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Functional training impact on the cardiovascular adaptation to exercise of junior female volleyball players

Influenţa antrenamentului funcţional (functional training) asupra capacităţii de adaptare cardiovasculară la efort a jucătoarelor de volei junioare I

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Abstract

Background. This study started from the fact that over the past time period, in order to obtain an optimal physical level specific for sport games, professionals together with coaches have tried to include some alternative motor activity programmes from other sport branches such as aerobic gymnastics, fitness etc., in physical training.

Functional training has, through the methods and materials used, the highest impact with regard to the improvement of functional capacity on 1st age class junior female athletes.

Aims. This study aimed to emphasize the functional training impact on the functional capacity development of 1st class junior female volleyball players.

Methods. The study was carried out over a period of 11 months (July 2013 – May 2014), during the National Volleyball Championships, 2013-2014, for 1st class junior female players. Tests were carried out on 7 volleyball players (6 players + 1 libero player), at the end of the games. Female players were tested in 2 games of the Championship round, in 2 games of the Championship return, in the semi-final games and in the final tournament.

Female players who participated in this experiment were assessed by the Ruffier test. This exercise test allows the investigation of the athletes' functional capacity from the point of view of the assessment of cardiovascular adaptation to exercise.

Results. By comparing the results obtained by the athletes from the two groups included in this study, an improvement of the functional capacity of the players in the experimental group was proven, in comparison to that of the players in the control group.

Conclusions. The study results obtained demonstrate that the means and methods in functional training are much more effective with regard to the optimization of the functional capacity of 1st class junior female volleyball players compared to traditional training methods.

Key words: functional training, functional capacity, volleyball, 1st class junior female players.

Rezumat

Premize. Cercetarea de faţă a pornit de la premiza conform căreia, în ultima perioadă, pentru obţinerea unui nivel de pregătire fizic optim specific jocurilor sportive, specialiştii împreună cu antrenorii au încercat introducerea în cadrul pregătirii fizice a unor variante de programe de activităţi motrice din alte ramuri sportive, precum gimnastica aerobică, fitness etc.

Antrenamentul funcţional are, prin mijloacele şi materialele folosite, cel mai mare impact privind îmbunătăţirea capacităţii funcţionale, raportându-ne la categoria de vârstă junioare I.

Obiectiv. Prin această cercetare s-a urmărit evidenţierea efectului antrenamentului funcţional asupra dezvoltării capacităţii funcţionale a voleibalistelor, junioare I.

Metode. Cercetarea s-a efectuat pe o perioadă de 11 luni (iulie 2013- mai 2014), de-a lungul Campionatului Naţional de Volei ediţia 2013-2014, junioare I. Testările au fost efectuate pe 7 jucătoare (6 jucătoare + 1 libero) şi au avut loc la încheierea meciurilor. Jucătoarele au fost testate la 2 meciuri din turul campionatului, la 2 meciuri din returul campionatului, la turneul semifinal şi la turneul final.

Jucătoarele care au participat la acest experiment au fost evaluate prin proba Ruffier. Această probă de efort permite investigarea capacităţii funcţionale a sportivelor, din punctul de vedere al evaluării adaptării cardiovasculare la efort.

Rezultate. Prin compararea rezultatelor obţinute în cadrul experimentului de sportivele din cele două loturi supuse acestei cercetări, s-a putut constata îmbunătăţirea capacităţii funcţionale a jucătoarelor lotului experimental, în detrimentul celor din lotul de control.

Concluzii. Rezultatele cercetării obţinute demonstrează faptul că mijloacele şi metodele din cadrul antrenamentului funcţional sunt mult mai eficiente în ceea ce priveşte optimizarea capacităţii funcţionale a jucătoarelor de volei junioare I, faţă de metodele clasice de antrenament.

Cuvinte cheie: antrenament funcţional, capacitate funcţională, volei, junioare I.

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Introduction

To obtain high-performance results in the "volleyball game, it is needed to review the training concepts in order to take into consideration the parallel approach of all training elements" (Cojocaru & Cojocaru, 2012).

Physical training represents the support for all the other training elements, being considered a basis for the entire training process and a foundation for the approach of the other training elements.

"Physical training represents a true methodological reference, being one of the most significant requirements for obtaining high performance, whose effective management must rely as objectively as possible on continuous monitoring and assessment, throughout the process, by those responsible for the management process." (Neagu, 2012)

Physical training along with tactical, technical, theoretical, biological-psychological, artistic training and recovery are the basis for obtaining success and performance in sport.

"Physical training consists of a system of measures, means and methods which ensure the development of morphological indices, functional capacity, basic motor skills specific for different sport branches" (Teodorescu, 2009).

"Physical training in volleyball requires the development of basic and special motor skills, harmonious physical development and the training of joints and segments significant for volleyball" (Mârza, 2006).

The development of scientific research specific for the sport field is due to the high interest, shown over the past time period, in obtaining sports performance in optimal real time that can manifest in a more effective form.

Lately, in order to obtain an optimal physical level specific for sport games, professionals together with coaches have tried to include some alternative motor activity programmes from other sport branches such as aerobic gymnastics, fitness etc., in physical training.

According to research carried out by professionals in the field (Bota, 2007; Dragnea, 1984; Drăgan, 2002), functional training must align with general motricity and sometimes, it must prevail.

"Aerobic activity, by the means and methods applied, has significant pedagogical, biological, psychic and social results" (Dobrescu, 2008).

The implementation of functional training results in functional adaptations at body level, which induce in their turn prophylactic effects for different disorders.

Functional training is a full physical training system aimed at training the entire human body in the way it will be used during competitions, being currently the most effective coaching form (Boyle, 2004).

According to authors Reiss & Prévost (2013), an effective functional training programme must observe the following steps: *discussion, observation, movement, exercise.* These 4 elements represent *the "DOME System"*.

Discussion: it takes place between the coach and the athlete and covers the following matters: the athlete's background, medical history, targeted goals, etc.

Observation: before establishing the exercise programme for an athlete, the assessment of his/her static posture is required**.**

Movement: the execution of some movements may give the opportunity to observe some functional imbalances.

Exercise: there are 2 types of exercises: basic and corrective.

One of the main goals of optimizing the physical status of 1st class junior female volleyball players is the improvement of the main functions (cardiovascular and respiratory) of the human body.

Bota (2000) considers that practicing physical exercises is important because this brings many benefits to the human body systems and functions.

The most important benefits are:

a) *The cardiovascular system*

The functional adaptations that take place at this level lead to an increase in the amount of blood that can be pumped by the heart, increasing the vascular blood flow. Blood becomes fluid and circulates more easily through the blood vessels.

b) *The respiratory system*

The pulmonary capacity significantly increases and the lungs become able to ventilate a higher air quantity per minute.

c) *The musculoskeletal system*

Fitness exercises increase both muscle resistance, strength, elasticity, and bone system resistance, preventing motor system trauma.

d) *Fat tissue*

One of the big issues, regardless of gender, is weight or more precisely, fat mass. By exercise, the amount of fat tissue is reduced.

e) *Carbohydrate metabolism*

Functional adaptation appears when the muscle capacity to extract or take over glucose from blood increases, which is very difficult to obtain in the absence of physical activity.

Physical exercise increases the capacity of muscle to take over fats from the blood and to use them to produce energy, decreasing in this way the risk of atherosclerosis.

f) *The body defense function (immunity)*

Sport improves the immune system capacity to respond to microbial aggression, which minimizes the occurrence of infections.

g) *Digestive processes*

Intestinal transit is improved by exercise, which eliminates constipation and prevents colon cancer.

h) *The nervous system*

Movement coordination is improved and very important reflexes are formed in daily life.

i) *Cognitive functions*

Feedback speed improves and reactions to different stimuli become more rapid.

j) *Psychic-social behavior*

Functional training as a physical training method primarily aims, through the targeted objectives, at the muscle toning and the adaptation of the human body to efforts of variable intensities.

Timmermans et al. (2010) consider that in order to be effective, a functional programme should include different elements that can be adapted to the needs or goals of each and every athlete.

The attractiveness and diversity of functional training programmes bring more involvement with obvious effects on the functional component of 1st class junior female volleyball players.

Functional training improves human body balance, coordination, mobility, strength and resistance, while the exercises used during functional training have positive effects on the respiratory, cardiovascular and muscle-ligament systems.

Functional training has its roots in recovery gymnastics. Physiotherapists trained the injured athletes with a view to their comeback to sport, using global training very similar to the effort and movements typical of competitions.

Functional training consists of physical movements typical of daily life and implies the elimination of very heavy weights and fixed apparatus, using the weight of the human body, involving both free movements and special training accessories.

During functional training, the correct execution of exercises will lead to the development of the mobility and stability of athletes. The improvement of these abilities reduces the risk of accidents suffered during effort (Orr, 2013).

Functional training develops strength by using techniques intended for the whole human body (Radcliffe, 2007).

Specific functional training means represent one of the ways for increasing the interest and creative activity of 1st class junior female volleyball players.

The researchers at the CHEK Institute (Corrective Holistic Exercise Kinesiology) have elaborated a handbook to determine the validity of functional exercise. This handbook comprises the following characteristics of functional exercises (1):

1. Getting postural reflexes of balance and straightening
2. Keeping the center of gravity over the support area:
   a) Dynamic posture component
   b) Static posture component
3. Generalizing the motor compatibility programme
   a) Open/closed channel compatibility
   b) Improvement of relevant biomotor ability:
      - Balance reaction
      - Position recovery reaction.

A study performed by Maiorana et al. (2000) investigated the effects obtained after cardiorespiratory circuit fitness training. This study, which included 13 persons, lasted 8 weeks and aimed to monitor the changes in muscle strength and body composition. After the 8 weeks during which cardiorespiratory circuit fitness training was applied, increases in VO2 from 19.5 to 22 ml/kg/min were recorded. The sub-maximal exercises performed caused changes in cardiac frequency. Cardiac frequency was lower after training, between 60 and 80 bits per minute. Following the application of cardiorespiratory circuit fitness training, functional capacity and muscle strength were improved in the studied athletes.

Due to the changes induced by physical effort made during functional training, a number of adaptations of the cardiovascular system develop in time, which could also lead to higher performance in competitions.

The purpose of physical training in volleyball is to optimize exercise capacity; optimal specific physical training also plays a significant role in the improvement of the biomotor ability of female athletes. The inclusion of adapted functional training programmes may contribute to the increase of the attractiveness and effectiveness of training, improving the physical status for the effort typical of the high-performance volleyball game.

Objectives

The study aims to emphasize the role of functional training in the optimization of the functional capacity of 1st class junior female volleyball players.

Hypothesis

It is assumed that the modernization of the physical training programme content for 1st class junior female volleyball players by including some specific functional training means will determine the optimization of the functional capacity parameters of 1st class junior female volleyball players.

Material and methods

We mention that according to the Helsinki Declaration, the Amsterdam Protocol and Directive 86/609/EEC, the approval of the Ethical Commission of the University of Medicine and Pharmacy Tîrgu-Mures was obtained. The informed consent of the participants in this research was given.

Research protocol

a) *Period and place of the research*

The research was carried out over a period of 8 months (September 2013 – May 2014), during the National Volleyball Championship for 1st class junior players, 2013-2014, on a number of 14 players, divided into two groups: the experimental group and the control group. The experimental group athletes were functionally trained based on adapted functional training programmes, while the control group athletes were traditionally trained.

The players from both groups participated in four training sessions weekly.

b) *Subjects and groups*

The study sample included 14 1st class junior female athletes aged 16-18 years.

All subjects and their parents consented to the publication of the results of this research.

The experimental group was formed by 7 athletes, members of the CSU Medicine CNUE Tg. Mureş team, while the 7 athletes of the control group were members of the CSS Blaj team, matched for age with the athletes of the experimental group.

c) *Tests applied*

To test the cardiovascular functional capacity, the Ruffier test was used.

Tests were carried out at the end of the following games: 2 matches in the Championship round (scored in tables M1, M2), 2 matches in the Championship return (scored in tables M3, M4), 4 semi-final games (scored in tables M1, M2, M3, M4) and 5 games in the final tournament (scored in tables M1, M2, M3, M4, M5), in all the players.

d) *Methods applied*

The methods used in this research were: data collection

methods, namely study of reference materials (specialized and related field materials); experiment (the independent variable was applied to the experimental group, which caused adapting phenomena); tests (the standardized Ruffier test).

The research assesses only the cardiovascular activity adaptation to effort following the application of complex functional training, which also influences other systems that will be subsequently investigated.

The means used in the training of the experimental group consisted of exercises performed with the body weight, sets of exercises with the medicinal ball, exercises with dumbbells, barbells, TRXs, kettlebells, the oval ball etc. (Table I).

During general physical training (July 2013), work consisted of special functional training programmes (60-80 min).

During the month of August 2013, special physical training was carried out: during that period, the athletes were trained twice a week (60 minutes) by using specific functional training means, while during the other 3 training sessions, they were technically trained. We mention that in the final part of the 3 technical training sessions, adapted functional training circuits were performed (20-30 min), while in the warm-up part of these sessions, athletes worked with aerobic gymnastics means.

From 1 September to 14 December 2013, special technical and tactical training was performed. During this time period, at the end of the training sessions, adapted functional training circuits were performed (20-30 min).

During the transition period (16 December 2013 - 25 January 2014), training was carried out as follows: the functional training programme was carried out twice a week between 16-23 December 2013 and 6-11 January 2014, while at the end of the other 3 training sessions, functional training and stretching circuits were performed.

Starting with 11 January until the end of the Championship (6 May 2014), special technical and tactical training was performed again, by using at the end of the training sessions adapted functional training (20-30 min) and stretching circuits.

As a novelty, the 1st class junior female players were trained by using the core training programme which addresses the muscles that support posture and link the limbs to the trunk, abdominal belt, scapular belt, posture muscles.

The control group athletes were traditionally trained based on traditional training programmes.

Results

Following the functional test applied to the 7 athletes of the experimental group, the following results were seen:

The volleyball game coordinator (CA) achieved an improvement of aerobic exercise capacity from the start until the end of the game, according to the Ruffier test. According to Table II data, in the first Championship game, CA had an RI index equal to 4, which represents a good exercise capacity, while, in the final tournament, the player

Table I

Functional training planning model.

Content					August Weekly cycle - 4 training sessions			
Means used					I	II	III	IV
Speed of		Reaction		Reps	8x	10x	12x	12x
		Execution		Reps	8x	8x	8x	12x
		Repetition		Reps	6x	6x	10x	10x
		Movement		Reps	6x	6x	10x	10x
		Acceleration		Reps	6x	6x	10x	10x
Global resistance		Uniform rhythm		Meters	3000	3500	4000	4000
		Varied rhythm		Meters	600	600	800	800
		Unleveled surface		Meters	1000	1400	1700	1700
		CORE Training Exercises		Reps	8x	8x	12x	16x
Strength	Upper body	Dumbbell exercises (side flapping, lateral raise of dumbbell, alternative forward raise of dumbbell, arm bending)		Kg.	1.5	2	2.5	3
		TRX exercises		Reps	8x	8x	16x	16x
		Kettlebell exercises		Kg.	8x	8x	16x	16x
		Abdomen	Mattress	Reps	20x	30x	40x	50x
			Inclined plane	Reps	20x	30x	40x	50x
			Time Const.	Reps	30	30	30	30
		Raising thighs	On wall bar	Reps	20x	25x	30x	30x
			On box	Reps	20x	25x	30x	30x
		Extension /Straightening		Reps	15x	20x	25x	30x
		Elastic tape exercises		Reps	8x	8x	16x	16x
Strength	Lower body	Genuflexions	With bells	Kg.	8x	8x	16x	16x
			With the bar	Kg.	8x	8x	12x	12x
			With TRX	Kg.	8x	8x	16x	16x
		Semigenuflexions/Toe raises		Reps	8x	8x	16x	16x
		Lunges		Reps	8x	8x	16x	16x
		Stepper exercises (straightening, lunges)		Reps	8x	8x	16x	16x
		Leg flexion		Reps	8x	12x	16x	20x
		Lunging gait		Reps	8x	8x	12x	12x
Spring	Plyometric exercises	Genuflexions with vertical raise, jumps on stepper, lateral jumps from one leg to the other)		Reps	12x	12x	16x	16x
		Jumps over obstacles, low fences		Reps	12x	12x	16x	16x
		Exercises on the training ladder		Reps	4x	4x	8x	8x
Skills	General			Min.	5	5	10	10

reached a very good exercise capacity characterized by an RI between 0 and 0.4. The difference between the first match test results and the final tournament test results was 4.4 units, as showed in Table III.

The left back player (LB), a universal player, had a good result (RI = 3.6) at the beginning of the Championship as showed in Table II, reaching values between -1.2 and 0.4 for RI at the end of the Championship, the difference being 4.8 units according to Table III. The initial value (3.6) represents a good exercise capacity and the final tournament values represent a very good exercise capacity.

The pivot-line player (PP) had, after the first Championship game, an RI value of 2.8 as showed in Table II, representing a good exercise capacity. This player reached in the final tournament RI values between -1.2 and -1.6, showing a very good evolution represented by the difference of 4.4 units between the first test results and the final test results, as showed in Table III, due to physical training performed using specific functional training means.

During the Championship, the middle back (MB) player of the CSU Medicine CNUE Tg. Mureş team improved her functional capacity, obtaining at the first testing an RI of 2.8, a good result, and reaching at the final tournament test RI values between -0.8 and -1.6, according to Table II, which means a difference of 4.4 units between the first test results and the final test results, as showed in Table III, due to physical training performed using specific functional training means.

The right back player (RB) had a good result (RI=1.6) at the beginning of the Championship, as showed in Table II, reaching a value of -3.6 at the end of the Championship, a very good exercise capacity for this player, the difference being 4.4 units according to Table III, which represents an increase of 275%, according to Table III data, due to physical training performed using specific functional training means.

The left wing player (BR) obtained at the first testing an RI value of 2.0, a good result, as showed in Table II, which indicates a good exercise capacity, while at the final tournament test, RI values were between -3.2 and -2.8, a very good exercise capacity. This player had an evolution of 4.8 units between the first test results and the final test results, as showed in Table III.

The libero player (LP) of the Tg. Mureş team obtained at the first testing an RI value of 1.6, which represents a very good value for the exercise capacity of the human body. During the matches played, her RI value improved, according to Table II data, reaching values between 0 and -0.4 during the semifinal tournament, and the value of -2.8 during the final tournament, which means a very good exercise capacity in the semifinal. The evolution of this player during the Championship was 4.4 units.

In the control group, it can be seen that following the application of the Ruffier test, the athletes showed lower improvements in their functional capacity than those of the players in the experimental group for the tests applied at all times, with good RI values. We consider that this aspect is explained by the fact that the traditional training exercises applied and practiced do not mainly target functional capacity.

Discussions

Player BV of the control group had an RI value of 6.0 (proving a moderate exercise capacity), according to the Ruffier test results in the first games, as showed in Table II, and reached in the semifinal tournament an RI value of 5.6 (moderate exercise capacity) and in the final tournament, RI values between 4.8 and 4.0, representing a good exercise capacity. The evolution of this player between the initial and final testing was 2.2 units, which represents 33% as showed in Table III.

The universal player TI obtained in the first tests an RI value of 6.0, indicating a moderate exercise capacity.

Table II

Evolution of RI values in the experimental and the control group of players in the Championship round and return games, as well as in the semifinal and final games.

Indicator	Individual RI values for the experimental group							Individual RI values for the control group						
	CA	LB	PP	MB	RB	BR	LP	BV	TI	DF	MN	OP	PB	MI
M1-ROUND	4.0	3.6	2.8	2.8	1.6	2.0	1.6	6.0	6.0	5.6	4.8	6.4	4.8	4.8
M2-ROUND	4.0	2.8	2.8	2.4	2.0	2.0	1.6	6.0	6.0	5.6	4.8	6.4	4.8	4.8
M3-RETURN	3.2	2.8	2.0	2.0	1.6	1.6	0.8	6.4	6.0	5.6	4.8	5.6	4.8	4.8
M4-RETURN	3.2	2.0	1.6	1.6	1.6	1.2	1.2	6.4	6.4	4.4	4.4	5.6	5.2	5.2
M1-SEM	2.4	1.6	0.4	0.4	0	0.4	0	6.4	5.6	4.8	4.8	6.0	4.0	4.0
M2-SEM	2.4	1.6	0.4	0.4	0	0.8	0	6.0	5.6	4.4	4.4	5.2	3.6	3.6
M3-SEM	2.0	0.8	0	0.4	0.4	0	-0.4	5.6	6.0	4.4	4.4	5.2	3.6	3.6
M4-SEM	1.6	0.4	-0.4	0	0	0	0	5.6	5.6	3.6	3.6	4.4	3.6	3.6
M1-FINAL	0.4	0.4	0	-0.4	-3.2	-3.2	-2	5.2	5.2	4.0	4.0	4.4	2.8	2.8
M2-FINAL	0	0	-0.8	-1.2	-2.8	-2.8	-1.6	4.8	5.2	3.6	3.6	3.2	3.2	3.2
M3-FINAL	0.4	-0.4	-0.8	-1.2	-3.6	-3.6	-2	4.8	4.8	3.6	3.6	3.6	2.8	2.8
M4-FINAL	0	-1.6	-1.2	-0.8	-2.8	-2.8	-2.4	4.0	3.4	3.2	3.2	3.2	2.8	2.8
M5-FINAL	-0.4	-1.2	-1.6	-1.6	-2.8	-2.8	-2.8	4.0	3.4	3.2	3.2	3.2	2.8	2.8

Table III

Summary of the percentage increase achieved.

Name / Indicator	Individual RI values for the experimental group							Individual RI values for the control group						
	CA	LB	PP	MB	RB	BR	LP	BV	TI	DF	MN	OP	PB	MI
IT	4	3.6	2.8	2.8	1.6	2.0	1.6	6.0	6.0	5.6	4.8	6.4	4.8	4.8
FT	-0.4	-1.2	-1.6	-1.6	-2.8	-2.8	-2.8	4.0	3.4	3.2	3.2	3.2	2.8	2.8
Diff. IT-FT	4.4	4.8	4.4	4.4	4.4	4.8	4.4	2.0	2.6	2.4	1.6	3.2	2.0	2.0
% increase	110	133	157	157	275	240	275	33	43	43	33	42	42	42

In the semifinal tournament, the player obtained an RI of 5.6 and in the final tournament, RI values between 4.8 and 3.4, expressing a good exercise capacity. The difference between the initial and final test results is 2.6 units, according to Table III data.

The pivot player DF of the control group obtained following the first tests a result showing a moderate exercise capacity, and reached in the semifinal tournament RI values between 3.6 and 4.4, which indicate a good exercise capacity, and in the final tournament, an RI value of 3.2 (good exercise capacity), according to Table II data. Data in Table III indicate an evolution of 2.4 units between the final and initial test results of this player.

The middle-back (MN) player of the control group obtained at the first test an RI value of 4.8, indicating a good exercise capacity, and this value slightly improved during the Championship. Thus, in the semifinal tournament, player MB had RI values between 4.4 and 3.6 (good exercise capacity), reaching a 3.2 value in the final tournament. This player did not succeed in significantly improving her RI values either, mainly because she traditionally trained without focusing on the optimization of functional capacity. The difference between the initial and final test results of 1.6 units is still small, as showed in Table III, representing a capacity increase of 33%.

The left wing player obtained an RI value of 6.4 in the round and return game tests, as showed in Table II, representing a moderate exercise capacity. In the semifinal tournament, the RI value reached 4.4, representing a good exercise capacity, while in the final tournament, RI values ranged between 3.2 and 3.6, indicating a good exercise capacity. The evolution of this player was 33% according to Table III data.

The right wing player had a good exercise capacity in the first tests, represented by an RI value of 4.8, reaching 3.6 (good exercise capacity) in the semifinal tournament, and 2.8 in the final tournament, according to Table II data. The difference between the initial and final test results was 2.0, meaning an improvement of 42%, as showed in Table III.

The libero player of the control group had a good exercise capacity in the first round and return game test results, according to the RI value of 4.8. This value improved, as showed in Table II, reaching 3.6 in the semifinal and 2.8 in the final, which represents a good exercise capacity. The difference between the initial and final test results is 2.0, according to Table III.

Conclusions

1. By comparing the results obtained by the two groups - the experimental group and the control group, it can be seen that the athletes of the experimental group succeeded much better in improving their exercise capacity than the control group of athletes. Thus, the experimental group of athletes started from RI values indicating a good exercise capacity to finally reach higher RI values, showing a very good exercise capacity. The control group of athletes also succeeded in improving their exercise capacity, all the 7 tested players reaching RI values expressing only a good exercise capacity.

2. Following a brief analysis of the results obtained by the athletes of the two tested groups, we could find that the means used to optimize the functional capacity of the experimental group were more effective than those used by the control group. We may conclude that the results obtained confirm the research hypothesis.

3. The development and implementation of an adapted functional training exercise programme would be useful to improve and optimize the functional capacity of 1st class junior female volleyball players aged 16-18 years.

Conflicts of interests

There were no conflicts of interests.

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