

A study on attention optimization in high performance female volleyball players through attentional training

Studiu privind optimizarea atenției la jucătoarele de volei de performanță prin training atențional

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Abstract

Background. The present study refers to optimizing the concentration of attention in female volleyball players through a specially designed attentional training program. The research is based on the reasoning that voluntary attention is the product of education and training, which supports the work of the individual in the most important moments in power consumption proportional to the task.

Aims. The objectives of the study consist of implementing a preparatory stage attention intervention in female volleyball players, which will optimize attentional focus by increasing the effectiveness of the game in attack and defense.

Methods. This experiment comprised the players of two woman volleyball teams, who participated in the National Championship, in division A2, series West (CSU LPS University of Oradea, established as the experimental group, and CSS CNE Baia Mare, as the control group). The attention evaluation was made by a computer assisted software, PSITEST Cabinet (which is the computerized version of J.M Lahy Test), which provided data on the evolution of focused attention by calculating indices on correct answers, errors, omissions and an accuracy index. Statistical analysis of data was performed using the SPSS 17.0 program for Windows.

Results. Intragroup comparisons between the pretest and posttest results of the two groups included in this experiment, Student test for paired samples for the four indicators evaluated: correct, where: ($p = .024$ experimental group, control group $p = .225$), errors: ($p = .001$ exp. group and $p = .635$ control group), omissions: ($p = .006$ exp. group, $p = .930$ control group) and accuracy index: ($p = .000$ exp. group and $p = .121$ control group). The data confirms our hypothesis regarding the improvement of the number of correct answers and the reduction of the number of wrong answers in the experimental group, while the control group achieved positive but insignificant results.

Conclusions. The results of the concentrated attention test for the studied indicators confirmed the significant value of our intervention compared to the results obtained in the control group, who followed a traditional training program.

Key words: focused attention, education, performance, volleyball.

Rezumat

Premize. Studiul prezentat se referă la optimizarea concentrării atenției la jucătoarele de volei de performanță printr-un training atențional special conceput. Cercetarea se bazează pe raționamentul că atenția voluntară este produsul intrinsec al educației și antrenamentului, care susține activitatea individului în momentele cele mai importante printr-un consum energetic proporțional cu sarcina respectivă.

Obiective. S-a urmărit implementarea unui program atențional de intervenție în etapa pregătitoare a jucătoarelor de volei, pentru optimizarea concentrării atenției, prin creșterea eficienței acțiunilor de joc din atac și apărare.

Metode. La acest experiment au participat componentele a două echipe feminine de volei, care participă la Campionatul Național, în divizia A2, seria Vest (CSU LPS Universitatea Oradea, constituită în lotul experimental și CNE CSS Baia Mare, în lotul de control). Evaluarea nivelului de atenție a fost făcută printr-un program asistat pe calculator, PSITEST Cabinet (care reprezintă varianta informatizată a Testului lui Lahy), care oferă date cu privire la evoluția atenției concentrate prin calcularea indicilor privind răspunsurile corecte, erorile, omisiunile și indicelui de exactitate. Analiza statistică a datelor a fost efectuată cu ajutorul programului SPSS 17.0 pentru Windows.

Rezultate. Comparațiile intragrup rezultate între momentul pretest și posttest ale celor două loturi incluse în acest experiment, testul student pentru eșantioane pereche la nivelul celor patru indicatori evaluați: corecte, unde: ($p = 0,024$ lot experimental respectiv $p = 0,225$ lot control), erori: ($p = 0,001$ lot exp. și $p = 0,635$ lot control), omisiuni: ($p = 0,006$ lot exp. respectiv $p = 0,930$ lot control) și indice de exactitate, unde: ($p = 0,000$ lot exp. respectiv $p = 0,121$ lot de control), date care confirmă ipoteza noastră cu privire la ameliorarea numărului de răspunsuri corecte și a scăderii numărului de răspunsuri eronate pentru lotul experimental, în

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timp ce lotul de control a obținut rezultate pozitive dar ne semnificative.

Concluzii. Prin valorile rezultatelor obținute la testul de atenție concentrată cu ritm impus și câmp de observație dinamic, la indicatorii apreciați s-au confirmat diferențe semnificative între rezultatele inițiale și finale, la lotul experimental unde s-a aplicat un program de 31 de exerciții pentru optimizarea capacității atenționale, comparativ cu lotul de control care a urmat un program de pregătire tradițional.

Cuvinte cheie: Atenție concentrată, învățare, performanță, volei.

Introduction

For high performance athletes, obtaining a good result only once is not enough; constant high performance results are expected from them. Mental stability is a subcomponent and condition of performance stability in general, also indicating effort efficiency. Two American psychologists, Hosen and Mann (cited by Cezar, 2008), consider that psychic stability is the result of psychological training and is characterized by reduced variation of the athletes' results in improper circumstances.

Success in special activities, such as competitions, is based on the ability to self-regulate emotions, thoughts and actions, the ability to focus and rapidly shift attention, to carry out a difficult action for a long time, to manage effort under circumstances of tiredness and disturbing external factors (Bull, 2011).

Voluntary control implies "executive attention efficiency, including the ability to inhibit a dominant answer and/or to trigger a subdominant answer, to plan and detect errors" (Rothbart & Bates, 2006).

Considering the potential overlapping of attention, work memory and executive control in the cognitive psychology and cognitive neuroscience literature, theoreticians seem to encounter difficulties in defining the attention control concept in a way that can fully satisfy any one of them (Cocs, 2005, Astle & Scerif, 2009; Abrams, 2010).

Attention stability consists of maintaining for a while the orientation and concentration on the same object or on the same activity. Stability does not consist of freezing attention in a state of fascination; it manifests itself with certain fluctuations which, however, do not interrupt the basic orientation of activity. Due to attention fluctuations, in performing an activity for a longer period of time, variations related to efficiency may occur; the decreases are more significant when the activity concerned requires higher concentration (Cioară, 2006).

Attention fluctuations occur as an effect of protective inhibition. If, as mentioned before, they do not change the basic activity orientation, they represent adaptive phenomena, providing the rest moments required for a lasting activity. The presence of disturbing agents does not necessarily lead to a decrease of activity efficiency (Crăciun, 2012). In the same author's opinion, there are two types of disturbing stimuli: irrelevant and interference stimuli. Even though irrelevant elements slow down concentration, they do not completely damage performance, but decrease its level. The interference elements are of internal or external nature, such as: opponents, negative thoughts, over- or under-motivation, anxiety, stress, monotony, noise, fatigue.

Concentration implies avoiding the disturbing stimuli and focusing on the target stimulus. As the number of analyzers involved in the detection of the identification stimulus increases, the risk of elaborating a wrong answer will decrease through efficient feed-back, even if negative

(experienced athletes can use it with a positive effect to eliminate errors, which is not true for beginners because of the lower level of specialized perception development) (Cox, 2005, Dilignieres, 2008).

We should emphasize the fact that the efforts to which athletes are subjected are targeted towards their entire personality system, and mental recovery, particularly in the field of high performance sports, where training and competition activity is carried out with great physical and mental efforts, becomes a major and complex problem that falls under the competence of a specially trained team responsible for the athlete's performance. The use of a well-chosen and well-managed attentional program in order to ameliorate attention parameters can be learned, becoming a possible practical endeavor with proper scientific support, and even though it is less understood exactly because of the complexity of the elements involved in its development, it becomes necessary in high performance.

Therefore, to blame in case of failure only one person, the trainer in our case (because in case of victory the glory goes entirely to the team), means to regard the high performance sport phenomenon in a superficial, journalistic manner.

Objectives

The purpose of this research is to establish proper and efficient training means in order to improve attention in high performance female volleyball players during the play, especially during decisive moments, which should lead to success.

Hypothesis

We consider that applying to an experimental group an attentional program of physical exercises specific to the volleyball game, conceived to improve attention, as part of training, can improve attention parameters compared to a group of players who attend a traditional training program.

Material and methods

Research protocol

We mention that according to the Helsinki Declaration, the Amsterdam Protocol and Directive 86/609/EEC, the approval of the Ethical Committee of the University of Oradea for research on human subjects was obtained, and the subjects participating in the research gave their informed consent.

a) Period and place of the research

The study was conducted during the 2008-2009 National Championship and comprised two evaluation moments, the initial testing of concentrated attention with manual response (ACRM), computer-assisted, and the final testing, which took place after a 12-week period, during which our intervention occurred, consisting of a 31 exercise program, of which we present 8 exercises. During this time interval, the groups attended a training

program, according to the high standards required by the participation in the championship matches.

b) Subjects and groups

The research was carried out with the participation of two female volleyball teams with similar performance levels, participating in the National Championship in the A2 North series.

- Group 1 – experimental group, formed by the members of the CSU – LPS Oradea team (n = 12);
- Group 2 – control group, formed by the members of the CNE CSS Baia-Mare team (n = 12).

c) Tests applied

The tests were applied using the PSITEST Cabinet program, under specialized psychological guidance, and they provided data referring to the response indicators: correct, errors, omissions and accuracy index.

Test description: rows of 7 letters pass through a drawn slot. The subjects must push the button of a handle every time they notice in the row one of the two letters indicated to them (p1 = C,O; p2 = M,N; p3 = P,R; p4 = S,Z).

For individual administration, it is recommended to use the first post (p1 = C,0). The examination program is

made up of two sequences: adjustment and basic test. The adjustment program consists of running 50 rows of letters, out of which only 1/2 contain a stimulus letter. The feedback information for the examiner is displayed in the form of a table that provides real-time information referring to the subjects' efficiency.

The basic test consists of running 300 rows of letters in two speeds of 150 rows. Like in the adjustment program, only 1/2 of the rows contain "stimulus-letters".

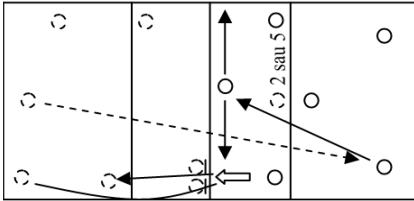
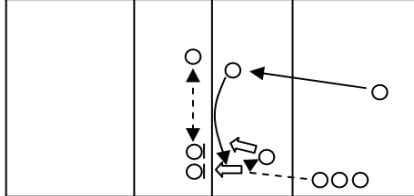

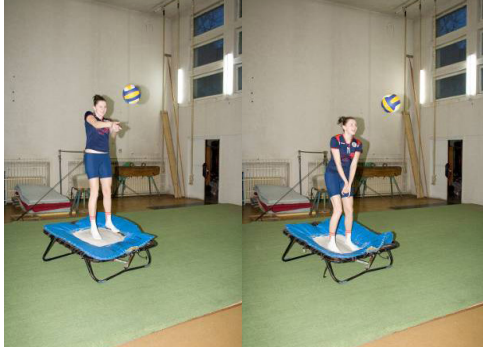
d) Statistical processing

The interpretation of the results obtained in the two groups was made using the statistical SPSS 17.0 program, mixed Anova, variance analysis (F) and the Student test for individual and paired samples.

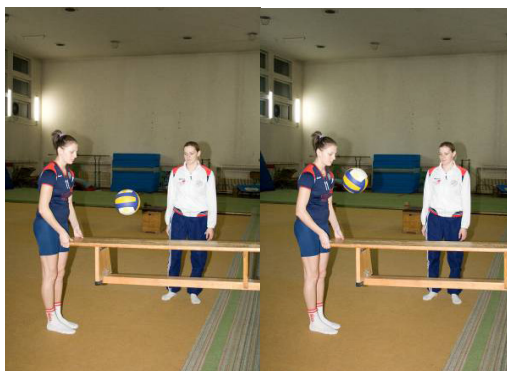
The study was carried out during the training period between the 5th and the 12th stages of the championship, by the application of certain means selected and included in the training plan, for the optimization of attentional capacity and for the development of specialized perceptions required by the volleyball game, of which we present the following 8 exercise structures (Table I).

Table I

Exercise structures conceived for attention optimization in female volleyball players – content and description.

Technical description	Graphic representation	Dosage
<p>Bilateral school play, with the execution of an attack hit placed on the lane when figure 2 is indicated (for example) and behind the blockage when another figure is indicated by the trainer, 5 (for example). The figure is announced while the ball goes towards the coordinating player (R).</p>		<p>Executed for 8 minutes, in two series.</p>
<p>Two consecutive attack hits from area 4 with blockage. At the first hit, one player at blockage, at the second, two players. The attack hit is placed towards the starting spot of the second player. After the second hit the player goes to the blockage in the other side of the court and so on in turns.</p>		<p>Executed in two series of 3 minutes, as a playing structure</p>
<p>With three players, using the long skipping rope, jumping face front or laterally, simultaneously with the execution of ball juggling exercises for one minute for each executor.</p>		<p>Executed in two series</p>
<p>Successive jumps on the trampoline, with the rejection of balls thrown towards the executor in various stages of the jump.</p>		<p>4 series of 30 seconds each</p>

In standing position, facing the fixed ladder, holding the end of the light bench, the other end being hooked on a step (at a certain level), by repeated movements downwards-upwards, successive hits of the ball while maintaining it jumping on the bench.



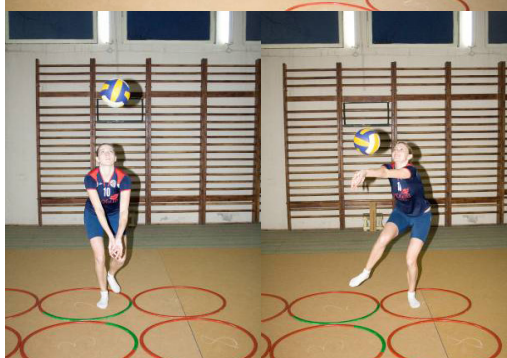
Executed for 30 seconds alternatively, in the form of competition, twice.

Repeated individual passes, upwards or downwards, with two hands, while passing over various obstacles: bench, gymnastics box.



Executed in two series of one minute each

Consecutive individual (control) passes performed by successive jumps in gymnastics hoops, in a pre-established order.



Executed in two series of one minute each

In pairs, passes upwards and downwards, or alternatively, with two balls, one ball by kicking.



Executed in two series of one minute each.



Results

The visual inspection of average values obtained by the two groups for the ACRM indicator – correct – indicates a higher level of maximum values for the control group compared to the experimental group at the pretest moment

(max. 147.0 vs. max. 146.0); however, at the posttest moment, the experimental group had a 5 units increase in average values compared to the control group (from 137.0 to 142.25 units vs. from 129.6 to 130.3 units), which was mainly due to the evolution of minimum values (Table II).

Table II
Correct ACRM.

Indicator	Mean value		Standard deviation		Minimum value		Maximum value	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Group I	137.0000	142.2500	8.32302	3.64629	121.00	134.00	146.00	147.00
Group II	129.6667	130.3333	10.20992	9.53780	117.00	116.00	147.00	144.00

The magnitude of these differences from a statistical point of view was determined by the analysis of the variance index (F), which indicates a significant value only for the experimental group (intervention F = 8.066, p = .010) (Table III).

Table III
Variance analysis.

Source	Sum of squares	df	Average squares	F	p
Intervention	105.021	1	105.021	8.066	.010
Group	1111.687	1	1111.687	8.832	.007
Intervention * group	63.021	1	63.021	4.840	.039
Error (intervention)	286.458	22	13.021	-	-
Error (group)	2769.125	22	125.869	-	-

The intergroup comparisons for independent samples, made between the two evaluation moments using the Student test, do not differ significantly (t = 1929, p = .067 in pretest and t = 4043, p = .001 in posttest), but the comparison made for paired samples shows significant differences in the performance of the two groups between the two evaluation moments (t = - 2614, p = .024 experimental group, t = - 1201, p = .225 control group) (Table IV).

Table IV
Intergroup comparisons (between the pretest and posttest moments, for the two groups included in the study) – t test for paired groups.

Source	t	df	p
Experimental group	-2.614	11	.024
Control group	-1.201	11	.255

Regarding the evolution of the two groups for the ACRM indicator – errors – the mean values obtained by the experimental group are 6 units lower between the two evaluation moments (m = 25.750 units, m = 19.750 units, respectively), mainly due to the decrease of the maximum number of errors (from 39.000 units to 29.000 units). In the control group, the difference in the mean values between

the two evaluation moments is small (m = 11.609 pretest, 9.398 posttest) (Table V).

The analysis of the variance index shows a significant difference only for the experimental group regarding attentional performance (intervention F = 9.666, p = .005), which is mainly due to our intervention (Table VI).

Table VI
Variance analysis

Source	Sum of squares	df	Average squares	F	p
Intervention	140.083	1	140.083	9.666	.005
Group	363.000	1	363.000	1.954	.176
Intervention * group	80.083	1	80.083	5.526	.028
Error (intervention)	318.833	22	14.492	-	-
Error (group)	4088.000	22	185.818	-	-

The intragroup comparisons made for independent samples between the two evaluation moments indicate insignificant values for the pretest moment between the two groups included in the research (t = .641, p = .528), and significant values in posttest (t = - 2269, p = .033). On the Student test for paired samples, the evolution between the two moments of the research is significant only for the experimental group (t = 4.325, p = .001 experimental group vs. t = .489, p = .635 control group), Table VII.

Table VII
Intragroup comparison (between the pretest and posttest moments, for the two groups included in the study) - t test for paired samples.

Source	t	df	p
Experimental group	4.325	11	.001
Control group	.489	11	.635

For the ACRM indicator – omissions – the results obtained place the experimental group scores under the level of the control group by four units, for the pre-intervention moment (m = 18.750 control group, m = 14.250 experimental group), but in posttest, an ample evolution of the results of the experimental group is noted

Table V
ACRM errors.

Indicator	Mean value		Standard deviation		Minimum value		Maximum value	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Group I	25.7500	19.7500	10.65257	8.00142	10.00	9.00	38.00	29.00
Group II	28.6667	27.8333	11.60982	9.39858	12.00	14.00	50.00	42.00

Table VIII
ACRM omissions

Indicator	Mean value		Standard deviation		Minimum value		Maximum value	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Group I	14.2500	7.7500	7.47268	3.64629	6.00	3.00	29.00	16.00
Group II	18.7500	18.6667	8.45442	8.46741	3.00	6.00	30.00	32.00

compared to those recorded in the control group ($m = 7.750$ experimental group and $m = 18.666$ control group). This is due to the decrease of minimum values to half (from 6.00 units pretest to 3.00 units posttest) and of the maximum values from 29.00 units pretest to 16.00 units posttest, while in the control group, there is a slight increase of minimum and maximum values (max. = from 30.0 units to 32.0 units) (Table VIII).

The value recorded for intervention F (intervention $F = 9.442$, $p = .006$) indicates a significant effect of our program on the dependent variable, which is also supported by the value of the effect produced on attentional performance between the two moments of evaluation of the groups (intervention*group $F = 8.970$, $p = .007$) (Table IX).

Table IX
Variance analysis.

Source	Sum of squares	df	Average squares	F	p
Intervention	130.021	1	130.021	9.442	.006
Group	713.021	1	713.021	7.718	.011
Intervention * group	123.521	1	123.521	8.970	.007
Error (intervention)	302.958	22	13.771		
Error (group)	2032.458	22	92.384		

The comparisons made on the number of omissions, for the ACRM test – omissions – using the t test for independent samples, show that in pretest the performances achieved by the two groups do not differ significantly ($t = -1.382$, $p = .181$); however, in posttest the values of these differences are highly significant ($t = 3.370$, $p = .006$ experimental group vs. $t = .098$, $p = .930$ control group), (Table X).

Table X
Intragroup comparisons (between the pretest and posttest moments, for the two groups included in the study) – t test for paired samples.

Source	t	df	p
Experimental group	3.370	11	.006
Control group	.089	11	.930

The last indicator studied for the concentrated attention test with manual response in this research is that of the accuracy index, for which the data obtained in the two groups show a higher mean value in the control group at the initial testing moment, but in posttest, the experimental group manages not only to reduce the existing difference, but also to overcome it ($m = .7850$ vs. $m = .7408$). This appreciation is due to the increase of minimum and maximum values by 13 units and 24 units, respectively (from .53 to .66 for minimum values and from .72 to .96 for maximum values) (Table XI).

The variance analysis for the ACRM indicator – accuracy index – shows that the independent variable

does not significantly change the dependent variable because (group $F = .312$, $p = .582$); however, there are significant differences between the two groups due to our intervention, between the two evaluation moments, because (intervention*group $F = 26.027$, $p = .000$) (Table XII).

Table XII
Variance analysis.

Source	Sum of squares	df	Average squares	F	p
Intervention	.104	1	.104	58.299	.000
Group	.004	1	.004	.312	.582
Intervention * group	.046	1	.046	26.027	.000
Error (intervention)	.039	22	.002		
Error (group)	.272	22	.012		

The intergroup comparisons for independent samples, performed with the Student test, reveal the fact that between the experimental group and the control group, for the ACRM test – accuracy index, there are significant differences only at the pretest evaluation moment and not at the post-intervention moment, as ($t = 1.089$, $p > .05$), which is why we shall suspend the decision referring to the hypothesis suggested by us at the beginning of this test, according to which the achievement of different results for the two groups is due solely to the program proposed by us.

On the other hand, the t test for paired samples shows that the performances obtained by the control group do not differ significantly between the two evaluation moments, but for the experimental group, we must accept the specific hypothesis because the performances achieved between the two evaluation moments support this ($t = .9.781$, $p = .000$) (Table XIII).

Table XIII
Intragroup comparisons (between the pretest and posttest moments, for the two groups included in the study) – t test for paired samples.

Source	t	df	p
Experimental group	-9.701	11	.000
Control group	-1.679	11	.121

Discussions

In Romania, there are currently very few studies on aspects regarding the improvement of attention in high performance athletes, or if such studies exist, they are not published in specialized journals for more or less justified reasons.

Understanding the attention “phenomenon” clarifies the way in which human capacities are mobilized and demobilized in order to accomplish minimum or maximum tasks, as well as the way of “marginalizing” disturbing

Table XI
ACRM accuracy index.

Indicator	Mean value		Standard deviation		Minimum value		Maximum value	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Group I	.6300	.7850	.05326	.09259	.53	.66	.72	.96
Group II	.7100	.7408	.07544	.10561	.58	.58	.82	.96

information by educating attention. Thus, the psyche will be prepared and will limit the level of superfluous efforts, orienting performance towards the top (Jarvis, 2010).

The education of attention must take into account, on the one hand, the formation and reinforcement of voluntary attention and, on the other hand, the cultivation of attention qualities (concentration, volume, distribution, stability, adaptability etc.), as well as the development of the skill and habit of paying attention every time the circumstances call for it (post-voluntary attention) (Moran, 2006), also see the awareness theory (Collatz, 2003).

The responses to stressful situations, which will mobilize the entire body, are an adjustment requirement of the human being (and not only). In sport, stress occurs as a continuous oscillation between homeostasis and heterostasis. Competition, having a huge emotional load, can place the psycho-behavioral system in a limit state, with which the athlete has to cope. The effects of stress can be diminished using a series of techniques with good scientific support: autogenic training, progressive relaxation, bio-feed-back, mental training, suggestion and self-suggestion, movement repetition by presentation, etc.

Noise is one of the most encountered factors in sport, with a direct impact on performance, and if it also has an unpredictable and uncontrollable character, it will have even worse effects. These aspects affect the individual's homeostasis even when the adjustment state has been achieved, generating cognitive fatigue. The degradation of attention concentration will follow a descending curve, which will be more marked and rapid as the stressor action is more powerful (Altherton et al., 2008).

In the case of the noise-attention relationship, which appears as an inverted "U", absolute silence has negative effects on concentrated attention, while a sound stimulation, with certain intensity and frequency characteristics, can trigger a series of stimulating effects. Therefore, the double role played by noise is confirmed: as a distraction, incapacitation factor or as an activation factor, depending on the circumstances in which it manifests. From a practical point of view, the problem of determining the understress (monotony) and overstress limits that can be allowed is posed (Karageorghis & Terry, 2011).

The education of attention stability by creating states of inattention to stimuli with a disturbing role is of great practical interest for the field of high performance, and can be achieved by the use of well-modulated and carefully conducted strategies, using a series of alternative methods. At the same time, the use of training programs related to attention in volleyball players will improve the level of specific technical-tactical execution, especially during the important moments of the play or at its end, by developing efficient specialized perceptions (Asta, 2007).

The purpose of this research was to approach the methodology of complex technical-tactical training in high performance sport using other methods than conventional ones, which can have a deep impact on the attention phenomenon, aspects that have been little studied in Romania.

Conclusions

1. The attentional program used in this experiment had a favorable effect on the optimization of concentrated attention in high performance female volleyball players, for all studied indicators.

2. The optimization of attention parameters contributes to making more efficient the finalizations of attack and defense actions in the volleyball play, especially during its important moments.

3. Attentional concentration can be educated by using specially selected means, which contributes to constant achievement of high performances.

4. The conclusions drawn following this scientific endeavor can represent guidelines for the training strategy of the teams involved in high performance sport.

Conflicts of interests

Nothing to declare.

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