

RELEVANT ASPECTS OF NEUROPHYSIOLOGIC PATTERN AT ATHLETES

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Abstract: Purpose of our study was to outline some aspects of physiologic pattern at athletes, including the selection of future sportsmen, objective evaluation of training quality and highlights of sub-clinical lesions existence, that may influence sportive performance, with the help of some electroneurographic parameters, muscular response and nervous conduction velocity, in order to emphasize the differences between sports and athletes' gender.

The study included 27 athletes, 14 boys and 13 girls, with an average age of 17 years, who practiced professional handball, volleyball or fence, sportive disciplines, where the use of upper members is asymmetrical.

By stimulating the median nerve, of each subject of the studied group, were recorded symmetrically, at right and left hands, the muscular response and nervous conduction velocity, by using Nihon-Kohden MEP-9600 device.

When comparing the group of sportsmen with that of the sportswomen, were recorded numerous statistically significant differences, for both studied parameters.

Thus, when comparing data obtained for the entire group with the subgroups of tested sports, as well as between sports, significant differences for amplitude, area and duration of muscular response were recorded and only the ones, of the handball-fence subgroups, were different, when comparing the values of nervous conduction velocity.

Present study revealed specific functional neurological and muscular adaptations, determined by professional training, which represent different aspects of athletes' neurophysiologic profile, so important and necessary to obtain high sportive performance.

Keywords: motor response, motor conduction velocity, athletes, neurophysiologic pattern.

Introduction

Nervous conduction velocity (NCV), coordination and reaction time, influence the level of sportive performance, therefore, is essential to determinate and track them in sporting activities [1,2].

Purpose of our study was to outline some aspects of physiologic pattern at athletes, including the selection of future sportsmen, objective evaluation of training quality and highlights of sub-clinical lesions existence, that may influence sportive performance, with the help of some electroneurographic parameters, muscular response and nervous conduction velocity, in order to emphasize, the differences between sports and athletes' gender.

Soudmand et al. [3] have signalled an inverse correlation between NCV and the subjects' height for the lower members; however, this study has not shown a similar correlation for the upper members, which was also presented, by Lang and Bjorkqvist, ten years before [4].

Present study was performed by the necessity of assuring a neurophysiologic characteristic for a sportive discipline, which would be useful both in selecting those, that practice the respective sport and for following the efficiency of specific training, while avoiding over training [5, 6].

In 1991, Takano et al, obtained clear results, due to the large number of investigated subjects, on the correlation of nervous conduction velocity with the tested subjects' height, higher velocity being present at lower height individuals and establish a relation between NCV and the diameter of nervous fibers (those with a large diameter have a faster NCV) [7].

Material and methods

Nervous conduction velocity (NCV) was tested, by stimulating the median nerve, at three levels: radiocarpian articulation (1) between the tendons of the flexor carp radial and palmary long muscles, elbow (2) near the brachialis artery and bicipital groove (3), successively, for both arms, at a group of 27 athletes, 14 boys and 13 girls, the average age for the tested group was 17 years.

Every athlete was initially screened for any history, signs or symptoms of either peripheral neuropathy or compression syndrome of the upper extremities and were informed about the study procedure, purposes and known risks and gave their informed consent., this study being conducted according to the guidelines of the Declaration of Helsinki.

Percussion tests of the nerves along their course were performed, subjects were asked about the presence of any pain during training.

We performed a bipolar percutan stimulation of the median nerve, after previously degreasing the area, at the three levels previously mentioned, with rectangular impulses, of a duration of 0,1 ms and an intensity value necessary to obtain the maximal muscular response. The stimulation device was provided by the Nihon-Kohden firm, for the apparatus MEP-9600 used for this test. Muscular response, was recorded at the level of the tenar muscles (abductor pollicis brevis), using surface electrodes, with a diameter of 8 mm and a distance between them of at least 20 mm. Stimulation was made at a distance, of at least 70 mm from the proximal recording electrode. Skin temperature was measured at the level of lower third of the forearm.

Recordings were made in the morning, before trainings, on an ambient temperature, that did not vary significantly, from one recording to the next [8].

Reference temperature for correcting nervous conduction velocity was of 32,5 degrees Celsius, literal correction for this value, was automatic made, through the program provided by the menu of the utilized device. Data obtained by recording the muscular response was processed separately, providing values for: latency, duration, amplitude, area. The utilized software was also used in computing the latency differences of muscular

responses, obtained by stimulating the three levels: distal (radiocarpian articulation = level 1), elbow=level 2 and proximal (bicipital groove=level 3), thus, by stimulating the mentioned three levels, the following information was obtained: for level 1 muscular response latency, the actual NCV values being obtained through latency difference 2-1 (distal NCV) and 3-2 (proximal NCV).

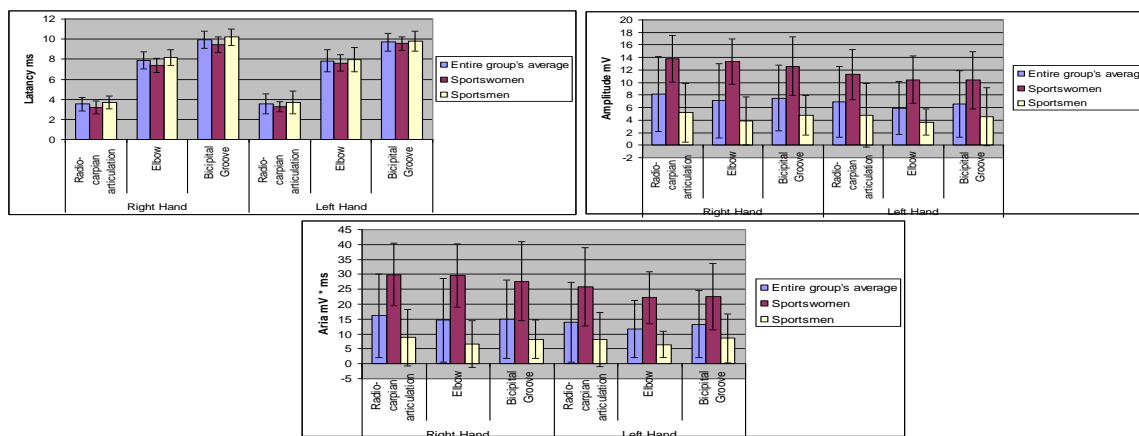
The interval, as shown by the program for level 1 is, in fact, the latency of the muscular response, followed by the levels 2 and 3, which are the only ones, that show the actual latency difference.

For statistical analysis, of the values obtained by processing the recordings of the muscular response and NCV testing, were used Student test and Pearson correlation coefficient.

Results

The following parameters of muscular response were analysed and statistically processed: latency, duration, amplitude, area, interval (last one represents difference between latencies from segments of the same limb).

Unlike the latency for muscular response, which presents significant differences between the two subgroups (boys-girls), only when stimulating the elbow and bicipital groove, for the right hand, the values of amplitude and area, presented highly significant differences, for all levels of stimulations, at both upper limbs, as shown in Figures 1- 3.



Figures 1-3. The average values of muscular response latency, amplitude and aria for the entire group

As for the duration of the muscular response, when comparing sportsmen with sportswomen, significant differences, are only recorded for stimulations, of the left hand elbow, as presented in Figure 4).

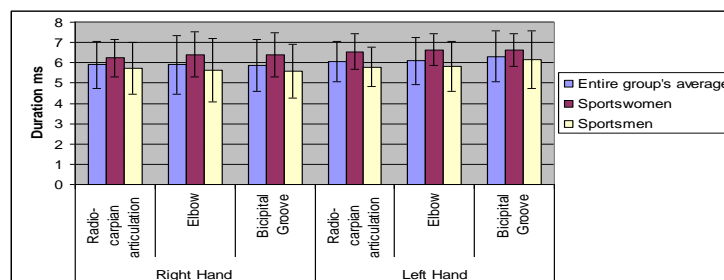


Figure 4. The average values of muscular response duration for the entire group

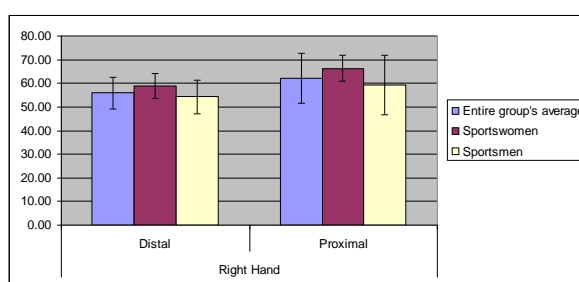
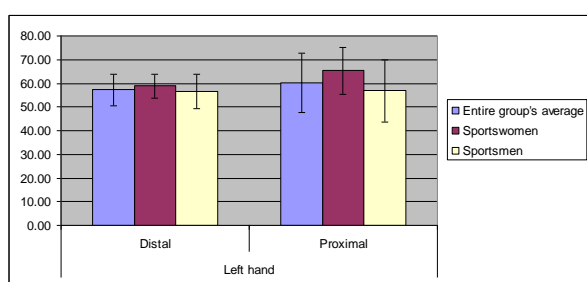
When comparing various sports, for each gender, there were no significant differences for boys, with the exception of the duration parameter, right hand, elbow stimulation, when comparing fencing-volleyball on left hand, distal level stimulation and elbow stimulation, when comparing fencing-handball.

For girls, there were a higher number of statistical differences, which were presented for: area parameter, right hand, stimulation at three levels and amplitude one, same hand, only for proximal and distal stimulation.

Statistical processing between sportive disciplines, for the interval values, does not show significant differences, both when comparing each sport with the entire group and when comparing handball, volleyball and fence between them, the exception being handball, compared with the entire group, right hand, proximal stimulation.

When comparing handball, the entire group with the subgroup of boys, following stimulation on the right hand, proximal level, significant statistical differences were present.

The average values of nervous conduction velocity, obtained by proximal and distal stimulation of the left and right hands, were not significantly different (Figures 5 - 6).



Figures 5-6. The average values of NCV obtained by proximal and distal stimulation

In the case of inter-sports comparisons, the only significant differences, for the values of nervous conduction velocity, were present, following stimulation of the proximal segment of right hand, at handball and volleyball subgroups, as indicated in Table 1.

Table 1. The values of NCV for the studied groups

		<i>Right hand</i>		<i>Left hand</i>	
		<i>Distal</i>	<i>Proximal</i>	<i>Distal</i>	<i>Proximal</i>
Entire group	Average	54,84	61,16	56,17	61,12
Fence	Average	55,42	67,74	55,68	62,43
Handball	Average	51,74	58,51	58,81	60,22
Volleyball	Average	56,53	60,18	55,79	59,30

Analysis of NCV values obtained in the case of sportswomen, did not show significant differences, with the exception of fence-handball, at the forearm level (2-1=elbow-distal), left hand, modifications which were not present, when analysing the sportsmen subgroup.

Discussions

Our research aimed to emphasize the adaptations and differences of NCV, depending on the specificity, of each of the three studied sport disciplines: handball, volleyball, fence, with varied degrees of upper limbs' use, by studying, both muscular response and NCV, which brought additional aspects to the electroneurophysiologic pattern of athletes..

As shown previously, the latencies of the muscular response, when comparing sportsmen and sportswomen, shows significant differences, only when stimulating the median nerve, at elbow and bicipital groove, with girls, presenting lower latencies than boys and slightly higher NCV values.

In case of NCV values, the significant differences between sportsmen and sportswomen, can be partially explained, by gender characteristics and height differences [9,10].

What is also, interesting to reveal, when comparing boys-girls, are the statistic differences, between the values of amplitudes, areas and the duration of the muscular response, obtained at all three levels of stimulation, for both upper limbs. The higher values recorded for sportswomen, compared to sportsmen, can be explained by possible functional adaptive modifications (muscular hypertrophy) [11], that are reduced for girls, allowing the stimulation, of a higher number of fibers, which produce the increase of muscular responses, of a higher duration and evidently, on a larger area at sportsmen.

These differences between genders, can also be commented on, in the light of discoveries made during games and contests of fence, where the sportsmen, require higher force and engagement, with a heightened risk of lesions, even if only, sub-clinical [12, 13].

So, these more numerous sub-clinical lesions occurring for boys, can take part, in explaining the lower values of amplitudes, areas and durations recorded on them. This aspect, is in concordance, with that observed by Stecker, [14], whose experimental research, has shown the sensibility of NCV parameters to minimal compression, finding decreases, of up to 50 % of the muscular response amplitude, for the same level of

compression, the author, did not signal, NCV modifications bigger than 5 %.

The inter-sports analysis of values characteristic to the muscular response, did not show statistic differences between the subgroups handball-fence and handball-volleyball. When comparing data of the volleyball subgroup with the fence subgroup, statistic differences were recorded, when stimulating the left hand, proximal and elbow level, for the amplitude and area parameters, higher values recorded by the fence subgroup, being in concordance with the characteristics, of the effort type, sustained by the practitioners of respective sport activity.

Boys-girls inter-sports comparison, showed the presence of functional modifications, specific to each sport, for both girls and boys and thus, significant gender dependant differences.

Conclusions

The specific physical effort, induce both structural and functional modifications, which influence the values of NCV and implicitly, of muscular response, very important informations, which can help establish an efficient level of training, appropriate to the athlete physical capacities, in order to obtain sportive performance, avoiding over training and extenuation of the athlete.

In the same time, these determinations can emphasize functional changes, which represent sub-clinical neuropathies present at professional sportsmen, thus, these affections can be treated in advance, the complications can be prevented and in many cases, the athletes can restart their physical activity.

Present study revealed specific functional, neurological and muscular adaptations, determined by lng professional training, which represent different aspects, of athletes' neurophysiologic profile, so important and necessary, to obtain high sportive performance.

Author contribution

All authors have contributed equally to this article.

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