

# THE EFFECTS OF NEUROMUSCULAR TRAINING IN THE MAINTENANCE OF FITNESS IN VOLLEYBALL PLAYERS DURING THE JUNIOR PERIOD

A.M. COJOCARU<sup>1</sup>    M. COJOCARU<sup>1</sup>

**Abstract:** *The paper wants to present the importance of performing neuromuscular training in order to permanently maintain a form of high fitness throughout the competitive period. The aim of this work was to verify the effects of training on neuromotor variables in young volleyball athletes at different times of the program. The hypothesis of the study starts from the fact that further investigation together with the realization and application of a training program, will contribute to the achievement of training fitness during competitive periods. The outcomes of implementing this training regimen with young female volleyball players underscore the suitability of engaging in competition during their initial phase.*

**Key words:** *Volleyball, neuromuscular, juniors, fitness*

## 1. Introduction

The participation of sports children or young people in sports activities creates a physical, affective, cognitive and emotional development, when they are introduced in specialized programs, in a correct, appropriate way [10].

Carrying out specialized and intense training in order to increase their ability to participate in important competitions is a permanent concern of all sports science specialists [13].

During this period, several physical, psychological and psychosocial changes and peculiarities appear that can have consequences on the body, which can make changes on the athlete's abilities.

That is why this period must be extremely well used and oriented towards consolidating and perfecting the technique, which needs a good base of the specific physical condition [19].

Even under these conditions, more and more athletes are specialized from a young age in a single sports branch, without having a multilateral sports training, which would help them to develop fundamental skills, to form an extremely large motor baggage, which to help them achieve diversified sports skills [13].

It is the time to develop all physical skills, through systematic and rational, pedagogical actions, which must not lead to the development of another motor

---

<sup>1</sup> Faculty of Physical Education and Sport, *Spiru Haret* University of Bucharest, Romania

function of the athlete. The pedagogical action of developing physical skills contributes to the major emergence of one of them [3].

Studies have shown the importance of resistance development at the age of puberty, because it presents an important anatomical change, namely the development of heart volume, which shows the possible improvement of motor resistance, mainly of cardiorespiratory type, at that age level [14].

That is why young athletes, who start strength training, without an experience that allows neuromuscular control when performing basic movements, from the point of view of biomechanics, can lead to poor performance, and can even cause damage to the skeletal muscles [6].

All these things highlight the necessity and importance of carrying out training programs aimed at the neuromuscular growth of young athletes, with the aim of increasing muscle strength and power, extremely useful in the development of speed and explosion in executions [11]

Due to the increased demands of technical training and competition, in-season strength and conditioning programs are often designed to maintain adequate levels of strength and power over several months. [5]

From the point of view of tasks and training methods, during adolescence, tasks approximately equal to those of adults can be used, but adapted to their performance capacities, because it is the age of the growth period, where the cartilages of the bone epiphysis can suffer damage [9]. At this level, an increased volume of work and a moderate intensity

must dominate, based on a continuous increase in the loads in strength training.

So it is observed that there are positive effects on strength and endurance indices, in athletes who pass from the adolescent phase to the adult phase, based on well-structured training programs.

The purpose of this study is to analyze the application of a specific neuromuscular training program, based on changes in maximal oxygen consumption and based on vertical jumps, specific to the game of volleyball, in female U16 athletes (15-16 years old).

## 2. Material and Methods

The method of studying specialized literature

The method of observation

The method of tests and measurements

- Motor ability tests

- Tests aimed at the development of functional capacity

The method of pedagogical experiment

The statistical-mathematical method of data processing and interpretation

The method of graphic representations

In order to optimize the physical training of the junior volleyball players and the optimal utilization of the performance capacity, an experiment was carried out based on the use, in the training of the national team, of an adapted neuromuscular program.

The sampling was made from the athletes of the U16 national team, who trained in the Izvorani Olympic Sports Complex, with the aim of qualifying for the European Championship in Hungary, 2023.

These sportswomen started practicing volleyball as a game, around the age of 9.3 ( $\pm$  2.7) years, and the start of volleyball training took place at 10.4 ( $\pm$  1.0) years and the number of participation at National Championship competitions was 4.0 ( $\pm$  0.8) events by the start of this study.

During the preparation for the national team, the specific training consisted of jumping, throwing the medicine ball and exercises with weights in the fitness room, along with technical and tactical training on the field, as a result of the periodicity proposed by the technical team.

The structure of the adopted training periods was based on well-known international theories (Bompa, T., 2002) in which the annual training cycle is divided into three periods: the preparatory period, in which the development of sports ability is aimed at; the competitive period, which aims to maintain sports ability, and the transition period, i.e. the moment when a decrease in sports activity is observed.

The training macrocycle was developed with the aim of reaching the peak of sports fitness at the end of the training period, ending with the participation in the European Championship qualifications.

The methods and procedures for improving the general motor capacity used in the preliminary research were:

### **2.1. Method of explosive type efforts (power training)**

This method aims to develop the force in the speed regime (relaxation).

The method assumed the performance of all exercises and repetitions at maximum speed, the loads used in this method were between 75-95% of the possibilities with 6-8 series of 3-6 repetitions, (heart rate reaches high values 190-200 beats / minute).

The breaks between exercises were 2-3 min. and between series of 3-5 min. After the breaks, the pulse returned to the initial values.

### **2.2. Plyometric training**

Plyometrics exercise is used to produce fast and powerful movements, to improve nervous system functions (muscle reaction time) and to improve sports performance.

To determine the maximum oxygen consumption ( $VO_2$  max), the 1,000 meters test of the Klissouras protocol was used [8], and to assess the vertical jump, the relaxation measuring device was used, with the jump from place, specific to the block and with momentum, specific to the attack shot.

### **3. Results**

Table 1 shows the mean values and standard deviations (SD) of the performances of the vertical release with momentum (attack), the vertical release from the place (blocking) and the 1000 m run, to which the maximum  $VO_2$  calculation is added, in initial and final testing.

Table 1

*Mean and standard deviation in vertical jump and 1000 m*

Assessments for initial and final test	Initial test	Final test
Attack range	2,66 ± 0,09	2,71 ± 0,09
Blockage	2,54 ± 0,10	2,56 ± 0,10
1000 m	315,50 ± 15,5	327,80 ± 20,5
VO2 max	49,30 ± 2,5	50,30 ± 3,1

There was a significant increase in the test ( $p < 0.05$ ) but in the other block and attack interval test at the final measurements.

*The statistical results of the vertical jump test*

Table 2

Variable	P value (T1 x T2)
Attack range	0,58
Blockage	0,58
1000 m	1,00
VO2 max	1,00

Table 3 shows the absolute and percentage values between the training periods, which were realized with the means chosen for those periods, where the preparatory period was not included, because the athletes came from the championship period.

*The differences between absolute values and percentages between the two periods*

Table 3

Phases Tests-Differences	Specific training		Competitive training	
	Abs	%	Abs	%
Attack range	0,07	2,34%	0,07	2,34%
Blockage	0,08	2,75%	0,08	2,75%
1000 m	6,45	2,04%	6,27	1,84%
VO2 max	0,95	1,90%	0,91	1,83%

**4. Discussions**

The trends of the last period regarding the achievement of high quality technical executions at the level of juniors, volleyball, require, in addition to the technical-tactical component, a good physical training that is the basis for supporting performance and efficiency.

The objectives of general physical training aim at maintaining the motor indicators at the level of the development norms of each individual, hardening the body through diversified methods and means, recovering the body through means and methods in natural environments, developing the motor

capacity at the level required by the social model.

Motor competence is a significant indicator in analyzing high-level sports performance [18].

Furthermore, the stability of motor skill levels in childhood may have implications for talent identification as well as potential health benefits across the lifespan [4].

The performance test, for the vertical release, showed a significant difference of  $p < 0.01$  comparing the initial tests, and for the attack shot there were no significant differences.

These results are consistent with other studies [15], which showed the same characteristics in female athletes between the ages of 15.8 years and 17.1 years. An increase in performance was found in each test and especially throughout the macrocycle and especially when performing the block compared to the attack shot, which did not present significant differences.

In the general preparation phase, the training is based on multiple jumps, which would lead to a higher growth, later in the macrocycle, but this phase is carried out at the clubs where the athletes come from. This was the basis of the 0.05 difference increases in the attack and block tests, because this is due to the improvement of coordination within the muscle, based on the contraction effect. This fact is reinforced by Ugrinowitsch and Barbanti 1998 [17] - proponents of incorporating more jumping suggests is that it improves coordination and increases the muscular system's ability to generate force quickly.

The low experience at this age sometimes explains the differences between the performances achieved in

the blocking and attacking actions, because work is still being done on the automation of the coordination elements involved in these two actions specific to the game of volleyball. In 1996 Smith shows that the automation and refinement of jump biomechanics is one of the key components that achieve an increase in vertical release ability.

That's why plyometric exercises, along with strength development, are what develop the vertical jump both when blocking and when attacking.

During the competitive period, the accumulations from the preparatory period at the clubs were preserved and maintained, through certain squat exercises on the bar and together with the specific technical-tactical training; therefore an improvement in jumping performance was achieved.

Bompa 2003 [2], claims that the adaptation process in sports activity is not limited only to the increase of driving force, but also to the abilities of the superior athlete to use this power effectively.

So I think it would be correct to say that it is essential to use an increased power, a maximum force, which leads to an improvement in coordination, by increasing the speed of contraction.

Regarding aerobic endurance, there were percentage increases, but insignificant, because the vast majority of athletes had not completed this 1000m test, which led to these values. After it was done a few times, they understood how to dose your effort in order to perform this test in optimal conditions and achieved better values.

Filin, 1996, [3] says that at the age of 15, girls are in a difficult period to develop general aerobic endurance, and in order

to achieve significant values, you need to do it at least three times.

Regarding aerobic power, the values of 49.3 and 50.3 ml/Kg/min found in the evaluations showed increased values, than other researchers, who studied the phenomenon, but did not present significant differences.

Studies have shown that for tennis, volleyball and football, the recovery period is longer than during the exercise.

## 5. Conclusions

The findings of this study indicate that neuromuscular training promotes significant gains in motor competence and physical performance in female U15 volleyball players.

Following the implementation of the operational approach, the main conclusion is that the preliminary general hypothesis was confirmed, namely that the application of a specific neuromuscular training program, based on changes in maximum oxygen consumption and based on vertical jumps, specific to the game of volleyball, in sportswomen U16 cadets (15-16 years old), create the conditions for achieving efficiency in the game.

The application of a training program for U15, in volleyball, highlights the obligation to participate in all competitions provided by the competition system.

The variety of training methods, means and materials also determined the optimization of the motor and functional capacity of the U15 volleyball players, which determined and instilled a much more active participation among the athletes, due to the great variety of means of operation, as well as the degree of their attractiveness.

These programs must take into account the fact that these athletes still need neuromuscular skills. In this sense, the science of training has a relevant role in maintaining the health of athletes, allowing a greater modernization of the structure towards more intense competitive phases.

Based on the results observed in this study, we can see that the training carried out at the clubs, during the general training period, generated increases in the jumping, blocking and attack indices, and in the pre-competitive period an increasing trend, but constant and more small, compared to the previous one.

During the competitive period, it was observed the continuation of the constancy of the values from the pre-competitive period, but due to the improvement of the biomechanics of the jump, first in stable conditions and then in competition conditions, an increase in the value of the jump for the attack shot and blocking was observed, but also an increase in the effectiveness of these procedures, based on the increase of resistance in the jumping regime, of sportswomen.

For the efficiency of the 1000 m test, it turned out that it is extremely important that it is known, that it has been used at least three times, for the sportives to realize the perception of the speed rhythm, and to lead to a constancy of its realization.

Our results support that female U15 athletes should first build an important foundation by developing movement competence, then build and enrich volleyball-specific skill sets.

This study highlights the potential of using neuromuscular training in conjunction with volleyball training as a

useful, time-efficient and practical mode of exercise to improve movement competence along with physical performance.

## References

1. Bompa, T.: *Teoria și metodologia antrenamentului. Periodizarea (Training theory and methodology. Periods)*. București, Editura Ex Ponto, C.N.F.P.A., 2002.
2. Bompa, T.: *Totul despre pregătirea tinerilor campioni (All about training young champions)*. Constanța, Editura Ex Ponto, 2003.
3. Filin, V.P.: *Desporto juvenil*. Londrina, PR: CID, 1996.
4. Fransen, J., Deprez, D., Pion, J., et al.: *Changes in physical fitness and sports participation among children with different levels of motor competence: A 2-year longitudinal study*. In: *Pediatr. Exerc. Sci.* Vol.26, 2014, p. 11–21.
5. Graham, J.: *Periodization research and an example application*. In: *Strength Cond J.*, Vol. 24, 2002, p.62-70.
6. Hewett, T.E., Myer, G.D., Kiefer, A.W., et al.: *Longitudinal increases in knee abduction moments in females during adolescent growth*. In: *Med Sci Sports Exerc*, Vol. 47, 2015, p.2579–2585.
7. Ionescu-Bondoc, D.: *Bazele antrenamentului sportiv (The basics of sports training)*, Note de curs. Brașov, 2008.
8. Klissouras, V.: *Prediction of potential performance with special reference to heredity*. In: *Journal of Sports Medicine*, Vol., 13, 1973, p.100-107.
9. Kraemer, W., Fry, A., Frykman, P., et al.: *Resistance training and youth. Pediatric Exercise Science*, Vol.1, 1989, p.336-50;
10. Myer, G.D., Faigenbaum, A.D., Edwards, N.M., et al.: *Sixty minutes of what? A developing brain perspective for activating children with an integrative exercise approach*. In: *Sports Med*, Vol. 49, 2015, p.1510–1516.
11. Myer, G.D., Faigenbaum, A.D., Chu, D.A., et al.: *Integrative training for children and adolescents: Techniques and practices for reducing sports-related injuries and enhancing athletic performance*. In: *Phys Sports Med.*, Vol.39, 2011, p.74–84.
12. Marques, A.T., Oliveira, J.: *O treino e a competição dos mais jovens: rendimento versus saúde*. In: *Esporte e Atividade Física Interação entre rendimento e saúde*. Org.: Barbanti VJ, Amadio AC, Bento JO, Marques AT. 1ª ed. Barueri, SP: Manole, 2002;
13. Myer, G.D., Lloyd, R.S., Brent, J.L., et al.: *How young is “too young” to start training?* In: *ACSMs Health Fit J.*, Vol.17, 2013, p.14–23.
14. Oliveira, A.C.C., Araújo, C.G.S.: *Avaliação da idade biológica e sua aplicabilidade na educação física*. In: *Fundamentos biológicos medicina desportiva*. Coord. Araújo CGS. Rio de Janeiro: Ao Livro Técnico, 1990;
15. Oliveira, P.R.: *O efeito posterior duradouro de treinamento (EPDT) das cargas concentradas de força Investigaç o a partir de ensaio com equipe infanto-juvenil e juvenil de voleibol*. Campinas, 1998. Tese (Doutorado) Universidade Estadual de Campinas.
16. Smith, T.K.: *Off-season vertical jump training for junior high volleyball*

- players*. In: *Strength and Conditioning*, Vol.2, 1996, p.24-28.
17. Ugrinowitsch, C., Barbanti, V.J.: *O ciclo de alongamento e encurtamento e a "performance" no salto vertical*. In: *Revista Paulista de Educação Física*, Vol.12, 1998, p.85-94.
18. Vandorpe, B., Vandendriessche, J.B., Vaeyens, R. et al.: *The value of a non-sport-specific motor test battery in predicting performance in young female gymnasts*. In: *J. Sports Sci.* Vol.30, 2012, p.497–505.
19. Weineck, J.: *Biologia do esporte*. São Paulo, Manole, 1991.