0.43±0.03	0.001
summerperiod								
1.	Simple	400	248.1±0.12	400	289.6±0.13	400	336.8±0.11	0.001
2.	Complex	200	362.2±0.13	200	376.2±0.11	200	486.1±0.11	0.001
3.	Errors (number)	200	0.03±0.01	200	0.24±0.03	200	0.46±0.03	0.001

Table 2. Changes in the visual-motor reaction indices of a seamstress in the spring and summer periods of observations, mls

№ п/п	Indicators of the visual-motor reaction (mls)	Atthebeginning work		Beforelunchbreak		Intheend work		Credibility
		n	M±m	n	M±m	n	M±m	$p<_{3-7}$
springperiod								
1.	Simple	400	278.9±0.12	400	285.9±0.13	400	293.0±0.12	0.001
2.	Complex	200	321.9±0.1	200	327.8±0.2	200	339.8±0.2	0.001
3.	Errors (number)	200	0.11±0.02	200	0.26±0.03	200	0.38±0.03	0.001
summerperiod								
1.	Simple	400	259.1±0.9	400	288.8±0.12	400	295.9±0.07	0.001
2.	Complex	200	348.0±0.1	200	367.1±0.06	200	377.9±0.1	0.001
3.	Errors (number)	200	0.19±0.02	200	0.22±0.02	200	0.47±0.03	0.001

It is noted that in the summer period, the severity of changes increases, which is probably due to a more pronounced manifestation of production fatigue. Table 2 presents the results of studying the visual-motor reaction in a seamstress. In this professional group, the nature of the changes in the visual-motor reaction in the dynamics of the working day is the same as that of the harvesters. At the beginning of work, the time of a simple visual-motor reaction was on average equal to 278.9±0.12 mls, by the lunch break it increased to 285.9±0.9 mls, and by the end of the shift - to 293.0±0.2 mls , that is, 5% compared with background indicators.

Table 3. Changes in the visual-motor responseat the trainers and pickers in the spring and summer periods of observations, mls

№ п/п	Indicators of the visual-motor reaction (mls)	Atthebeginning work		Beforelunchbreak		Intheend work		Credibility
		n	M±m	N	M±m	n	M±m	$p<_{3-7}$
springperiod								
1.	Simple	400	325.8±0.16	400	337.5±0.14	400	345.6±0.15	0.001
2.	Complex	200	339.8±0.27	200	369.6±0.17	200	448.9±0.21	0.001
3.	Errors (number)	200	0.07±0.01	200	0.23±0.03	200	0.51±0.03	0.001
summerperiod								
1.	Simple	400	296.1±0.13	400	320.3±0.12	400	331.8±0.28	0.001
2.	Complex	200	347.8±0.27	200	336.8±0.17	200	430.6±0.31	0.001
3.	Errors (number)	200	0.07±0.01	200	0.31±0.03	200	0.55±0.03	0.001

Table 4. Changes in the indicators of the correctional test of workers in shoe production in the spring and summer periods of observations

Indicators of the proof test	Atthebeginning work		Beforelunchbreak		Intheend work		Credibility
	n	M±m	n	M±m	n	M±m	$p<_{3-7}$
springperiod							
tasktime, with	75	62.3±1.2	75	65.1±1.1	75	69.1±1.3	0.001
number of crossed out characters	75	55.4±1.7	75	53.6±1.6	75	52.5±0.7	-
numberofmistakes	75	1.1±0.1	75	1.6±0.2	75	2.0±0.1	0.001
actualperformance	75	430±1.6	75	428±1.1	75	421±2.1	0.01
summerperiod							
tasktime, with	75	68.8±0.9	75	69.5±0.5	75	71.8±1.0	0.05
number of crossed out characters	75	51.9±1.5	75	53.9±1.1	75	54.6±1.1	-
numberofmistakes	75	1.1±0.03	75	1.6±0.1	75	2.6±0.1	0.001
actualperformance	75	433±1.6	75	427±1.3	75	406±1.1	0.01

In the summer period of observations in the dynamics of work, the reaction time increased by 14.2%. The time of the successive visual-motor reaction in the dynamics of the shift also increased in the spring period by 5.5%, in the summer period by 8.5%. In addition, there is an increase in erroneous reactions to a differentiating stimulus in the spring period by 45%, in summer - by 58%. Table 3 presents the results of the examination of the visual-motor reaction of the preparators and pickers. In the dynamics of the change, the time of the visual-motor reaction increased from 325.8 to 345.6 mls (6.7%) in the spring period of observations and from 296.1 to 331.8 mls (12.5%) in the summer period. At the same time, the time of consecutive visual-motor reaction increases from 339.8 to 448.9 mls (by 32.1%) - in spring and from 347.8 to 430.6 mls (by 45.4%) - in summer, in addition in the spring period, the number of erroneous reactions to the differentiating stimulus increased from 0.07 to 0.51, and in summer, from 0.07 to 0.55. Consequently, the nature of the labor processes of harvesters, seamstresses and shoemakers, who require eye strain and attention from workers, causes considerable fatigue among working women, which is manifested in the development of the predominance of inhibitory processes in the central nervous system, sequential inhibition and an increase in differentiation errors, moreover, at elevated air temperatures at workplaces, in the summer period of observations, the change in indicators is more pronounced. Taking into account that one of the leading adverse factors of footwear production is noise, in the dynamics of the working day, the parameters of the auditory-motor reaction of women of the main occupational groups were studied. Research results show that in all professional groups from the beginning to the end of the shift, an increase in the time of both simple and complex hearing-motor response is observed. If at the beginning of work, the time of a simple auditory-motor reaction ranged from 237 to 277 mls, on average, by the lunch break it increased to 241-287 mls, and by the end of work - to 245-291 mls, that is the speed of a simple hearing-motor reaction in the dynamics of work significantly ($p<0.001$) decreased in all professional groups.It is noteworthy that if at the time of the seamstresses and preparers, the simple hearing and motor reaction increased by the end of work by 3 and by 4.8%, respectively, then for the harvester workers by 6%, which is probably due to the fact that the harvesters are subjected to higher noise levels (up to 104 dB), which is manifested by an adequate response of the body - a more pronounced predominance of inhibition on a sound stimulus, as a sign of production fatigue. In addition, in the dynamics of work in women of all surveyed occupational groups, the rate of complex hearing-motor response was decreased, and the number of errors per differentiating stimulus was increased, which was a manifestation of developing sequential inhibition and deterioration of differentiation. During the summer period of observations, the background pre-work time indices of both simple and complex hearing-motor response were lower than in spring, which is probably due to the fact that high both external and internal shop air temperatures increase the mobility of the nervous processes in the central nervous system. In the dynamics of work, the time of a simple hearing-motor reaction increased on average from harvesters from 196.3 to 290.9 milliseconds, from a seamstress - from 209.5 to 240.6 milliseconds, from trained women and pickers from 246.8 to 282.7 ml. Moreover, if, for seamstresses, trainers and pickers, a change in the rate of a simple auditory-motor reaction is 14%, then for harvesters – 48%, which can be attributed to the effect of a higher noise level. More pronounced shifts were established in terms of a complex hearing-motor response. In the dynamics of work of the harvesters at elevated air temperatures, the reaction time increased from 307.2 to 438.1 mls (42%), in a seamstress - from 320.3 to 347.4 mls (8.4%), in preparators and pickers - from 310.8 to 397.2 mls (27%). In addition, in all professional groups, the number of errors per differentiating stimulus increased. If at the beginning of the working day this indicator in various professional groups was on average equal to 0.08, by the lunch break it was 0.35 - 0.36, by the end of the shift it was 0.53 - 0.54, which indicates deterioration in differentiation, those. reduced attention. The obtained data are confirmed by the results of testing working on the correction test (taking into account the unidirectionality of changes in the

visual-motor reaction and the auditory-motor reaction in women of the main occupational groups, the data on the corrective test are presented on average for all surveyed, without breaking down into professional groups). The results of the research are presented in Table 4. The materials show that in the spring, the task execution time on the proofreading test significantly increased from 62.3 to 69.1 s, while at the beginning of the work 1.1±0.1 errors were made on average, for the lunch break - 1.6±0.2, and by the end of the work - 2±0.1. The increase in the number of errors was accompanied by a decrease in the actual performance calculated by the Whipple formula: if at the beginning of work it was equal to 430±1.7 conventional units, then at the end it decreased to 421±2.1 ($p<0.01$). The number of crossed out signs in the dynamics of change did not change significantly. The increase in errors and the decrease in actual performance can be regarded as a deterioration in the quality of work and a decrease in the level of efficiency associated with developing production fatigue.

In the summer period of observations, at elevated air temperatures, the direction of change in the indices of the correction test was similar to that described above. However, attention is drawn to the fact that in the summer before work on the execution of the sample, more time was spent than in the spring. In addition, by the end of the work, a greater number of errors were allowed, and the actual productivity more significantly, i.e. in summer, the quality of work was worse than in spring, and the level of efficiency was lower, indicating a more pronounced production fatigue. Consequently, at elevated air temperature and in terms of the correction test, the examined workers of the main professional groups revealed a disturbance in the relationship between the excitatory and inhibitory processes, the predominance of inhibition processes in the central nervous system, and weakening of differentiation. The described shifts in the correction test indicators are associated with a negative impact on the working temperature factor.

Conclusions

- Working conditions and the nature of labor processes in workers develops a predominance of inhibitory processes in the central nervous system, sequential inhibition and an increase in differentiation errors, and at elevated air temperatures at workplaces, changes in simple and complex visual-motor response are more pronounced and significantly exceed maximum permissible values of physiological changes.
- The dynamics of the working day also revealed the development of inhibitory processes in terms of simple and complex hearing-motor response, with more pronounced shifts observed in those occupational groups where higher levels of noise at workplaces are registered (procurers), as well as at higher temperatures the environment.
- It has been established that in the dynamics of work the indicators characterizing the function of the attention of working women deteriorate: the number of errors increases, the actual performance decreases, the time spent on the assignment increases, during the summer observation period the quality of the corrective test decreases, and the level of performance decreases indicates a more pronounced production fatigue.

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