

Dynamic control of functional condition as prevention's technology of mental disadaptation transport's workers

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Abstract The algorithm of parameters calculation of two psycho-diagnostic systems is presented in the article. The aim is to compare the results of research on the dynamic control of functional condition of transport's workers, the calculation of the individual average indication and individual norms that must be taken into account when making a conclusion. Dynamic control of functional condition is an effective technology for the prevention of mental adaptation breakdowns, which allows to prevent deterioration of workers health in time and as a consequence, the occurrence of emergency situations.

Keywords *Dynamic control of functional condition, individual norm, reaction to moving object, standard deviation, the average response time.*

I. INTRODUCTION

The question of maintaining the physical and mental health of transport workers is one of the most important in traffic safety and trouble-free operation of technical equipment [3]. Dynamic control of functional condition (DCFC) is an effective technology for the prevention of break of mental adaptation, which makes it possible to prevent the deterioration of workers health condition and, as a consequence, occurrence of emergency situations.

Both domestic [4, 5, 8], and foreign researches [7, 9] convincingly prove that the rational organization of work and timely psychopreventive actions are able to prevent failure of adaptation and prolong professional longevity of workers, especially if their work is carried out in a condition of nervous and mental tension and mobilization [2].

It should be noted that, according to the results of our study, the technology of DCFC of transport workers, compared with professional selection and periodic psycho-physiological examination, reveals a number of shortcomings, namely: in the individual cards of results of DCFC of the individual norm is not defined or determined incorrectly; in the individual cards of the results of DCFC fit the results of other surveys (for example, extended psycho-physiological examination); incorrectly calculated individual average and others.

It is known that functional condition of the worker, along with his professional suitability are the main factors which determine the safety of traffic and reliability of the human factor [3]. The main purpose of dynamic control is to analyze functional condition and identification of transport

workers with a possible deterioration of functional condition and efficiency.

DCFC is aimed at assessing of efficiency, body's functional reserves of workers, social and mental adaptation, determining psychophysiological readiness to work.

3 Tasks of DCFC:

1. Measurement of the current functional condition and its comparison with the individual norm.
2. Identification of persons who need of correcting and rehabilitating procedures.
3. Definition of individual norms (boundary values) for each worker.

The solution of tasks of DCFC with observance of the principles of psychodiagnostics is possible only at comparison of the results obtained by means of necessary and sufficient quantity of psychophysiological methods and a set of individual norm for each worker.

The individual norm is a range of quantitative indicators for each of the methods used in the DCFC: the minimum individual normative indicator by the method and the maximum individual normative indicator by the method.

Our researches have shown that for the calculation of individual norm it is necessary to use at least six measurements: the data of three measurements of the person on admission to work and at least three subsequent measurements with DKFS for each of the techniques. The boundary values of the individual norm should not exceed the normative values by the method and are represented by two quantitative indicators in the form of a simple fraction – the minimum individual normative indicator by the method (numerator) and the maximum individual normative indicator by the method (denominator) for the period of at least six researches.

The frequency of calculation of the individual norm corresponds to the age classification of the World health organization [1]: the young age – the persons of 25–44 years old, the average age the persons of 45 – 60 years old, the elderly age – the persons of 61 – 75 years old. Recalculation of an individual norm is made, respectively, in 45 years and 61 years, and also in the presence of resistant deterioration of functional condition as a result of the previous diseases and injuries.

At the present in order to carry out psycho-physiological examination time two types of psychodiagnostic systems

"Vibor" and "UPDS" are used in the laboratories of psycho-physiological support and psychologist's offices of transport companies. This raises the question of comparing the data obtained on these complexes. To calculate the individual average and the individual norm, it is necessary to take into account the data obtained from the two above-mentioned psychodiagnostic systems.

As there are no recommendations on the comparison and calculation of individual average indicator and individual rules for two psycho-diagnostic systems the algorithm of calculation of individual average indicator and individual norm have been developed on the example of method of assessment of response to moving object.

Let's consider the algorithm of calculation of individual average indicator and of individual norm for methods "Reaction to moving object" [6] for psycho-diagnostic systems "UPDS" and "Vibor".

II. EASE OF USE

Methods and techniques of a research. Clinico-psychological technique (the analysis of the individual cards of the results worker's DCFC), data mathematical and statistical analysis were used in order to perform a goal. The results of the technique assessment of reaction to a moving object (RMO) were analyzed/ The analysis was based on several indicators derived from 74 individual cards of results workers' DCFC with measurements' data received from two psychodiagnostic systems.

The algorithm for calculating of the individual norm for the method of assessment of reaction to a moving object (RMO) for the universal psychodiagnostic system UPDS.

1. To calculate the individual average indication of average reaction time (ART) by the formula:

$$X = \sum i/n$$

where, X is the arithmetic mean;

×, each observed value of the characteristic;

i - index indicating the serial number of the given value of sign;

n – number of observations;

Σ is the sign of summation.

2. To calculate the individual average indication root-mean-square deviation is indication (the formula is the same: $X = \sum i/n$).

1. In UPDS ART and root-mean-square deviation specified in seconds, so when calculating the average reaction time to determine the standard deviation, in accordance with the procedure, it is necessary to translate the obtained value from seconds to milliseconds (1 sec = 1000 milliseconds). Example. 0.028 sec = 28 milliseconds.

2. To calculate the individual average indication, only indicators corresponding to the methodical norm are used [6]. If at dynamic control of the functional state the surveyed showed the result exceeding standard value (for the technique of RMO the average reaction time (ART) shall not exceed 100 milliseconds), for calculation of the individual

average indicator it is necessary to use results of the following dynamic control of the functional state.

3. To determine the minimum and maximum individual normative indicators of the average reaction time (ART) of the RMO to (use data from at least six measurements): the data of three measurements of the examined person obtained on admission to work and at least three last measurements with dynamic control of the functional state (DCFC). To select from the analyzed number of indicators of the average reaction time (ART) the minimum value – the minimum individual standard SVR indicator, and the maximum value – the maximum individual standard ART indicator. To write in the form of a simple fraction – the minimum individual normative indicator by the method (numerator) and the maximum individual normative indicator by the method (denominator) in the column "Individual norm", RMO ART.

4. To determine the normal indicators of root-mean-square deviation for the range of individual norms: the data corresponding to the minimum and maximum individual standard indicator of the average reaction time (ART). To write in the form of a simple fraction in the column "Individual norm", RMO root-mean-square deviation to write the data of root-mean-square deviation in to the numerator corresponding to the minimum individual normative indicator of the average reaction time (ART). To write data corresponding to the maximum individual normative indicator of the average reaction time (ART) into the denominator.

5. To calculate the individual average indication number of advanced reactions - N_a (the data of the three measurements of the surveyed on admission to work) on the above formula $X = \sum i/n$. To enter the obtained value in the column "Individual average" in the section of the RMO N_a .

6. To calculate the individual average number of late reactions – N_l (data of three measurements of the surveyed at admission to work) on the formula:

$$X = \sum i/n.$$

To enter the obtained value in the column "Individual average indication" in the section of the N_l .

To calculate the individual average of the number of advanced (N_a) and late (N_l) reactions, only indicators corresponding to the methodological norm for the average reaction time (ART) are used [6]. If at dynamic control of the functional state the surveyed showed the result exceeding standard value (for the technique of RMO the average reaction time (ART) should not exceed 100 milliseconds), for calculation of the individual average indicator it is necessary to use results of the following dynamic control of the functional state.

7. To determine the minimum and maximum individual standard indicators number of advanced (N_a) and late (N_l) reactions of the technique of the RMO we should use data of the last six measurements: measurements the data of three when a person admitted to work and three more subsequent dimensions following DCFC. Choose from an analyzed number of indicators of advanced (N_a) and late (N_l) reactions minimum value – the minimum individual standard values of advanced (N_a) and late (N_l) reactions,

and maximum values – the maximum individual standard indicators of advanced (N_a) and late (N_l) reactions. To write in a simple fraction – individual minimum standard indications technique (numerator) and maximum individual standard rate according to the method (denominator) in to the column "Individual standard", N_a RMO and RMO N_l .

8. When making a conclusion about the functional condition it is necessary to compare the data obtained by DCFC with indicators of individual standard.

The algorithm for calculating of the individual norm for the method of assessment of the reaction to a moving object (RMO) for the psychodiagnostic system "Vibor".

In the psychodiagnostic complex "Vibor" data on the method of RMO show the average time of the advanced reaction – ART_a (indicator with the sign a "mine") and the average time of the late reaction – ART_l (indicator with the sign "plus"). In order to bring the diagnostic data to a single standard, it is necessary to calculate the average reaction time (ART) and to enter it in to the individual card of the results of dynamic control of the functional condition.

1. To calculate the average reaction time (ART) by the formula

$$ART = (|ART_a| + |ART_l|) / 2,$$

where ART is the average reaction time;

ART_a – the average time of the advanced reaction;

ART_l – average time late reaction;

2 – number of indicators.

To calculate the individual average indicator, only indicators corresponding to the methodological norm are used. If at dynamic control of the functional condition the surveyed showed the result exceeding standard value (for the technique of RMO the average reaction time (ART) should not exceed 100 milliseconds), for calculation of the individual average indicator it is necessary to use results of the following dynamic control of the functional condition.

2. To calculate the indicator of root-mean-square deviation according to the formula: root-mean-square deviation (RMSD) = $(RMSD_a + RMSD_l) / 2$,

where RMSD – root-mean-square deviation;

$RMSD_a$ – root-mean-square deviation of the advanced reaction;

$RMSD_l$ – root-mean-square deviation of the late reaction;

2 – number of indicators.

If you get a decimal number, then round it to integers.

Further we act according to the algorithm of calculation of indicators for UPDS: count individual average indicator (ART) of root-mean-square deviation (RMSD), define minimum and maximum individual standard indicators of average reaction time (ART) and root-mean-square deviation (RMSD), calculate individual averages indicators, and minimum and maximum individual standard indicators of the number of advanced (N_a) and late (N_l) reactions.

The conclusion about the functional condition is an important thing. If there are individual average indicators, the following conclusions are made: "Functional state is within the norm"; "Functional condition is reduced"; "Functional condition is below the individual norm". At unsatisfactory performance of one of the techniques by DCFC the conclusion on a functional condition is taken out at the discretion of the psychologist. For example, if the indicator slightly deviates from individual norm, it is possible to draw the conclusion that the functional condition is reduced; if the indicator significantly deviates from the individual norm or in the course of the research, the psychologist finds evidence of a possible violation of the functional condition, it is possible to conclude that the functional condition is reduced. In this case the employee is sent to an extended psychophysiological examination. Extended psychophysiological examination is aimed at an in-depth study of the functional state, professional performance and personal characteristics of the employee.

III. CONCLUSION

The conclusion about the functional condition is written in to the individual card of the results of the dynamic control of the functional condition of transport workers, which allows to organize and analyze the data, specifying the individual indicators of workers.

Thus, the application of the developed algorithm for data comparison and calculation of individual average and individual norm for different psychodiagnostic complexes allows to avoid the interruption of the system of dynamic observation and ensure the reliability of DCFC indicators, which, in turn, allows to predict the psychophysiological condition transport's workers.

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