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Original Article

Psychophysiological features of 15-16-year-old hockey players with various types of heart rate regulation

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Abstract
The study aims to determine the features of the psychophysiological profile of 15-16-year-old hockey players with various types of heart rate regulation. 15-16-year-old elite hockey players participated in the study. Heart rate variability study was carried out in the preparatory and competitive training periods (July-December-February). Well-established psychophysiological methods were used (namely, recording the time and accuracy of visual sensorimotor reactions, assessing the functional status of the cortical areas of the central nervous system) along with psychological methods (Luschercolortest) and HRV analysis with heart rate regulation types detection.
Psychophysiological features of the dynamics of psychomotor abilities, as well as the functional and emotional statuses in hockey players with a predominance of central (Type I - II) and autonomous (Type III - IV) mechanisms of heart rate regulation are revealed in a training macrocycle (July - December - February). In July, Type I - II hockey players had decreased values of the functional status of the cortical centers of the central nervous system (interference)compared to Type III - IV players. In the competitive period, these differences wereleveled. Regardless of the type of heart rate regulation, by the end of the competitive period, there was a decrease in the reaction time (interference), an improvement in the accuracy ofchoice reactions (CR) and a decrease in the accuracy of moving object reactions (MOR). In hockey players withType III - IV, the patterns of a decrease in the speed of SMR and choice reactions were observed together with the improvement of CR accuracy. In hockey players withType III-IV, the functional status of the cortical areas of the central nervous system remains stable throughout the entire training period. In players with Type I - II (interference), it tends to deteriorate. Regardless of the type of regulation, by the end of the competitive period, the concentration of excitation improves. The emotional statuscan be described by multidirectional trends.
Keywords:psychophysiological status, functional status, heart rate variability, athletes, hockey

Introduction

The performance of the functional systems responsible for the organization of movements is determined by many factors, includingthe psychophysiological status (Ilyin E.P., 2003; Suvorov GB, &Chesnokov VB, 2009;Ion-Ene M., Iconomescu T.M., Talaghir L.G., Neofit A., 2016). The formation of new movements occurs due to the plasticity of the nervous system (Kandel E.R., Schwartz J.H., &Jessell T.M., 2000). The properties of nerve centers (excitability, mobility and lability) and the balance of nervous processes affect the development of physical qualities (speed, coordination, strength and speed-strength abilities) (Ilyin E.P., 2003; Cherepov E.A., Kalugina G.K., Khafizova A.S., 2019; Galan, Y., Zoriy, Y., Briskin, Y.,Pityn, M., 2016; Berdilă, A., Talaghir, L.G., Iconomescu, T.M., & Rus, C.M., 2019).

In functional systems responsible for the organization of movements, the interaction of the somatic and autonomous components plays an important role (Bernstein N.A., 2004). Consistency in their performance provides a high degree of efficiency at the lowest "physiological cost" of muscle work. Heart rate variability (HRV) is widely used to assess the mechanisms responsible forthe regulation of visceral systems (Sivokhov V.L., Sivokhova E.L., &Mirolevich D.V., 2010; Abad CC, do Nascimento AM, Gil S, Kobal R., Loturco I., Nakamura FY, Mostarda CT, & Irigoyen MC, 2014; Leti T., &Bricout VA, 2013; Plews, DJ, Laursen, PB, Le Meur, Y., Hausswirth, C., Kilding, AE, &Buchheit, M., 2014; Danieli A., Lusa L., Potočnik N., Meglic B., Grad A., &Bajrovic FF, 2014; Plews DJ, Laursen PB, Stanley J., Kilding AE, &Buchheit M ., 2013).

In recent decades, when assessing HRV indicators and their dynamics, much attention has been paid to the typological approach (Shlyk, NI, 2009; Shlyk N.I., Sapozhnikova E.N., Kirillova T.G., & Semenov V.G., 2009; Gavrilova, EA, 2015). The typological approach in the scientific school of N. Shlyk distinguishes four types of heart rate regulation - two types with centralization: moderately expressed (Type I) and significantly

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expressed (Type II) and two types with autonomy: moderately expressed (Type III) and significantly expressed (Type IV). It is believed that the types of regulation are hereditary (Shlyk N.I., 2009).

According to the authors, athletes with TypeIII heart rate regulation adapt to physical exertion with a minimum physiological "cost" (Shlyk N.I., Sapozhnikova E.N., Kirillova T.G., & Semenov V.G., 2009; Shlyk N. I., Lebedev E.G., &Vershinina O.S., 2019). Type IV regulation can have a double meaning and corresponds to both the optimal state of the body (high fitness) and a pre-pathological one (Shlyk N.I., 2009). For athletes withType I and II (the predominance of the central mechanisms of heart rate regulation), in contrast to their peers who do not go in for sports, the functional status differs depending on the period of training. Athletes with the predominance of the central mechanisms of heart rate regulation in the preparatory period of the annual macrocycle should be under the supervision of specialists in sports medicine.

The maximum risk of overtraining during this period is observed in athletes withType II heart rate regulation (significantly expressed centralization) (Shlyk N.I., 2009). However, in the competitive period, Type I and II can be interpreted as a high level of competitive readiness. During this period, researchers registered an increase in centralization in heart rate regulation (Earnest CP, Jurca R., Church TS, &Chicharro JL, 2004; Shlyk, NI, 2009; Agadzhanyan N.A., Batotsyrenova T.E., & Semenov Yu.N. , 2006; D'Ascenzi F., Alvino F., Natali BM, Cameli M., Palmitesta P., Boshetti G., Bonifazi M., Mondillo S., 2014). In hockey, such studies are scarce, especially when it comes to puberty. An increase in disturbing environmental influences, including psychogenic factors, can lead to a mismatch between the somatic and autonomous components of the functional systems responsible for the organization of movements.

Hypothesis: there are differences in the data of the psychophysiological status of 15-16-year-old hockey players depending on the degree of heart rate autonomy or centralization.

Purpose of the study: to determine the features of the psychophysiological profile of 15-16-year-old players with various types of heart rate regulation.

Materials&Methods

The study of HRV features in15-16-year-old hockey players was carried out during the 2010/2011 competitive season. The study was divided in three stages, which in time corresponded to the beginning of the preparatory period (July), the middle of the competitive period (December) and the end of the competitive period (February). Study conditions were standardized: morning time, same researcher, one day of rest between training sessions.

Psychophysiological research methods. The examination was carried out at relative rest using the NS-Psychotest software and hardware complex (Neurosoft, Russia). The time of sensorimotor reactions was determined, namely, a simple motor reaction (SMR), a choice reaction (CR), a moving object reaction (MOR), a reaction in conditions of interference (interference). In addition to the time of sensorimotor reactions, reaction accuracy was calculated for SMR, CR, Reaction time (interference) by using the Whipple coefficient (WC); for MOR the relative number of accurate, advanced and delayed reactions (in%) was used. The functional status of the cortical nerve centers was determined for two types of reactions (SMR and the reaction under interference) according to the criteria of T.Loskutova (cited by IN Mantrova, 2007): the functional level of the system (FLS), reaction stability (RS) and the level of functional capabilities (LFC). The values of FLS, RS and LFC were calculated using logarithmic equations (Mantrova I.N., 2007). The concentration of excitation was determined as the ratio of the average time of simple motor reactions and the time of reactions in conditions of interference. The psychological status of the subjects was determined using the Luschercolortest: the indicators "Total deviation from the autogenous norm" and "Anxiety" were calculated (Mantrova IN, 2007).

Heart rate variability. An electrocardiogram (ECG) was recorded in the supine position (5 minutes). The HRV study was conducted according to international standards (Heart rate variability. Standards of measurement…, 1996). The VNS-MICRO software and hardware complex was used (Neurosoft, Russia). The equipment has an international certificate of conformity. The type of heart rate regulation was determined by rapid HRV analysis (Shlyk N.I.)in the authors' modification: Type I (moderate predominance of central mechanisms); Type II (pronounced predominance of central mechanisms); Type III (moderate predominance of autonomous mechanisms); Type IV (pronounced predominance of autonomous mechanisms). To determine the type of regulation, spectral analysis and variational pulsometry were used (Mikhailov V.M., 2000; Gavrilova E.A., 2015). Spectral analysis provided for the calculation of the following indicators: TP (ms^2) - the sum of all waves in the spectrum; HF (ms^2) - power of high frequency waves (0.15-0.40 Hz); LF (ms^2) - power of low frequency waves (0.04-0.15 Hz); VLF (ms^2) –power of very low frequency waves (≤0.04 Hz). The stress index (SI) was calculated according to the formula:

$$SI = \frac{AMo}{2BP \cdot Mo},$$

where Mo is the range of values of the most frequent cardiac intervals; AMo - the number of cardiac intervals into the Mo range; VR - the difference between the maximum and minimum values of the cardiac interval. The stress index reflects the degree of centralization in heart rate regulation. The method of N. Shlykwas modified by specifying quantitative criteria in accordance with the recommendations of R.M. Baevsky (Baevsky, R. M., & Ivanov, G. G., 2000). Criteria for determining the type of heart rate regulation: Type I (SI - more than 90 cu; VLF - more than 250 ms^2; TP - 1500-2900 ms^2); Type II (SI - 100 cu and more; VLF - less than 250 ms^2; TP - less than 1500 ms^2); Type III (SI - 25-89 cu; VLF - more than 250 ms^2; TP –2500-6000 ms^2); Type IV (SI - 24 cu and less; VLF - more than 250 ms^2; TP - 8000-10000 ms^2 or more).

Statistical processing of the results obtained was carried out by nonparametric methods according to the Mann-Whitney and Wilcoxon criteria in the Statistica 10.0 program.

Results

Intragroup differences in psychophysiological indicators for different types of heart rate regulation were registered only at the beginning of the training process (July), namely, in terms of the number of delayed moving object reactions (MOR) and criteria for the functional status of the central nervous system (SMR) (Tables 1-3). In the competitive training period (December and February), all intergroup differences in psychophysiological indicators weredisappearing.

During the competitive period there were no intragroup differences in all psychophysiological datain hockey players withTypeI-II heart rate regulation (p>0.05 in all cases). Unlike hockey players withTypeI-II heart rate regulation, in hockey players withTypeIII – IV, by February, there was an increase in motor reaction time (197.75 ± 2.91; 16.49 (July); 192.71 ± 4.16; 15.55 (December); 203.67 ± 3.47; 17.01 (February); $p_{(December-February)} = 0.050$) and choice reaction time (293.00 ± 14.01; 39.62 (July); 297.50 ± 4.21; 14.59 (December); 319.04 ± 7.02; 34.38 (February); $p_{(December-February)} = 0.032$).

Table 1. Speed and accuracy of motor reactions of 15-16-year-old hockey players depending on heart rate regulation type

Indicator	July		p	December		p	February		p
	Type I – II M±m; σ (n=11)	Type III – IV M±m; σ (n=32)		Type I – II M±m; σ (n=8)	Type III – IV M±m; σ (n=22)		Type I – II M±m; σ (n=8)	Type III – IV M±m; σ (n=25)	
SMR (reaction time), ms	202,18± 4,61; 15,28	197,75± 2,91; 16,49	0,446	205,75± 8,88; 17,76	192,71± 4,16; 15,55	0,233	197,88± 6,61; 18,69	203,67± 3,47; 17,01	0,654
SMR (WC), cu	0,96 ± 0,01; 0,02	0,94± 0,01; 0,07	0,816	0,99± 0,02; 0,03	0,95± 0,01; 0,04	0,101	0,96± 0,01; 0,02	0,96± 0,01; 0,03	0,685
CR (reaction time), ms	326,00± 16,27; 39,85	293,00± 14,01; 39,62	0,142	302,25± 7,30; 14,59	297,50± 4,21; 14,59	0,645	326,00± 16,30; 46,09	319,04± 7,02; 34,38	0,404
CR (WC), cu	0,90 ± 0,02; 0,04	0,89± 0,02; 0,07	0,662	0,90± 0,02; 0,03	0,90± 0,02; 0,03	0,959	0,91± 0,03; 0,08	0,91± 0,01; 0,06	0,848
Interference (reaction time), ms	330,64± 9,52; 31,56	321,48± 3,89; 21,63	0,498	335,50± 14,51; 29,01	314,21± 3,82; 14,30	0,277	314,63± 6,89; 19,49	308,54± 4,29; 21,03	0,535
Interference (WC), cu	0,9 5± 0,01; 0,04	0,93± 0,01; 0,04	0,257	0,98± 0,01; 0,03	0,88± 0,07; 0,25	0,127	0,92± 0,02; 0,07	0,96± 0,01; 0,05	0,104
MOR, ms	-5,50± 2,17; 6,87	-1,71± 1,32; 7,24	0,148	3,78± 5,06; 10,13	-0,50± 1,65; 6,18	0,574	-0,02± 1,46; 4,12	-1,13± 1,07; 5,26	0,564
MOR (number of accurate responses), %	51,60±2 ,96 9,35	56,68± 2,14; 11,70	0,102	53,50± 4,45; 9,11	53,07± 2,55; 9,56	0,878	46,25± 3,39; 9,59	51,04± 3,82; 18,71	0,404
MOR (number of advanced responses), %	28,80± 3,09; 9,77	31,40± 2,11; 11,57	0,590	18,25± 5,12; 10,24	31,21± 3,16; 11,83	0,061	27,63± 4,56; 12,88	34,29± 4,30; 21,05	0,564
MOR (number of delayed responses), %	19,60± 2,60; 8,24	11,93± 1,50; 8,23	0,022	28,25± 8,73; 17,46	15,64± 2,09; 7,82	0,127	26,13± 6,39; 18,08	14,71± 2,48; 12,16	0,064

Table 2. The functional status of the central nervous system of 15-16-year-old hockey players depending onheart rate regulation type

Indicator	July		p	December		p	February		p
	Type I – II M±m; σ (n=11)	Type III – IV M±m; σ (n=32)		Type I – II M±m; σ(n=8)	Type III – IV M±m; σ (n=22)		Type I – II M±m; σ (n=8)	Type III – IV M±m; σ (n=25)	
FLS (SMR), s^{-2}	3,65± 0,56; 1,85	4,62± 0,16; 0,91	0,016	4,63± 0,10; 0,21	4,59± 0,36; 1,36	0,158	4,24± 0,62; 1,75	4,63± 0,21; 1,02	0,749
RS (SMR), s^{-1}	1,36± 0,27; 0,91	2,05± 0,12; 0,65	0,014	1,90± 0,30; 0,61	2,20± 0,21; 0,79	0,327	1,99± 0,33; 0,94	2,11± 0,12; 0,59	0,848
LFC (SMR), s^{-2}	2,71± 0,45; 1,49	3,66± 0,16; 0,88	0,019	3,50± 0,30; 0,61	3,76± 0,32; 1,20	0,277	3,45± 0,53; 1,50	3,70± 0,18; 0,89	0,782
FLS (interference), s^{-2}	3,73± 0,58; 1,92	3,23± 0,40; 2,20	0,896	3,35± 1,13; 2,25	3,38± 0,51; 1,90	0,878	3,41± 0,78; 2,20	3,43± 0,38; 1,85	0,915
RS (interference), s^{-1}	1,85± 0,33; 1,09	1,55± 0,21; 1,14	0,516	1,78± 0,63; 1,25	1,37± 0,25; 0,93	0,382	1,68± 0,52; 1,50	1,43± 0,18; 0,86	0,983
LFC (interference), s^{-2}	2,78± 0,45; 1,50	2,41± 0,30; 1,66	0,735	2,60± 0,88; 1,77	2,31± 0,37; 1,39	0,574	2,56± 0,66; 1,88	2,38± 0,27; 1,33	0,983
Concentration of excitation, %	38,51± 1,67; 5,54	38,26± 0,95; 5,30	0,978	38,52± 2,10; 4,20	38,59±1 ,10; 3,97	1,000	37,11± 1,67; 4,71	35,39±2,0 2; 9,88	0,204

Table 3. Psychological data of 15-16-year-old hockey players depending on heart rate regulation type

Indicator	July		p	December		p	February		p
	Type I – II M±m; σ (n=11)	Type III – IV M±m; σ (n=32)		Type I – II M±m; σ(n=8)	Type III – IV M±m; σ (n=22)		Type I – II M±m; σ (n=8)	Type III – IV M±m; σ (n=25)	
Anxiety, cu	2,64± 0,73; 2,42	2,31± 0,45; 2,52	0,631	3,13± 1,01; 2,85	2,00± 0,50; 2,19	0,360	2,00± 0,71; 2,00	1,91± 0,54; 2,00	0,611
Total deviation from the autogenous norm, cu	14,00± 2,17; 7,21	14,19± 1,18; 6,67	0,967	15,63±2 ,28; 6,46	12,37± 1,19; 5,18	0,283	15,50± 1,92; 5,43	12,44± 1,51; 7,23	0,203

Among the indicators of both the emotional status and the functional status of the central nervous system, changes are statistically significant only in terms of concentration of excitation: 38.26% ± 0.95; 5.30 (July); 38.59% ± 1.10; 3.97 (December); 35.39% ± 2.02; 9.88 (February); $p_{(July-February)} = 0.025$; $p_{(December-February)} = 0.026$. In the observation period, general trends were revealed, namely, a decrease in the reaction time in conditions of interference (Figure 1); improved accuracy in choice reaction (Figure 2). Regardless of the type of heart rate regulation, there is a trend towards a decrease in the number of accurate moving object reactions (R2 = 0.51 –Type I - II; R2 = 0.70 –Type III - IV).

Hockey players withType III - IV are characterized by an increase in the accuracy of SMR (Figure 2b) and an increase in the number of advanced and delayedmoving object reactions (R2 = 0.97 and R2 = 0.52, respectively). The increased number of delayed responses is typical for players withType I - II (R2 = 0.52). In the conditions of simple activity, hockey players with Type I-II demonstratedimprovementin the functional status of the central nervous system according to two criteria proposed by T. Loskutova - RS(SMR) and LFC (SMR) (Figure 3b).

For hockey players withType I - II, by February, a downward trend was revealed according to all criteria of T. Loskutova, namely,FLS (interference), RS (interference) and LFC (interference) (R2 = 0.61; R2 = 0.99 and R2 = 0.88, respectively).For players with Type III - IV an upward trend was observed in terms of FLS (interference) (R2 = 0.92) with stable values of RS (interference) and LFC (interference). Hockey players with Type I - II were characterized by an increase in the concentration of excitation in the central nervous system (Figure 3a).

Significant differences were observed in the nature of trends in the indicators of the functional status of the central nervous system (Figure 3b-5).

a) b)

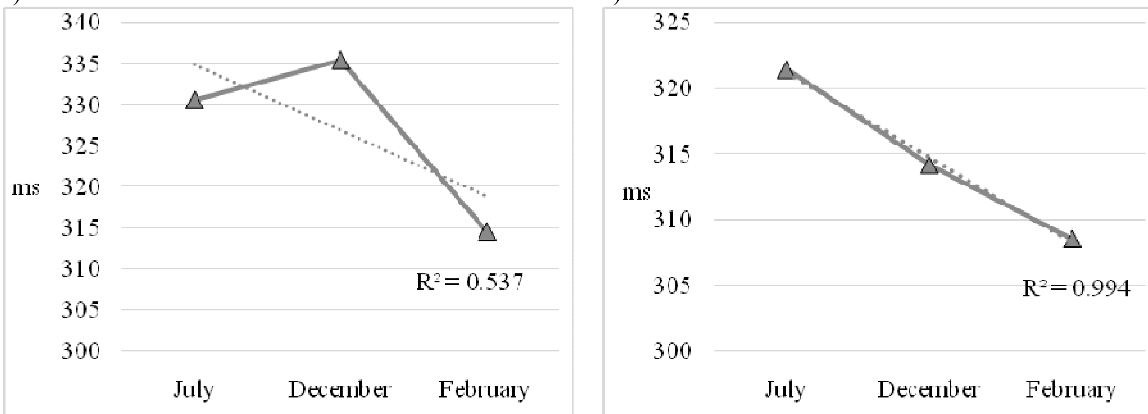

Figure 1. Dynamics of the reaction time (interference) of 15-16-year-old hockey players **depending on heart rate regulation type**

a) TypeI – II; b) TypeIII – IV

Note: R^2 – approximation coefficient; – trend line

a) b)

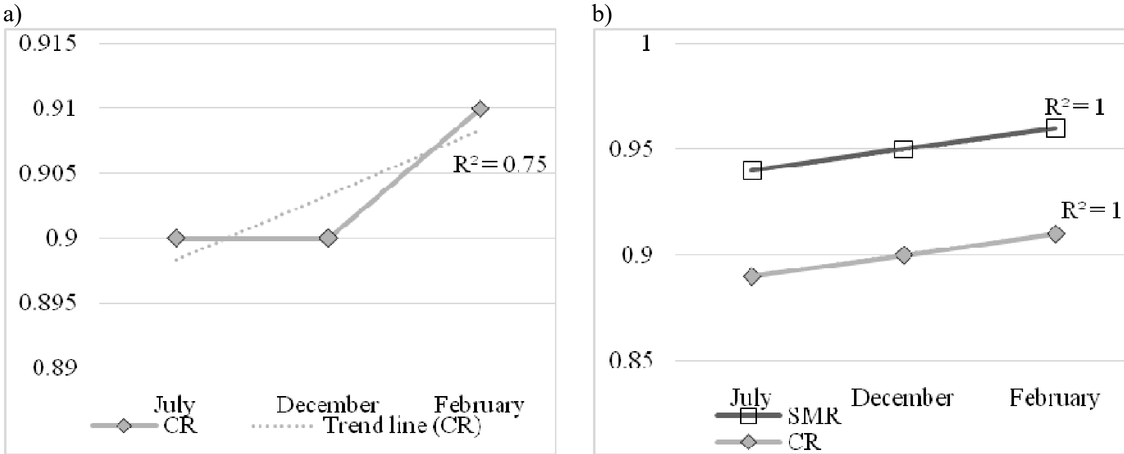

Figure 2. Dynamics of accuracy of sensorimotor integration (WC) of 15-16-year-old hockey players **depending on heart rate regulation type**

a) Type I – II; b) Type III – IV

Note: R^2 – approximation coefficient; SMR – simple motor reaction; CR – choice reaction

a) b)

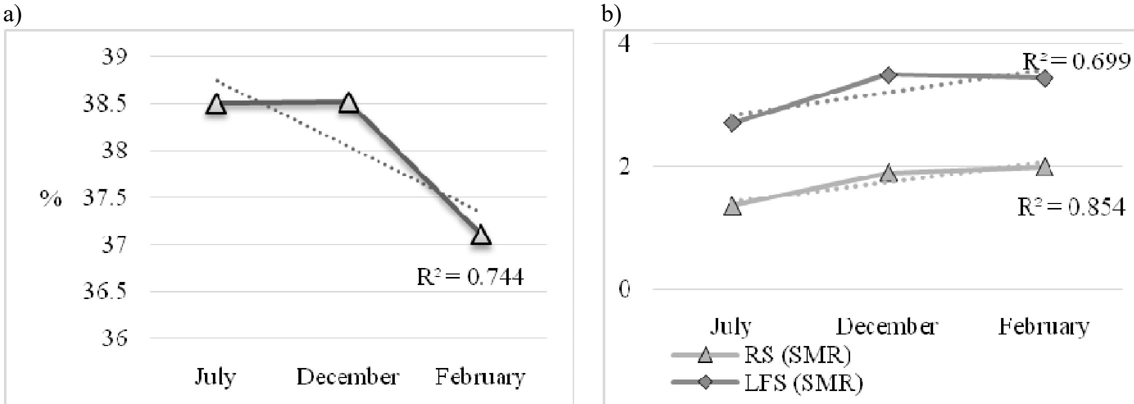

Figure 3. Dynamics of concentration of excitation and the functional status of the cortical centers of the nervous system (SMR) of 15-16-year-old hockey players **with Type I - II**

a) concentration of excitation; б) T. Loskutova criteria

Note: R^2 – approximation coefficient; – trend line

In hockey players with different types of heart rate regulation and the same initial values,opposite trends were revealed in terms of their emotional status. Despite the absence of statistically significant intergroup differences, by February, hockey players with Type I - II were characterized by an increase in Total deviation from the autogenous norm (approximation coefficient 0.69). At the same time, hockey players with Type III – IV were characterized by a decrease in the same indicator (approximation coefficient 0.72).

Discussion

In team sports, the situational nature of activity imposes high demands on the speed and efficiency of sensorimotor integration of movements. Sensorimotor integration is characterized by the speed and accuracy of simple and complex motor reactions under conditions of disturbing influences (Pascual-Leone A., Amedi A., Fregni F., Merabet L. B., 2005). Intragroup differences in psychophysiological data for different types of heart rate regulation were observed only at the beginning of the training process (July), namely, in the number of delayed moving object reactions (MOR) and criteria for the functional status of the central nervous system (SMR). In particular, in hockey players with Type I - II, these indicators are worse compared to athletes with Type III-IV. In hockey players with Type I - II, inhibition processes are more pronounced when predicting the trajectory of movements of a significant stimulus due to an increase in the refractory period in cortical neurons. A greater number of delayed responses in hockey players with Type I – II is characteristic only for the adolescent period. According to the literature, the number of delayed responses is minimizedfor older players (17-21 years old, Type I - II) (Kharitonova L.G., Pavlova N.V., Lindt T. A., & Makarova IM, 2009).There are no differences in FLS, RS,LFC(interference) and the emotional status in players with Type I - II compared to hockey players with Type III - IV. However,there is a decrease in the indicators of the functional status of the cortical centers of the central nervous system (for simple activity). A specific feature of the cortical nerve centers in players with a predominance of centralization (Type I - II) is a high mobilization activity of the cortical nerve centers in response to significant stimuli and a high degree of resistance to protective inhibition under the simultaneous action of various exogenous irritants. In the competitive period (December and February), all intergroup differences in psychophysiological indicators are leveled.

In July-February, hockey players with Type I-II were characterized by the stability of the functional status (including the emotional one) and sensorimotor integration (the speed and accuracy of reactions). Unlike hockey players with Type I - II, hockey players with Type III – IV demonstrated statistically significant changes in intragroup psychophysiological dataduring sports training. Relative to July-December, by February, there is an increase in the time of simple motor reaction and choice reaction. A decrease in the speed of these reactions can be regarded as an unfavorabletrend for competitive activity. However, as a counterbalance, the accuracy of motor reactions (interference) improves simultaneously. Among the indicators of the emotional status and the functional status of the central nervous system, the concentration of excitation increasesfrom December to February. At the same time, the tendency towards irradiation of excitation processes continues in the cerebral cortex.

Thus, in July, hockey players have intergroup differences depending on the type of heart rate regulation. However, by the competitive period, these differences are completely leveled. These processes occur in different ways - there are both general and specific trends in terms of result achievement by hockey players withType I - II and III - IV. For example, trends of decreasing reaction time (interference) by February and increasing accuracy in choice reaction regardless of the type of heart rate regulation, apparently, indicate an increase in players' functional fitness. However, despite the identical trends, the curve of the speed of motor reactions is of interest. In December, players withType I - II have a different character compared to hockey players with Type III - IV: intermittent with a decrease in the reaction time (interference) and stable in terms of the accuracy of choice reaction. The trend towards an increase in the accuracy of CR and SMR in hockey players with Type III - IV reflects the leveling of speed deterioration for these reactions by February. Regardless of the type of heart rate regulation, hockey players tend to decrease the number of accurate reactions to a moving object. However, in hockey players with Type I - II, the decrease occurs against an increase in the number of delayed reactions, and in players with Type III - IV - against an increase in both advanced and delayedreactions. In hockey players with Type I - II, the number of advanced reactions is stable. For athletes, the most favorable option is to increase the number of advanced reactions rather than delayedones(Kharitonova L.G., Pavlova N.V., Lindt T.A., & Makarova I.M., 2009), which increases the likelihood of operative correction of the motor program of the last phases of movements based on stimuli of re-afferentation. Regardless of the type of regulation, by February, hockey players increase their concentration of excitation in the central nervous system. A feature of hockey players with Type I - II is the smaller amplitude of the curve from December to February compared to players with Type III - IV. Significant differences are observed in the nature of trends in the indicators of the functional status of the central nervous system. Under simple conditions, hockey players with Type I - II demonstratedthe improvement of the functional status of the central nervous system, which made it possible to level by December the initial July intergroup differences (compared to players with Type III – IV). From statistical point of view,by February,the same functional status of the central nervous system (interference)is achieved in different ways: in hockey players with Type I-II, a downward trend was revealed according to all criteria of T. Loskutova, which is an unfavorable factor considering centralization of the autonomous nervous system. At the same time, Type III - IV players have a stable functional status(interference) and are characterized by a certain improvement. The functional status is assessed together with the psychological one(Gerasimov IG, 2011). The psychological status of hockey players with different types of heart rate regulation showed opposite trends regardless of the same initial values. At the same time, the indicators of the autogenous norm do not go beyond the conditional norm (Mantrova I.N., 2007). An increase in emotional stress in the competitive period in Type I - II hockey players may adversely affect their cognitive processes. However, it is believed that an increased sympathetic tone at this ageimproves cognitive processes and also reduces emotional sensitivity to possible mistakes and failures (Usenko A.B., & Kuzmina K.A., 2011). Literature describes that mental loads in highly skilled athletes (sympathotonics) are accompanied by an increase in the power of VLF-waves (Larionova E.L., &Vikulov A.D., 2005), which can be interpreted as an increase in the mobilization abilities of the body in response to stress. Therefore, an increase in emotional stress (in terms of the "Total deviation from the autogenous norm" indicator) in Type I - II hockey players can improve their mental performance during training and competitive activity.

Conclusions

The psychophysiological features of the dynamics of psychomotor abilities, as well as the functional and emotional statuses in hockey players with a predominance of central (I - II type) and autonomous (III - IV types) mechanisms of heart rate regulation are revealed in a training macrocycle (July - December - February). At the beginning of the training macrocycle, Type I - II hockey players have decreased values of the functional status of the cortical centers of the central nervous system (interference) compared to Type III - IV players. In the competitive period, these differences are leveled.

Regardless of the type of heart rate regulation, by the end of the competitive training period, there are changes in the speed and accuracy of sensorimotor integration. There is a decrease in the reaction time (interference), an improvement in the accuracy ofchoice reactions and a decrease in the accuracy of moving object reactions. In hockey players withType III - IV, the patterns of a decrease in the speed ofSMR and choice reactions were observed. At the same time, the quality of sensorimotor integration in choice reactions does not change due to the improvement of accuracy.

In hockey players withType III-IV, the functional status of the cortical areas of the central nervous system remains stable throughout the entire training period.In players with Type I - II (interference), it tends to deteriorate. Regardless of the type of regulation, by the end of the competitive period, the concentration of excitation improves, which has a favorable effect on the speed of reactions in conditions of interference. The emotional statuscan be described by multidirectional trends. An increase in emotional stress in hockey players with Type I-II has both an adaptive and mobilizing value for the competitive period. Maintaining a high level of excitability in the central nervous system will contribute to a more rapid activation of cognitive processes and the functional centers of the neuromuscular system in response to physical exertion.

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