*Palestrica of the third millennium – Civilization and Sport*
*Vol. 16, no. 3, July-September 2015, 223–227*

# Physical training, an important factor in the training of junior female volleyball players

# Pregătirea fizică, factor determinant în pregătirea jucătoarelor de volei junioare

**Laura Ciulea, Ioan Burcă**
*University of Medicine and Pharmacy, Târgu Mureş*

**Abstract**

*Background.* Recently, in order to achieve an optimal physical condition specific to sport games, volleyball professionals have tried to change the physical training plan starting at the junior level. Female volleyball players who are still in the period of physical development require a very good physical training which has an important role both in improving their functional capacity and in avoiding sport accidents, all these being essential for their future life as professional volleyball players.

*Objectives.* This research consists of the planning and experimental implementation of a physical training program with the aim of optimizing the physical condition of female junior volleyball players, in order to obtain best performances for long periods of time.

*Methods.* The research comprised two groups: the experimental group including twelve junior volleyball players of CSS Tg. Mures, and the control group formed by the junior volleyball players of CSS Sibiu. The motor capacity evaluation tests were: vertical jump with take-off and reaching the maximum point with one hand, 4 m lateral movement from lateral lunge by touching the line with the hand, combined balance and arm muscle strength test on the gym ball (fitball).

*Results.* The research results contributed to confirm the hypothesis that female volleyball players in the experimental group were superior compared to the control group, in all three sport tests. In the vertical jump test, the progress of the experimental group between the two evaluations (initial and final) was of 0.08 cm, and the control group obtained a difference of 0.03 cm.

In the 4 m lateral movement test, the subjects in the experimental group recorded a difference of 2.84 reps, compared with the control group, who obtained a difference of just 0.83 reps.

In the combined balance and strength test, the experimental group players achieved a progress of 4.08 executions, compared with the control group players, who improved their performance by just one execution.

*Conclusions.* The methods used in the case of the experimental group are much more efficient than the classical method used in the case of the control group.

**Key words:** volleyball, junior, physical training, elaboration, development.

**Rezumat**

*Premize.* În ultima perioadă, pentru obţinerea unui nivel de pregătire fizic optim specific jocurilor sportive, specialiştii din domeniul voleiului au încercat modificarea planurilor de pregătire fizică încă de la nivelul junioarelor. Jucătoarele de volei junioare a căror dezvoltare fizică nu este finalizată, pentru îmbunătăţirea capacităţii motrice şi funcţionale, dar şi pentru evitarea accidentărilor, au nevoie de o foarte bună pregătire fizică, aceasta stând la baza formării lor ca viitoare jucătoare profesioniste.

*Obiective.* Această cercetare constă în elaborarea şi implementarea experimentală a unui program de exerciţii, orientat spre optimizarea pregătirii fizice a jucătoarelor de volei, categoria junioare, în vederea valorificării optime şi îndelungate a capacităţii de performanţă.

*Metode.* Cercetarea s-a efectuat în perioada iunie 2014- decembrie 2014, şi a cuprins 2 grupe: grupa experiment formată din 12 voleibaliste junioare ale echipei CSS Tg - Mureş şi grupa control, compusă din voleibalistele de CSS Sibiu. Testele de evaluare a capacităţii motrice au fost: săritură pe verticală, cu elan, cu atingerea punctului maxim, cu o mână, deplasare laterală pe 4 m – din fandare laterală cu atingerea liniei cu mâna, testul combinat de echilibru şi de forţă a musculaturii braţelor, pe mingea de gimnastică (fitball).

*Rezultate.* Rezultatele cercetării au contribuit la confirmarea ipotezei, progresele înregistrate de sportivele grupei experiment au fost superioare grupei de control la toate cele trei probe. La proba de săritură pe verticală sportivele grupei exeperiment au înregistrat un progres de 0,08 cm între testarea iniţială şi cea finală, iar sportivele grupei control au realizat o diferenţă de 0,03 cm între cele două testări. În proba de deplasare laterală, sportivele grupei experiment au înregistrat o diferenţă de 2,84 execuţii, iar sportivele grupei control 0,83 execuţii între cele două testări. În proba combinată de echilibru şi forţă sportivele grupei experiment au realizat un progres de 4,08 execuţii, comparativ cu sportivele din grupa control, care au reuşit îmbunătăţirea rezultatului de la testarea iniţială, cu o singură execuţie.

*Concluzii.* Rezultatele cercetării obţinute demonstrează faptul că mijloacele şi metodele folosite în pregătirea echipei experiment sunt mult mai eficiente faţă de metodele clasice de antrenament.

**Cuvinte cheie: v**olei, junioare, pregătire fizică, elaborare, valorificare.

*Received:* 2015, March 22; *Accepted for publication:* 2015, April 10;
*Address for correspondence:* University of Medicine and Pharmacy, Târgu Mureş, 38 Gheorghe Marinescu St., 540139, Phone - 0754670730 Romania
*E-mail:* caffenoname@yahoo.com
*Corresponding author:* Laura Ciulea, caffenoname@yahoo.com

## Introduction

To obtain better results ”volleyball requires the review of training concepts so they may simultaneously take into account all the components of training” (Cojocaru & Cojocaru).

Volleyball is a sport that requires strength in the upper and lower limbs. Many experts have approached this subject in a number of studies (B. Forthomme, J.L. Croisier, G. Ciccarone, J. Crielaard, M. Cloes – 2005; M.C. Marques, R. Tillaar, J.D. Vescovi, J.J. Gonzalez-Badillo – 2008; F.R. Noyes, S.D. Barber-Westin, S.T. Smith, T. Campbell – 2011; Pereira A., A.M. Costa, Patricia Santos, Teresa Figueiredo, Paulo Vicente João – 2015).

Development of muscle strength and some specific technical skills of the volleyball game are particularly important for junior players as essential factors in achieving success (G. Ciccarone, J.L. Croisier, G. Fontani, G. Martelli, A. Albert, L. Zhang, et al. – 2008, G.G. Malousaris, N.K. Bergeles, K.G. Barzouka, I.A. Bayios, G.P. Nassis, M.D. Koskolou – 2008).

Approaching physical training and the development of individual motor capabilities is almost useless when this approach is not considered in the context of the particularities of a specific sport (Neagu, 2012).

In terms of physical capacity of the players, current requirements establish the following characteristics for junior volleyball players:

- increased specific resistance;
- attack hit executed at a greater height;
- lateral, forward and backward movements are more often seen in the play sequences;
- reaction and motor capacity is proportional to the speed of the ball, which is increasingly higher (FIVB, 2013, p.12).

Given the high level of the game and superior physical fitness at international level, as well as the low level of both the game and the players' physical fitness in Romania, we consider as advisable a change in physical training plans starting with junior players.

With regard to the strategies for regaining a top place in the elite of this game, experts estimate that the main interventions required must be focused on the problem areas of the game actions and model, selection strategy and player prototype, along with the use of the most efficient training methodologies (Cojocaru et al., 2013).

The physical training level of volleyball players has a major role in the game economy and the performance of each player. The technical level of players is also conditioned by the physical fitness level.

Some experts (1) feel that in the volleyball game, physical training plays a major role and it must be focused on the development of motor skills, especially the development of maximal strength and specific strength. To this end, it is recommended to use exercises with certain accessories: fitball, Trx, dumbbells, weights.

No special attention is paid to the physical training of junior volleyball players and as such, their muscles are not sufficiently developed. The implementation of a complex physical training routine will contribute to the development of skills specific to volleyball.

Based on the studies conducted by experts (Kraemer & Fleck, 2007), it was concluded that the age of juniors (16-18 years) is ideal for intensifying physical training. Mc Bride et al. (2002) stated that muscularity well developed by exercises with certain accessories contributes to the development of the players' speed, to an increase of lower limb strength and consequently, to the increase of the jumping height. Kotzamanidis et al. (2005) have shown that heavy training targeted on the development of strength, associated with sessions dedicated to speed development, contributes to obtaining major benefits in terms of strength, as well as speed. At the same time, it is recommended to use simple exercises which can be executed naturally. Păcuraru et al. (2000) show that ”general physical training of the athlete is aimed at a comprehensive education of the physical attributes which, although are not specific to this discipline, are conditioning one way or another sports activity success”.

In the volleyball game, the purpose of physical training is to optimize the effort capacity, given that optimal and specific physical fitness will play a key role in the biomotor capacity of volleyball players. According to Mureşan (2005), ”physical training is aimed at the development of motor skills by global work-out exercises and selective exercises for the segments and for the major functions of the body, consistent with the volleyball-specific effort”. With regard to physical training specific to volleyball, Mârza (2006) states that this game ”requires the development of basic motor skills and their specific aspects, balanced physical development and preparation of joints and major body segments for the volleyball game”.

The importance of this study consists of the design of an adapted exercise routine of functional training and aerobic gymnastics which will positively influence general physical development, as well as the development of motor and functional capacity in junior volleyball players.

Junior volleyball players, aged between 16-18 years, whose physical development is not completed, require very good physical training in order to improve their motor and functional capacity and avoid injury; this represents the foundation of their formation as future professional volleyball players.

To obtain high quality parameters for motor skills, it is recommended to include in the physical training of junior players more complex and more comprehensive exercises based on using teaching sports materials of the latest technology, such as fitball, dumbbells, weights, etc.

The advantage of these exercises is that they involve several muscle groups for each movement, providing a good muscular and postural balance.

By using a large range of functional accessories: medical balls, suspensions (TRX, gymnastics rings), dumbbells, weights, obstacles, skipping ropes, kettlebells, etc., in addition to the motor and functional effects, volleyball players also gain mental motivation stimulated by the diversity and amenity of these accessories' design.

## Objectives

The objective of this study is to improve the physical condition of junior volleyball players by selecting the action means, designing and applying an exercise routine focused on optimizing their physical training. The designed routines were structured depending on the training period: preparation period (general physical training period and

specific physical training period), competition period (specific technical and tactical training period), and transition period.

## Hypothesis

It is assumed that the selection and adaptation of physical training improvement means will have a positive influence on the motor capacity of volleyball players. The implementation of exercise routine specifically designed for the experimental group determines an improvement of physical training, leading to positive results in official matches, as well as in friendly matches (performance objectives).

## Material and methods

We declare on our own responsibility that we received from the Ethics Committee of the University of Medicine and Pharmacy the approval to conduct this research.

*Research protocol*

*a) Period and place of the research*

This research was conducted over a period of 7 months: June - December 2014, during the round of the 2014-2015 National Junior Volleyball Championship, and included 24 players, divided into two groups: the experimental group and the control group.

The subjects of the experimental group trained on the court of "Constantin Brâncuşi" Technological High-School in Târgu-Mureş, while the subjects of the control group trained in Sala Mică near Radu Stanca Theatre in Sibiu.

*b) Subjects and groups*

The research sample was composed of: the experimental group, including 12 players aged between 16-18 years, and the control group including 12 players of the same age. Both groups executed 5 training sessions per week.

The experimental group players trained using specially designed means, while the control group players trained using traditional means and analytical methods.

*c) Tests applied*

The tests used to assess the motor capacity of the players were the following:

- *vertical jump*, with take-off and reaching the maximum point with one hand;
- *4 m lateral movement,* with lateral thrust and reaching the line with the hand;
- *combined balance and arm muscle strength test*, on the fitball.

*d) Statistical processing*

This study used the following statistical-mathematical indices: arithmetic mean, standard deviation, variation coefficient, Student t test.

In order to calculate the Student t test and the correlation coefficient, the GrahpPad Prism program was used in this study.

The experimental group players trained based on the routines designed with more complex and complete exercises, using the latest sports accessories: TRX, fitball, dumbbells, weights.

Thus, at the end of each training session, a special exercise routine was introduced, for 25 minutes each day, working with various sports accessories (Monday - TRX, Tuesday - stepper, Wednesday - fitball, Thursday - dumbbells, Friday - weights) (Table I).

**Table I**

Weekly planning for functional training.

| Day | Activity type | Targeted training objective | Reps/ Duration | Series | Intensity % |
|---|---|---|---|---|---|
| Monday | Total resistance exercise (TRX) | Strength development | RMI | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | Mobility development | 20 sec. | 2 | RCT |
| | | | 20 sec. | 2 | RCT |
| | | | 20 sec. | 2 | RCT |
| | | Balance development | 20 sec. | 2 | RCT |
| | | | 20 sec. | 2 | RCT |
| | | | 20 sec. | 2 | RCT |
| Tuesday | Step aerobics | Strength development | RMI | 2 | RCT |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | Speed development | RMI | 2 | 65 |
| | | | | 2 | 65 |
| | | Coordination development | RMI | 2 | 65 |
| | | Balance development | 20 sec. | 2 | 65 |
| Wednesday | Fitball | Strength development | RMI | 2 | RCT |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | Coordination development | | 2 | 65 |
| | | | | 2 | 65 |
| | | Balance development | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| Thursday | Exercises with dumbbells | Strength development | RMI | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | Coordination development | | 2 | 65 |
| | | Mobility development | 20 sec. | 2 | RCT |
| | | Balance development | 20 sec. | 2 | RCT |
| | | | 20 sec. | 2 | RCT |
| Friday | Exercises with dumbbells | Strength and jumping height development | RMI | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | | | 2 | 65 |
| | | Mobility development | | 2 | 65 |
| | | Coordination development | 20 sec. | 2 | 65 |
| | | Balance development | 55 min. | 2 | RCT |
| Saturday | Aerobics | Strength and jumping height development | 16 | 2 | 40-60 |
| | | | 12 | 2 | 40-60 |
| | | | 8 | 2 | 40-60 |
| | | | 8 | 2 | 40-60 |
| | | | 8 | 2 | 40-60 |
| | | | 8 | 2 | 40-60 |
| | | | 8 | 2 | 40-60 |
| | | | 8 | 2 | 40-60 |
| | | | 12 | 2 | 40-60 |
| | | | 8 | 2 | 40-60 |
| | | Mobility development | 20 sec. | 2 | 40-60 |
| | | | 20 sec. | 2 | 40-60 |
| | | | 10 sec. | 2 | 40-60 |
| | | | 10 sec. | 2 | 40-60 |
| | | | 10 sec. | 2 | 40-60 |
| | | Coordination development | 8 | 2 | |
| | | | 8 | 2 | |
| | | | 8 | 2 | |
| | | | 8 | 2 | |
| | | Balance development | 20 sec. | 2 | |
| | | | 20 sec. | 2 | |

(Ciulea, 2015)

Legend: RMI – Maximum individual reps; RCT – Reps against the clock; Reps - reprises; TRX - Total resistance exercise.

In the weekly sampling of exercise routines used for the experimental group, the routines not used on the relevant day were shaded.

Diagonal reading of non-shaded columns represents the weekly training plan.

## Results

**Table II**

Statistical indices for the vertical jump with take-off.

| Groups | Test moment | X | Difference | CV | Student t | p |
|---|---|---|---|---|---|---|
| Experimental group | Ti | 2.26±0.01 | 0.08 | 2.42 | 3.44 | 0.002 |
| | Tf | 2.34 ±0.01 | | 2.39 | | |
| Control group | Ti | 2.25±0.01 | 0.03 | 1.67 | 1.980 | 0.06 |
| | Tf | 2.28±0.01 | | 1.71 | | |

The experimental group showed an increase of 0.08 cm in the arithmetic mean value for the two tests, generated by the original mean value of 2.26 m and the final test value of 2.34 m, according to the data presented in Table II. As indicated in Table II, for the control group the arithmetic mean value showed a lower difference between the two tests, the original value being 2.25 units and the final value 2.28, with a difference of 0.03 cm.

**Table III**

Statistical indices for 4 m lateral movement.

| Groups | Test moment | X | Difference | CV | Student t | p |
|---|---|---|---|---|---|---|
| Experimental group | Ti | 26.42±0.19 | 2.91 | 2.42 | 9.09 | 0.001 |
| | Tf | 29.33±0.25 | | 2.84 | | |
| Control group | Ti | 26.25±0.25 | 0.83 | 3.15 | 1.98 | 0.05 |
| | Tf | 27.08±0.33 | | 4.11 | | |

By comparing the results obtained for the two experimental and control groups, as shown in Table III, the evolution of the experimental group mean in the final test increased to 2.91 executions, while the evolution of the control group was of 0.83 executions.

**Table IV**

Statistical indices for balance and arm muscle strength .

| Groups | Test moment | X | Difference | CV | Student t | p |
|---|---|---|---|---|---|---|
| Experimental group | Ti | 18.42±0.28 | 4.08 | 5.18 | 11.08 | 0.0001 |
| | Tf | 22.50±0.23 | | 3.39 | | |
| Control group | Ti | 16.83±0.36 | 1 | 7.21 | 1.78 | 0.08 |
| | Tf | 17.83±0.42 | | 7.87 | | |

In this combined test, designed to test the balance and strength of the arm muscles, the players of the experimental group recorded a progress of the arithmetic mean value of 4.08 executions when comparing the two tests, while the players in the control group achieved a progress of 0.83 executions, according to the data in Table IV.

In the matches between these two groups, the experimental team won both matches against the control team.

## Discussions

The purpose of this presentation was to elaborate and experimentally implement a workout program aimed at optimizing the physical training of junior female volleyball players in order to obtain best performances for long periods of time.

By comparing the results of the players in the two groups, it can be seen that the experimental group achieved a better progress in all three motor tests as opposed to the progress achieved by the control group.

In the test of the vertical jump with take-off and reaching the maximum point with one hand, the experimental group players improved their original testing result by 0.08 cm, while the control group players achieved a 0.03 cm progress between these two tests, according to the data in Table II.

In the test of 4 m lateral movement, with lateral thrust and reaching the line with the hand, the experimental group players improved their original result by 2.91 executions, while the control group players improved their original result by 1 execution, according to the data in Table III.

In the combined test of balance and arm muscle strength on the fitball, the experimental group progressed by 4.08 executions, while the control group achieved a progress of 1 execution, according to the data in Table IV.

## Conclusions

1. By reviewing the results obtained by the players in both groups, we can conclude that the means used in the physical training of players in the experimental group provided a higher efficiency of the junior players' training.

2. It can be concluded that the selection and adaptation of physical training improvement means have a positive influence on the motor capacity of volleyball players. The implementation of an exercise routine specifically designed for the experimental group determines an improvement of physical training, leading to positive results in official matches, as well as in friendly matches (performance objectives).

### Conflicts of interests

There were no conflicts of interests.

### Acknowledgments

The article uses partial outcomes from the PhD thesis presentation *Optimization of fitness in female junior I volleyball players by implementing a tailored program of aerobics and functional training*. We mention that the thesis belongs to the first author, Ciulea Laura.

### References

Ciccarone G, Croisier JL, Fontani G, Martelli G, Albert A, Zhang L, et al. Comparison between player specialization, anthropometric characteristics and jumping ability in top-level volleyball players. Med Sport, 2008; 61(1):29-43.

Ciulea L. Optimizarea fitness-ului la jucătoarele de volei, junioare I, prin implementarea unui program adaptat de gimnastică aerobică şi functional training. Teză de Doctorat, Transilvania University of Braşov, 2015.

Cojocaru A, Cojocaru M. Volei. Curs în tehnologie IFR. Ed. Fundaţiei România de Mâine, Bucureşti, 2012,36.

Cojocaru A, Lăzărescu D, Ştefănescu A. Ghid orientativ al antrenorului de volei. Ed. Bucureşti, 2013.

Forthomme B, Croisier JL, Ciccarone G, Crielaard J, Cloes M. Factors correlated with volleyball spike velocity. J Sports Med, 2005;33(10):1513-1519.

Kotzamanidis C, Chatzoloulos D, Michailidis C, Papaiakovou G, Patikas D. The effect of a combined high intensity strength and speed training program on the running and jumping ability of soccer players. J Strength Cond. Res. 2005;19:369-375.

Kraemer WJ, Fleck J. Strength training for young athletes. Ed. Human Kinetics publishers, 2007.

Mârza D. Volei, bazele teoretice şi metodice. Ed. PIM Iaşi, 2006,168.

Malousaris GG, Bergeles NK, Barzouka KG, Bayios IA, Nassis GP, Koskolou MD. Somatotype, size and body composition of competitive female volleyball players. J Sci Med Sport, 2008; 11(3):337-344.

Marques MC, Tillaar R, Vescovi JD, Gonzalez-Badillo JJ. Changes in strength and power performance in elite senior female professional volleyball players during the in-season: a case study, J Strength Cond Res, 2008;22(4):1147-1155. doi: 10.1519/JSC.0b013e31816a42d0.

Mc Bride JM, Triplett-Mc Bride T, Davie A, Newton RU. The effect of heavy- vs. light-load jump squat on the development of strength, power, and speed. J Strength Cond Res. 2002;16(1):75-82.

Mureşan A. Volei. Selecţia şi pregătirea echipelor de juniori. Ed. Accent, Cluj-Napoca 2005,63.

Neagu N. Cuantificarea pregătirii fizice în antrenamentul sportive. Ed. University Press, Tg. Mures, 2012,12.

Noyes FR, Barber-Westin SD, Smith ST, Campbell T. A training program to improve neuromuscular indices in female high school volleyball players. J Strength Cond Res, 2011;25:2151-2160.

Păcuraru A, Iacob I, Balaiş F, Braharu O. Manualul profesorului de volei. Ed. Helios, Iaşi 2000, 220.

Pereira A, Costa AM, Santos P, Figueiredo T, Vicente PJ. Training strategy of explosive strength in young female volleyball players. Medicina at Science Direct.com, 2015;51(2):126-131. doi: 10.1016/j.medici.2015.03.004.

***. Fédération internationale de volleyball, Top Volley, Livret technique. Jeu, Techniques et Tactiques après les Championnats du Monde 2002, 2, 12.

**Websites**

(1) www. Locusport.net