

Psychophysiological Characteristics of Athletes-Volleyball Players with Hearing Impairment

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Article History	Abstract
<p>Received: 06 June 2023 Revised: 05 Sept 2023 Accepted: 01 Dec 2023</p> <p>CC License CC-BY-NC-SA 4.0</p>	<p><i>To reveal the features of the central nervous system and the severity of hemispheric asymmetry in volleyball athletes with hearing deprivation. Materials and methods: The study involved 14 athletes with hearing deprivation of varying degrees, aged 20 to 35 years (mean age 29.20 ± 1.3 years), with different sports qualifications. When evaluating the indicators of a simple visual-motor reaction, the reaction time, the degree of its stability, the level of functional capabilities of the nervous system of athletes were determined. To determine manual asymmetry, M. Annette's questionnaire, motor tests (dynamometry, tests for the interlacing of hands and applause) were used, and the coefficient of the right hand was calculated. When detecting visual asymmetry, the Rosenbach test and the spyglass test were used. The ratio of the right eye was also calculated. Results: It was revealed that a third of the examined athletes have a symmetrical distribution of signs both in the visual and manual spheres, a significant dependence of which on sports titles was not found. The time of a simple visual-motor reaction in volleyball athletes with hearing deprivation was reduced. The stability of the reaction and the level of functional capabilities were within the normal range and had a significant dependence on the sports title and category. Conclusion: It was revealed that volleyball players with hearing impairment form a special type of interhemispheric interaction, characterized by a more even distribution of functional activity between the right and left hemispheres, and in connection with this, a low level of development of manual and visual asymmetry.</i></p> <p>Keywords: Simple Visual-Motor Reaction, Interhemispheric Asymmetries Riya, Manual Asymmetry, Visual Asymmetry, Hearing Impairment, Athletes Volleyball Players, Adaptive Sport.</p>

1. Introduction

One of the most important medical and social problems of modern society is the disruption of the auditory sensory system. According to the latest data published by the World Health Organization over the past year, about 466 million people worldwide suffer from hearing impairment, and according to scientists' forecasts, the number of people deprived of hearing will increase [15-17]. With a decrease or loss of auditory function, a person experiences difficulties in learning, in the implementation of labor activity. At present, sports and physical culture are the most important and necessary conditions that provide physical and social adaptation of people with hearing impairments [12]. Mobility and lability of nervous processes, a high level of the functional state of the nervous system are the necessary components of successful physical activity of both healthy athletes and athletes with hearing deprivation, providing not only fast dynamics of movements, but also a change in the activity of the cardio-respiratory system and further adaptation of the body to sports training [13]. The purpose of the study was to identify the features of the central nervous system and the severity of interhemispheric asymmetry in volleyball athletes with hearing loss. 2.

2. Materials And Methods

The study of indicators of a simple visual-motor reaction and interhemispheric asymmetry of athletes was carried out on the basis of the Karakalpak State University. The study group included 14 athletes living in the city of Surgut, aged 20 to 35 years (mean age 29.20 ± 1.3 years) with hearing deprivation of varying degrees, who already had an outcome of the disease. Of these, 7 athletes had the title of

Candidate Master of Sports (CMS), 5 - the title of serviced masters of sports and masters of sports of international class (and 2 athletes at the time of the study did not have sports titles (no rank, w/r). All subjects were explained the tasks and methods of research, and confirmation was obtained that the tasks and methods were understood correctly and adequately. The main inclusion criteria for the subjects were the presence of diagnoses of sensorineural hearing loss, made on the basis of criteria in accordance with the modern classification developed by the expert group of the KSU, approved in 2014, and the absence at the time of the study of those transferred within two weeks, before examining acute illnesses. Obtaining informed consent of the subjects to the processing of personal data and to learning was a prerequisite element in the study.

The scheme of the study consisted in a single study of a simple visual motor reaction and the state of functional interhemispheric asymmetry in athletes. Testing of the subjects was carried out in the first half of the day (10-12 h). The study of neurodynamic processes and their characteristics in athletes was carried out using the software complex of the according to the method, which makes it possible to determine not only the response time to a stimulus, but also the functional state of the central nervous system. Assessment of manual asymmetry included self-assessment using the sensitized questionnaire by M. Annette [8], motor tests (tests "intertwining fingers", "Napoleon's posture", applause, in which the leading hand was determined), dynamometry.

The coefficient of hand asymmetry and asymmetry in the visual system was calculated according to the following formula [6]: $Kpr/pg = (Ep - El) / (Ep + El + Eo) \times 100$, where E_n is the number of techniques where the right hand/right eye, El - the left hand / left eye prevailed, Eo - there is no predominance of any of the hands / none of the eyes. When detecting visual sensory asymmetry, a set of tests was used - the Rosenbach test, the "Spyglass" test. To assess the degree of asymmetry, we used the scoring system proposed by B.Kazakov [8] and allowing to divide the examined athletes according to the degree of functional asymmetry.

The maximum number of points could be equal to 2 (for right-handers), the minimum - 0 (for left-handers). Statistical processing of the study results was carried out using the statistica v10 software package. To determine the normality of samples of the general population, the Shapiro-Wilk tests were used. The methods of parametric and nonparametric statistics were also used: one sample and two sample Student's test, analysis of variance, Mann-Whitney U test, Wallis test. The significance level for testing statistical hypotheses (Fisher's test) in the study was taken equal to 0.05.

3. Results and Discussion

The functional state of the nervous system is an important psychophysiological physiological index of indi adaptation species to environmental conditions [4]. Thus, a simple visual-motor reaction (VMR) is one of the classical methods of chronoreflexometry, which makes it possible to characterize such properties of the central nervous system as strength, mobility, and lability [8]. We assessed a simple visual-motor reaction as a characteristic of sensorimotor integration, reflecting the coordination and integration of motor and sensory weed processes at different levels of the brain [15]. As a result, a reduced reaction time was found in volleyball athletes with hearing deprivation (Table 1) in comparison with the average statistical data of people who do not go in for sports, whose latent period is about 228 ± 4.7 ms [8]. Table 1 Indicators of a simple visual-motor reaction of volleyball athletes with hearing deprivation descriptors of simple visual reaction in volleyball players with hearing impairment.

Table 1 Indicators of a simple visual-motor reaction of volleyball athletes with hearing deprivation descriptors of simple visual reaction in volleyball players with hearing impairment

Measured PZMR parameters Descriptor	Measured PZMR parameters Descriptor			Left hand meanings Values for the left hand			Right hand meanings Values for the right hand		
	C25 M	e	C75	C25	VieC75		C25	VieC75	
Response time, ms Reaction time, ms	253.00 2	71.50 28?	.00 253.2	5 272.00:	87.75 25	50 271.0	287.50		
Reaction stability, conv. units Reaction	1.63	2.17	2.35	1.63	2.10	2.34	2.34	2.20	2.33

stability, cu									
Functional level systems, conv. units Functional level of the system, cu	2.62	2.715	2.73	2.59	2.70	2.73	2.63	2.72	2.73
Functional capabilities	2.96	3.47	3.66	3.66	3.33	3.65	3.65	3.5	3.66

A number of authors [1, 5, 7, 10, 11] have studied the features of a simple visual motor reaction in athletes of various sports. In the course of these studies, it was found that in athletes aged 17-21 years old involved in skiing, the time of a simple visual-motor reaction is 194 ± 13.1 ms [1], in athletes aged 18-22 years old who have the title of candidates in the master of sports, this indicator is about 202.9 ± 18.2 ms [5], in the sports of shifts-judokas - 209 ± 18.5 ms [11], in combat athletes [7] and athletes of the service-applied sport [10] - 209 ± 5 and 219.77 ± 26 , respectively. The studied indicators "response stability" and "level of functional capabilities" in volleyball athletes with hearing deprivation were within the normal range [8], which indicates the stability of the state of the central nervous system and the normal ability to form a functional system adequate to the task with a sufficiently long its retention [3, 13]. In addition, these indicators had a significant dependence ($p < 0.02$) on the sports rank of the subjects: Honored Masters of Sports had higher indicators of reaction stability and the level of functionality. When comparing the stability of the reaction, the level of functionality and the functional level of the system for the right and the left hand of the athletes, no statistically significant differences were found ($p > 0.05$).

The obtained results indicate that athletes deprived of according to hearing, there is a compensation for the lack of auditory afferentation due to the equal participation of both hemispheres of the brain in the motor function of the hands. The definition of manual asymmetry is an important link in the study of interhemispheric asymmetry in humans. In the work, we evaluated various manifestations of symmetry - the asymmetry of the hands of volleyball players with hearing deprivation. As a result of using the M. Annette questionnaire, it was found that in the study group, 64.29% of athletes with hearing deprivation consider themselves to be pronounced right-handed, 14.29% and 7.14% have weak right-handedness and weak left-handedness, respectively, 14 were ambidexters. 29% of the subjects. Other results were identified using a number of manual tests (Table 1). When determining the features of the distribution of manual asymmetry in the study group, a fairly high number of ambidexters was revealed, namely, for 28.57% of the examined, a symmetrical distribution of lateral signs was characteristic, for 64.29% - the predominance of right lateral signs, the predominance of left lateral signs was observed only in 7.14 % of examined athletes. Similar trend distribution of the functional load between the cerebral hemispheres was also observed in the visual sphere (Table 3). As a result of the study of the asymmetry of the visual system, according to the general coefficient of the right eye, the dominance of the right eye was revealed in 64.29% of the subjects, visual symmetry was observed in 35.71% of the examined, and none of the athletes turned out to be the dominant left eye. However, if we evaluate the results of tests for visual asymmetry separately, then slightly different results were observed. The influence of sports categories and titles on the degree of expression of the coefficients of the right hand and the right eye are described on the example of the playing experience of tennis players T.A. Dobro hotovoy, which shows that at two after a year of playing experience, tennis players have a right hand coefficient equal to 10.50%; after reaching 15 years of playing experience, this coefficient increases to 23.80% [6].

Revealed Right Hand Coefficients and the right eye were low in athletes without sports titles and categories [6]. Athletes who are candidates for master of sports in accordance with the unified all-Russian sports classification (EVSK) have an average degree of severity of the coefficient of the right hand and right eye. For masters of sports of international class and honored masters of sports, the coefficients of the right hand and the right eye turned out to be above average (see figure). However, according to the Mann-Whitney U test and the Kruskal-Wallis test at the significance level $p > 0.05$, there is no confirmation of the significant influence of sports categories and titles on the value of the coefficients of the right hand and the right eye.

4. Conclusion

The psychophysiological characteristics of volleyball athletes with hearing impairment showed that the functional state of the central nervous system of athletes is at the level of “normal” and “slightly reduced” performance, which indicates an average degree of neuropsychic tension, a sufficient level of attention and concentration, necessary to achieve high results in sports activities. The adaptation process to training and competitive conditions reflects a significantly more effective level of processing of the sensorimotor reaction due to the even distribution of functional activity between the right and left hemispheres, and therefore leads to a low level of development of manual and visual asymmetry in volleyball athletes with hearing loss. During intense physical activity, it is necessary to monitor the indicators of the sensorimotor reaction in order to maximize the realization of individual sports capabilities and maintain a high level of performance.

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