

ABOUT RELIABLE INDICATOR OF PROPRIOCEPTION IN AGILITY CONTROL

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Annotation. Agility is seen as a complex physical quality due to a complex interaction of motor, visual, auditory, vestibular analyzers. A special role in this development is given to kinesthesia. This motor feeling largely determines the accuracy of the differentiation of power, temporal and spatial characteristics of voluntary movement and is regarded as one of the main indicators of quality in the structure of human mobility. *The purpose of the study* - to make a proposal to improve the procedures for monitoring mobility by quantifying the state of kinesthesia exercise. *Material and methods.* The study included 101 soccer players at the age of 14-18 years. Measured fidelity 50% of the maximum values of the force in the joints of upper and lower extremities seven times. Reliability measurement was evaluated by calculating the linear correlation between the results in the sequential series. Stability measurements evaluated in the same way between the results of precision in the first and seventh attempt.

Results. Among the surveyed found significant individual differences in the state of kinesthesia joint efforts in terms of accuracy. Also, different abilities learning accuracy differentiation efforts in a series of successive measurements.

Conclusions. The expediency of improving the control of mobility in the direction of study of quantitative and qualitative assessment of kinesthesia in the specific conditions of physical education.

Keywords: kinesthesia, control, differentiation, strength, joints, upper, lower extremity.

Introduction

Psycho-physiological principles and pedagogical aspects of training of dexterity, as one of human physical quality, have been comprehensively studied and reflected in the works of well-known specialists [1, 7, 10, 11, 13-16]. It has been shown, that kinesthesia (feeling of motion) mechanisms, which permits to differentiate accuracy of power, time and space characteristics of arbitrary movements in specific conditions of activity, underlie this quality. While perfection of kinesthesia mechanisms, to great extent, is conditioned by co-adjustment of activity of motion and other analyzers, that permit to quickly master new, complex co-ordinations, including taking optimal motion decisions in extreme, sudden conditions. In this connection it can be assumed that further cognition of psych-physiological mechanisms of dexterity can be directly connected with improvement of procedure of human kinesthetic state's measuring.

Concerning the problems of applied character, in particular improvement and control of dexterity in conditions of physical education and sports, here, in our opinion, there appear opportunities for further perfection. It is enough to carry out comparative analysis of materials, devoted to the problem of control in theory and methodic of education of adjoining physical qualities, videlicet, endurance, strength and quickness. Here physiological mechanisms, conditions of manifestation, qualitative and quantitative criteria, requirement to organization of control are clearly formulated [4, 5, 9].

Concerning the established practice of control's organization and formation of dexterity state's evaluation, this quality is controlled and estimated, in the most cases, by results of tests of indirect character. For example, by the time of test's fulfillment in different modifications of short distance run [4]. In this case, conclusions about dexterity's level become directly dependent on the level of other quality, for example quickness, and are expressed in seconds- units for measuring of quickness. Such practice of organization of dexterity control can not meet metrological requirements of objectiveness and reliability of estimations it is accepted in physical education and sports [10, 11]. Alongside with it, materials of this article do not exclude application of established traditions, methods and means for evaluations in the system of dexterity control. Here we present materials of research, underlining purposefulness of improvement of system of dexterity control, oriented on objective quantitative evaluation of kinesthesia state of trainees, as its integral component.

Purpose, tasks of the work, material and methods

The purpose of the research is to propose improvement of dexterity control procedure, by means of quantitative evaluation of kinesthesia's state of people, doing physical exercises.

The model of the research was built on procedure of kinesthesia's state measuring in joints of superior and lower limbs of the tested group in direction of increasing of measurements' reliability with differentiating of 50% from maximal values of strength.

The tasks:

1. To metrically describe reliability and stability of results of strength differentiation's accuracy measurement with multiplex repeated task in different joints.
2. To ground the procedure of objectification of kinesthesia' state evaluation, considering trend in series of sequential measurements.

It can be assumed that using of objective metrically reliable information about kinesthesia's state of trainees will permit to improve the system of dexterity control, increase reliability of diagnostic and prognostic evaluation of sportsmen's abilities in kinds of sports with complex structure of locomotion.

101 football players of 14-18 years old age took part in the research. From them: 18 years old -32 persons; 16.3 years old – 20 persons; 14.9 years old – 49 players. The research was conducted in scientific laboratory with observation of standard metrological requirements [2]. Measurements of accuracy of force differentiation in joints of superior and lower limbs were fulfilled seven times in static mode. Force value was registered in newtons with tensometric dynamometer DR4-P in block with potentials amplifier WTP3 and computer program MAXv5.5 (JBA, Poland). In compliance with conditions, every tested rendered forces 50% from his, previously registered maximal possibilities in each of joints for seven times.

Reliability of measurements was estimated by calculating of linear correlation coefficient between results of accuracy of 50% force rendering in pairs of sequential measurements in series of seven repetitions of task.

Stability of measurements was calculated by the same static method but between results of the first and the seventh measurement [5, 12].

Results of the research

The character of static distribution of accuracy results of forces differentiation in joints of superior and lower limbs was calculated separately for every age group of the tested. It was necessary as far as the quantitative membership of groups is different and in total quantity of data it would inevitably result in distortion of total curve of statistic distribution. Grouping of variants (value of measurements' errors) we carried out graphically, basing on commonly known approaches [7]. 98% of all results were located on sigmoid scale, within five its limits, corresponding to rule $\pm 3\sigma$. Mean limit of the scale was equal to mean value and contained all results of the tested within limits $\pm 1\sigma$. In further four limits of the scale results within limits $\pm 2\sigma$ и $\pm 3\sigma$ were located. As example, illustrating total character of statistic distribution of control measurements' results in age groups, we present indicators of accuracy of forces differentiation of 14 years old players' group (see fig.1).

As it is seen in fig.1 building of frequency polygon and histograms permitted only relatively consider that the scope of measurements of forces differentiation's accuracy of this age group meets the requirements of normal character. Here in the left part of histogram from mean value there are 21 measurements and in its right part – only 16. The similar, to some extent, asymmetric character was seen in the mass of results of forces' differentiation results' accuracy of other groups of the tested.

Frequencies	2	5	14	12	7	8	1
Cases, n			• • • • • • • • • • • •	• • • • • • • • • • •	• • • • • • • • •	• • • • • • • • •	•
Limits of grades (N)	179	205	235	M 256,7	284	307	332
	-3σ	-2σ	-1σ		1σ	2σ	3σ

Fig.1. Grouping of results of measurements' accuracy of forces evaluation (50% Fmax, N) in elbow joint of 14,9 years old tested (n=49)

Attention is also attracted by high variability of accuracy of forces differentiation in every of seven sequential measurements in every age group in joints of superior and lower limbs (see table 1).

Table 1.

Indicators of forces differentiation's accuracy in joints (N) of different age representatives (n=101)

Age, years	Hand		Elbow		Knee	
	M± σ	V%	M± σ	V%	M± σ	V%
18,0	43,5 19,1	88,6	21,9 8,1	78,4	39,1 16,7	74,5
16,3	40,4 17,7	87,9	28,6 10,6	78,3	41,4 18,6	84,3
14,9	32,0 13,2	82,7	18,8 8,0	75,5	27,0 10,3	75,9

As it can be seen in table 1 and fig.1 statistic distribution of total mass of experimental data of 101 respondents in series of seven sequential measurements of accuracy of forces differentiation in each joint was asymmetric. At the same time low accuracy of reproduction of repeated measurements was shown by most of the tested. Probably, low reproducibility of results of forces differentiation's accuracy (V% within 74,5 – 88,6) concerning some of the tested, can be explained by individual psycho-physiological peculiarities of contingent. Both geno- and phenotype factors can underlie the basis of such differences. In general, such differences between people can be considered natural. This exactly explains purposefulness of development and implementation of kinesthesia's state evaluation into practice of general system of dexterity's control.

At the same time, in all groups of the tested, in series of seven repeated measurements of forces differentiation's accuracy we marked clearly expressed trend of results from the first to the seventh measurement (see table 2).

Table 2.

Example of the trend of results of differentiation's accuracy 50% Fmax in elbow joint in the group of 14.9 years old tested (n=49)

Vakue of measurements' errors							
Measurements	1	2	3	4	5	6	7
Error (N)	31,7 ±13,0	22,6 ±11,9	18,9 ±10,9	14,1 ±9,9	15,7 ±7,6	13,3 ±6,9	14,0 ±7,3
Coefficients of correlations between repeated measurements							
	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	
	0,691	0,756	0,710	0,803	0,899	0,807	
% of comparability of repeated measurements							
	71,3	88,6	74,6	88,8	91,5	89,0	

In this case it was necessary to objectively, metrically show, which measurements from this series can be recognized as statistically reliable. For this purpose, we used commonly accepted method of calculation within test coefficients of correlation [5]. We calculated coefficients of linear correlation between adjoining measurements in series of seven attempts (test-retest method). In our opinion, calculation of correlation coefficients between measurements in such sequence could permit to more accurately characterize reliability, i.e. comparability of repeated measurements' results in situation of expressed trend (see table 2).

Comparison of results of reliability of measurements, registered in our research (see table 2), with general metrological requirements [5], is presented in fig.2.

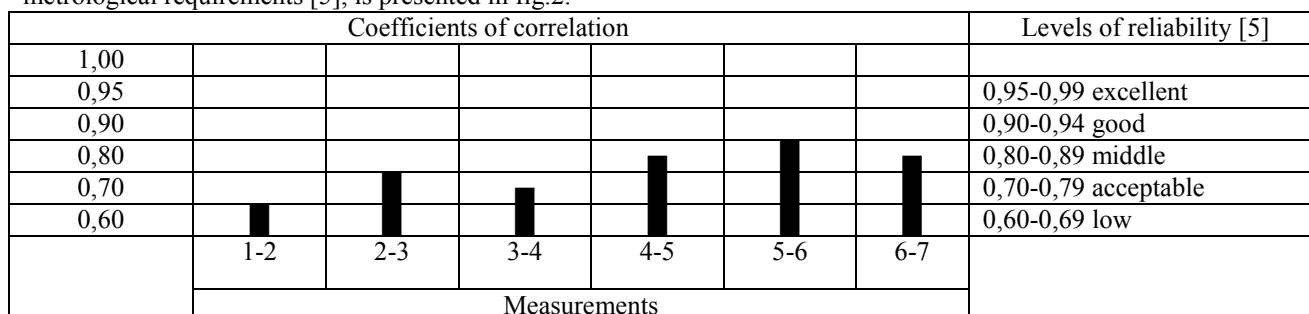


Fig.2. Diagram of establishing and evaluation of differentiation's accuracy 50%Fmax in series of sequential measurements in elbow joints of 14.9 years old football players (n=49)

Results of calculation permit to trace the character of trend of forces differentiation's accuracy of the tested in objective metric units of measurements (see table 2) and in coefficients of correlation, which characterize comparability of results of adjoining measurements in series. In the research we can clearly see the trend of increase of forces' differentiation's accuracy from measurement to measurement. As it is seen in fig.2, in our research already to 5th – 6th attempt the tested demonstrated sufficiently comparable, identical measurements' results at middle level of metrological reliability.

Results of forces differentiation's accuracy, which were registered in series of sequential measurements, permitted to objectively evaluate the state of kinesthesia of the tested by absolute values of accuracy and by quickness of learning capability of forces accuracy.

Discussion of the results

Thus, the main results of the research permit to make some conclusions. First: in the contingent of the tested of 14-18 years old age there were players with different level of kinesthesia development in conditions of differentiation of muscular forces. These differences were expressed in accuracy of reproduction of the set forces with repeated measurements as well as in the rates of learning capability concerning the accuracy of forces differentiation in series of seven sequential measurements. We can assume that different level of kinesthesia's development of different tested is of

natural population character, to large extent conditioned by genotype and phenotype factors. In this connection it becomes purposeful to evaluate the state of kinesthesia in total system of dexterity's evaluation, using, for this purpose, objective quantitative and qualitative criteria. Two criteria can be used for this: stability of reproduction of accuracy of repeated test tasks and quickness of learning of stable high accuracy of measurements.

Secondly, we can assume that it would be reasonable to carry out further perfection of evaluation system of kinesthesia's state in direction of grounding of complex estimation as ability to differentiate accuracy of power, time and space parameters of arbitrary movements.

Besides, it is necessary to consider literature data, which witness about poor transition of kinesthesia's state, formed in certain co-ordination conditions, into adjoining conditions of muscular activity [see reviews 7, 8]. In this connection it is reasonable to evaluate kinesthesia's state on the base of accuracy of differentiation of power, time and space movement's characteristics, in conditions of applying of specific test tasks. For example, in outdoor games such tasks can be accuracy of ball's throws from different initial positions in static and dynamic modes. Similar techniques can be used in other kinds of sports.

In general, materials of metrological evaluation of kinesthesia's state with differentiation of forces in joints, which were presented in the present article, can serve for grounding of general methodology of researches in the field of further perfection of kinesthesia's state, as a component of dexterity, control.

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