

## Special aspects of female volleyball players' coordination training at the stage of specialized preparation

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### Abstract

Purpose: Rising of effectiveness of female volleyball players' coordination training at the stage of specialized preparation.

Material: In the research 22 female volleyball players of 15-17 yrs age participated.

Results: Factorial analysis permitted to receive 5 components structure of female volleyball players' coordination abilities. Correlations and factorial weights, which characterize the structure of female volleyball players' coordination abilities, are presented. Besides, factorial analysis permitted to mark out 5 factors, which to large extent influence on formation of volleyball players technical- tactic fitness. Their contribution in general dispersion of sample was 75.7%. The first factor is ability to quickly coordinate movements and for kinesthetic differentiations (24.5%). The second factor is ability to quickly reconstruct motor actions (19.8%). The third factor is vestibular stability (12.1%). The fourth factor is space orientation (10.5%) and the fifth – ability to react (8.9%).

Conclusions: Improvement of female volleyball players' specific coordination abilities it is purposeful to realize with the help of targeted training means. With it, it is recommended to use game exercises and circular training. :

**Key words:** female volleyball players, training, coordination, abilities, correlation, structure.

### Introduction

Modern volleyball is connected with highly intensive loads; stability, distribution and re-switching of attention; maximal speed of players' reacting. Increased requirements are put forward to visual-motor coordination, precise differentiation of space-time and dynamic motor parameters. Effective fulfillment of game actions during the whole match requires high level of general and special motor abilities (Doroshenko, 2013; Rycarev, 2015; Zhelezniak, Portnov, & Savin, 2001).

As some authors note (Hirtz, Ludwig, & Ludwig, 2009; Kozina et al., 2016a; Nosko, Vlasenko, & Manievich, 2001), conception "technique-coordination" is a determining factor of high sport results in sport games. In other work it is affirmed (Platonov, 2015) that high sport results can be achieved only at the account of ability to assess dynamic, space and time motor parameters and to accurately regulate them.

By other data (Liakh, 2006; Zimmerman, 1988) the most important for sport games coordination abilities are: reacting (ability to quickly and precisely fulfill short-term movement in response to known or unknown signal); differentiation of motor parameters (which condition high accuracy and efficiency of space movements); power of movements (tonus of working muscles); time characteristics of movements (ability to feel the time of fulfillment); orientation (exact determination of body position and its change in proper time, movement in required direction); combining (fulfillment of separate movements and actions as holistic combinations); reconstruction and adaptation of motor actions (ability to quickly reconstruct the mastered forms of movements; transition from one motor actions to other); rhythm (accuracy of motor action's rhythm; adequate change of rhythm); balance (ability to keep certain body position in fulfillment of different motor actions).

In other studies (Bal'sevich, 2009; Kozina et al., 2016a) it is underlined that training success in the period of motor function's formation substantially depends on a number of factors: correspondence of training means and orientation with biologically conditioned age rhythm of athlete's motor abilities. It is important to find laws of coordination's development in children (Liakh, 2006; Sadovskij, 2003). These authors found high increment of coordination abilities in children from 7 to 11-12 years. From 12 to 14 years age partial stabilization of motor coordination is observed, which is caused by morphological-functional transformation in period of puberty. From 15 to 17 years coordination abilities continue to develop. In girls it is especially

concerns to their ability to control the movements of ballistic and sport-game character (Ivashchenko, et al., 2016).

In solution of coordination's development problems it was found the following:

- Assessment and monitoring of motor abilities (coordination) permits to determine the factors of athletes' successfulness in race walking (Cazzola, Pavei, & Preatoni, 2016);
- In sport selection it is possible to assess the prospects of 6 – 16 yrs age football players by motor coordination indicators, aerobic endurance and speed characteristics (Deprez, Franssen, Lenoir, Philippaerts, & Vaeyens, 2015);
- Individualized development of motor coordination indicators at every training stage can influence on training process and sport technique's perfection as well as choosing effective strategies in workability (Gierczuk & Sadowski, 2015; Kolumbet, 2017);
- Importance of early participation and training intensity for tennis players of 11-14 years age was found that can play important role in improvement of quickness and motor coordination (Sogut, 2017);
- Motor coordination is an important factor, which determines entering elite level in women volleyball (Pion et al., 2015)
- Correlation of the most important indicators' factorial weights, which characterize motor coordination structure in different age schoolchildren (Baginska, 2017; Kopeikina, Drogomeretsky, Kondakov, Kovaleva, & Iermakov, 2016);
- Development of coordination abilities facilitates students' health improvement (Podrigalo, Galashko, Iermakov, Rovnaya, & Bulashev, 2017; Drogomeretsky, Kopeikina, Kondakov, & Iermakov, 2017; Druz, Iermakov, Nosko, Shesterova, & Novitskaya, 2017).

Optimization of physical loads is also very important (Arziutov, Iermakov, Bartik, Nosko, & Cynarski, 2016; Kamaev, Proskurov, Potop, Nosko, & Yermakova, 2017; Nosko, Razumeyko, Iermakov, & Yermakova, 2016) as well as pedagogic control (Korobeynikov, Korobeynikova, Iermakov, & Nosko, 2016; Kozina, Iermakov, Crelu, Kadutskaya, & Sobyenin, 2017; Podrigalo, Iermakov, Rovnaya, Zukow, & Nosko, 2016).

Targeted improvement of coordination abilities in sensitive periods of their development will permit: to master arsenal of volleyball techniques at higher level; effectively use them in competition activity (Boichuk, 2010; Liakh & Vitkovskij, 2010).

Working out of methodic of coordination abilities' control and training require exact answer to the question: how these abilities interconnect and what is their structure (Boichuk, 2009). For increase of coordination abilities training effectiveness in case of junior athletes it is recommended to use factorial analysis (Golenko, Mikhuta, & Kuz'mina, 2010; Khudolii, Iermakov, & Ananchenko 2015; Zerf, 2017) Factorial analysis of correlations current state in structure of junior female volleyball players' coordination fitness will permit to find leading factors, which significantly influence on formation of technical-tactic fitness. The found age features of factors' importance in the structure of junior female volleyball players' coordination fitness will permit purposefully select means and methods of coordination abilities' development; to correctly determine the volume and correlation of coordination training means.

The choice of training means depends on interconnection between separate coordination abilities. The presence of strong correlations permits to use exercises of integrated character. Their absence admits seeking of means of addressed influence.

Contradictory situation was formed between demand in development of coordination abilities and insufficient scientific-methodic provisioning. It conditions practical and scientific relevance of the problem of our study.

*Hypothesis:* it is assumed that improvement of coordination training of 15-17 yrs female volleyball players will facilitate quick mastering of new motor actions and their rational usage in various situations. Besides, it will permit for female volleyball players to quicker reach higher sportsmanship and prolong sport life.

*The purpose of the research* is rising of effectiveness of female volleyball players' coordination training at the stage of specialized preparation.

### **Material and methods**

*Participants:* In the research 22 female volleyball players, who are at stage of specialized training, participated (n=22, age – 15–17years).

*Organization of the research:* Coordination abilities were assessed with the following indicators of abilities: balance; rhythm; reacting; kinesthetic differentiations; space orientation; coordination of movements; reconstruction of motor actions. In the research the following tests were used:

*Test 1:* ability for kinesthetic differentiation was assessed with test "Ball's throws to target from position "target behind the back"" (Liakh, 2006). Equipment for the test: measuring tape, 6 tennis balls, 1 hoop; 1 filled ball of 1 kg mass; 1 gymnastic mat 2x1 m. Athlete stand at throwing line with back toward target. The task was to throw ball over head or over shoulder and hit the target (at 2 meters' distance). Gymnastic mat was the target. In the center of the mat was hoop of 80 cm diameter. Inside the hoop – filled ball was located. Necessary explanation is given to the athlete and movements were demonstrated. Athlete was given one trial

attempt and five test attempts. Hitting gymnastic mat brought 1 score. Hitting inside hoop brought 2 scores. Hitting the space between filled ball and hoop brought 3 score and hitting the filled ball – 4 scores.

Ability to coordinate movements was estimated with tests 2, 3.

*Test 2:* ability to coordinate movements was estimated by the time of gymnastic stick's overstepping. The stick was hold by athlete's straight arms (Sergiienko, 2001). In initial position athlete holds stick by straightened arms. By coach's signal he oversteps the stick 5 times by right and 5 times by left legs. The time of task's fulfillment was measured in seconds.

*Test 3:* "Ten eights" (Sergiienko, 2001). Equipment for the test was tennis ball and stop watch. Initial position: torso bent forward, ball in one hand. By command "Go" athlete moves the ball between legs maximally quickly at knees' level (imaginable "eight" was the trajectory of ball's movement). With it the ball is passed from hand to hand.

Ability to reconstruct and adapt motor actions was assessed with tests 4-5.

*Test 4* was for finding of correlation of run time 3x10 m between two attempts: 1 – initial position – athlete fulfills exercise with face pointed forward; 2 –initial position athlete fulfills exercise with back pointed forward (%) (Sadovskij, 2003).

*Test 5* implied run 3x10 m with back forward (sec.) (Sadovskij, 2003).

*Test 6* is for athlete's ability for space orientation and means "Running to numbered balls" (Liakh & Vitkovskij, 2010). The test was fulfilled in two variants with following comparison of the results.

Equipment of the test included: five filled balls with numbers from 1 to 5 (mass 2 kg); 1 filled ball of 4 kg mass; measuring tape and stop watch. In semi-circle of 3 m radius there are 5 numbered balls at equal distance from each other. The sixth ball is located at 3 meters' distance from other balls. Athlete stands in front of sixth ball. Coach announces number and athlete, having turn by 180°, runs to appropriate filled ball, touches it and returns to sixth filled ball. After athlete's touching sixth filled ball the coach announces other number. Thus all five filled balls shall be touched by athlete. The test finishes, when athlete touches sixth filled ball after touching the last of five.

Approximately 10-20 minutes before test "Run to numbered balls" athlete fulfills shuttle run 5x3 m (like with mentioned above location of balls). Athlete runs in turn to every of five filled balls (with touching it). Result: 1) time of run to every of numbered balls (sec.); 2) difference between time of run to numbered balls and time of shuttle run 5x3 m (sec.); preciseness of test's measuring – up to 0.01sec.

*Test 7:* for assessment of athlete's ability to feel rhythm implied fulfillment of test "Run on hoops" (Liakh, 2006). Equipment of this test included: 11 hoops of 80 cm diameters, measuring tape, stop watch. First, athlete runs 30 meters' distance for time (result is registered with accuracy up to 0.01sec). Then, athlete again runs with maximal quickness other distance, on which 11 hoops are located. It obliges athlete to choose certain rhythm of run. Results were: 1) time of running on hoops; 2) difference between time of run along 1<sup>st</sup> and 2<sup>nd</sup> distances.

Determination of static and dynamic balance was fulfilled with tests 8 and 9.

*Test 8:* "Stance on one foot with closed eyes (Sergiienko, 2001) implies the following: athlete takes initial position on one foot with other leg bent in knee and maximally turned outside. Its heel touches under knee area of supporting leg. Hands are on waist. By command "Go" athlete closes eyes and coach switches on stop watch. Supporting leg shall be straightened. Stop watch shall be switched on at the moment of loosing balance. Results are registered by the best indicators of two attempts with accuracy up to 0.01c.

*Test 9,* for dynamic balance implied fulfillment "rotations on gymnastic bench" (Liakh & Vitkovskij, 2010). Equipment for the test included gymnastic bench and stop watch. Athlete took standing position (one foot in front of other) on narrow gymnastic bench (width 10 cm). During 20 seconds he was to fulfill as much rotations by 360° as quickly as possible. Rotations shall be fulfilled in turn: one – to the left and one – to the right without loosing balance. Result was the number of fulfilled rotations during 20 seconds (accuracy up to 0.5 of rotation). The best result of two attempts was registered.

Determination of ability for reacting (test 10-12):

*Test 10:* SVMR is simple visual motor reaction. For determination of simple and complex visual motor reaction's latent period we used computer program "Psycho-diagnostic" (Kozina et al., 2011). Athlete shall fulfill the following instruction: "When picture appears on screen press as quick as possible with right (left) hand the button of mouse". In real time the program registers and depicts on screen mean value of latent period (for 30 seconds of homogenous irritators' application). Besides, other statistical indicators of variation series re presented (mean square deviation, error of mean arithmetic, quantity of mistakes).

*Test 11 – RCh1-3* is for reaction of choice of one signal from three. It is characterized by determination of complex visual motor reaction: choice of one signal from three offered with the help of hand's reaction to certain irritator. Athlete shall fulfill the following instruction: when geometric figures or pictures appear on screen it is necessary to press as quickly as possible the button of mouse without reacting to other signals. The program registers and depicts on screen the same list of statistic indicators as in SVMR test.

*Test 12:* RCh2-3 is reaction of two signals' choice from three ones. It is characterized by determination of complex visual motor reaction: choice of two from three offered signals with the help of hand's reaction to certain irritator. The time of complex sensor-motor reaction of two signals' choice from three is registered.

Athlete shall fulfill the following instruction: “when geometric figures appear on screen it is necessary to press and release with left hand as quick as possible the button of mouse. When figure (of animal world) appears on screen it is necessary to press and release as quickly as possible the right button of mouse with right hand. When other figures appear no pressing shall be fulfilled.

*Statistical analysis:* the received data were processed with the help of SPSS 17.0 program. We fulfilled multiple correlation analysis. From all kinds of factorial analysis we used the kind of analysis, which ensured statistical analysis of main components with normalization by varimax rotation. Interpretation of correlations was fulfilled by examples of other researches (Ivashchenko et al., 2017; Khudolii, Ivashchenko, Iermakov, & Rumba, 2016).

### Results

For optimization of junior athletes’ training process in age aspect it is purposeful to find the structure of their fitness in general and coordination abilities in particular (Boichuk & Zakhharkevich, 2016; Kozina et al., 2016b; Sadovskij, 2003). For this purpose we used factorial analysis. With its help great number of variables (in our case 14) was reduced to less quantity of independent values (factors). In the structure of female volleyball players’ coordination fitness we marked out 5 factors, contribution of which in general dispersion of sample was 75.7%. The contribution of other (not determined) factors was 24.3%.

Table 1. Factorial structure of female volleyball players’ coordination fitness

Description of test	Component				
	1	2	3	4	5
Ball throw to target with back pointed to the target (differentiation of motor parameters), quantity of hits	<b>-,536</b>	,179	,371	,150	-,305
Overstepping of gymnastic stick (motor coordination), sec.	<b>,646</b>	,040	,157	-,238	,231
Test “ten eights” (motor coordination) sec.	,465	,373	,170	<b>-,594</b>	,056
Run to numbered balls (orientation), sec.	<b>,798</b>	,254	,074	,333	,152
Difference between time of run to numbered balls and shuttle run 5×3 m (orientation), sec.	-,014	-,321	,186	<b>,832</b>	,253
Stance on one foot with closed eyes (static balance), sec.	-,441	,238	,253	-,118	,435
Rotations on gymnastic bench (dynamic balance), quantity of rotations	<b>-,601</b>	,135	<b>,610</b>	,014	,230
Run 3×10 m with back pointed forward, sec.	,157	<b>,850</b>	-,322	,275	,125
Correlation of 3×10 m run time (face and back forward) (reconstruction of movements), sec.	-,201	<b>,716</b>	<b>-,538</b>	,231	,219
30 m run on hoops, sec.	<b>,696</b>	,327	,279	,190	-,339
Difference of 30 m run and 30 meters’ run on hoops, sec.	<b>,562</b>	-,105	,490	,221	-,276
SVMR, m.sec.	,329	,154	,391	-,075	<b>,623</b>
RCh1-3, m.sec.	,000	<b>-,807</b>	-,133	,036	,324
RCh2-3, m.sec.	<b>,582</b>	<b>-,573</b>	-,372	-,027	,145
<b>Contribution in general dispersion of sample,%</b>	<b>24,5</b>	<b>19,8</b>	<b>12,1</b>	<b>10,5</b>	<b>8,9</b>

In first factor (contribution in general dispersion – 24.5%) 7 variables had the highest factorial loads: ball throw with back towards target; run to numbered balls; Overstepping of gymnastic stick; rotations on gymnastic bench; 30 meters run on hoops; difference of 30 meters’ run on hoops and 30 meters’ run on straight distance; reaction of choice. The factor was interpreted as ability for motor coordination and kinesthetic differentiations.

Second factor (19.8%) is characterized by four statistically significant indicators: 3x10 m run with back in towards direction of movement; difference between 3x10 m with back towards direction of movement and face; two indicators of complex visual motor reaction in conditions of choice. The factor was named “ability for quick reconstruction of motor actions”.

In the third factor (contribution to general dispersion 12.1%) with high factorial loads the following indicators were included: quantity of rotations on gymnastic bench during 20 sec.; correlation of 3×10 m run time with face toward direction of movements. The factor was interpreted as vestibular stability.

Two variables (difference of time to numbered balls and shuttle run 5×3 m; results of “ten eights” composed the fourth factor, which was named “ability for space orientation”.

Fifth factor consisted of indicators of simple visual motor reaction and was named “ability to react”.

The next task of the research was to find correlations between 14 indicators of 7 coordination abilities. In total we regarded 169 correlations between mentioned above coordination abilities. In female volleyball players from 169 calculated correlations 5 were statistically significant. It was 3% of all correlations.

Analysis of correlation matrix showed confident positive correlations (from  $r=0.45$  to  $r=0.50$ ,  $p<0.05$ ) between indicators of ability for kinesthetic differentiations and dynamic balance and complex visual motor reaction.

Significant correlation ( $r=0.51$ ,  $p<0.05$ ) was found between indicators of movements' coordination and space orientation. Average correlation was found between volleyball players' sense of rhythm and space orientation ( $r=0.60$ ,  $p<0.05$ ). Indicator of volleyball players' dynamic balance was interconnected ( $r=0.58$ ,  $p<0.05$ ) with indicator of complex visual motor reaction.

### Discussion

One of leading places in perfection of junior volleyball players' training system is taken by the following problems: determination of effective structure of fitness; systemizing of existing and working out of new approaches to sport training planning. Importance of these problems' solution is noted in different works (Boichuk, Iermakov, & Nosko, 2017; Farfel, 2011). As on present time interest to coordination structure and scientists' wish to more profoundly study it have been sufficiently substantiated. That is why it is important to mark out the most important kinds of these abilities for different kinds of sports (Raiola, 2012; Zimmerman, 1988).

In other work (Liakh, 2006) it is affirmed that coordination abilities' structure has its own specific. The structure depends on the following: kind of sports; level of sportsmanship; sex; training impacts. All these shall be considered, when controlling coordination fitness and its training.

Having marked out 14 indicators of coordination-motor sphere, we received 5-components' structure of female volleyball players' coordination abilities. The first and second factors included tests, which determine the most complex abilities to coordination and adaptation. One factor included indicators of orientation in space and reacting that witness about their interconnection. Other factors included tests, which condition abilities for motor parameters' differentiation and motor actions' reconstruction.

Working out of coordination abilities' training methodic requires answer to question; how these abilities are interconnected in age aspect. The conducted correlation analysis showed the absence of confident correlations between different specific coordination abilities. Earlier it was found (Liakh, 2006; Golenko, Mikhuta, & Kuz'mina, 2010), that with age the quantity of positive correlations between coordination abilities reduces. Though they exist between separate coordination abilities, but in the future their differentiation happens (Platonov, 2015). Thus, results of correlation analysis witness about heterogeneous nature of specific coordination abilities. In our study confident correlations were found only between indicators, which have common meaningful, programmed and motor executive components. It confirms the opinion of other scientists (Bernshtejn, 1996). Besides, we found that between separate heterogeneous abilities there are confident positive dependences. Such correlations exist between: ability for orientation and reacting; between ability for motor coordination and reconstruction, rhythm and reacting. It is noticeable in the fact that one and the same factors with high factorial loads entered in a number of coordination abilities' indicators.

After determination of female volleyball players' coordination fitness structure there appears a question about selection of training means for coordination abilities' perfection.

According to modern conceptions of specialists (Liakh & Vitkovskij, 2010; Zimmerman, 1988) coordination training in sport games is divided into general and special. General coordination training implies complex coordination exercises with increased requirements to athlete and his/her coordination abilities. But these exercises (motor actions) do not contain elements of volleyball technique. Special coordination training is a system of application of complex coordination exercises with increased requirements to coordination. In the base of it there is volleyball technique. Basing on results of the researches we'll make an attempt to determine the place of female volleyball players' general and special coordination training.

It should be noted that with growing of athletes the time for general coordination training is reduced and for special training – increased. It is recommended to spend 5% of training time for perfection of general coordination abilities at this stage of many years training. 45% of training time shall be spent for special coordination and technical training (Boichuk, 2015; Farfel, 2011; Platonov, 2015). The volume of conditional and tactical training means for this age category athletes shall be 25% of every training session.

Alongside with it in practical aspect it is necessary to answer the question: from what ability it is desirable to start training to create pre-conditions for formation of other coordination abilities and in what sequence it shall be realized. As Hartman C. H. (1999) notes abilities for adaptation and motor actions' reconstruction shall be trained in the last turn. The author thinks: first shall be trained ability for space orientation, which will facilitate perfection of specific qualities (recognition of signal and situation – opponent, ball, partner and location on site). Next, it is necessary to improve abilities for reacting and coordination of movements. After application of the mentioned training impacts for perfection of the mentioned above qualities, it is necessary to pay attention to training of kinesthetic differentiations, rhythm and balance. Coordination exercises it is recommended to use in the main part of training after warming up. Results of our research and the data of other authors (Liakh, 2006; Golenko, Mikhuta, & Kuz'mina, 2010; Sadovskij, 2003) point at purposefulness of analytical exercises' application with accent on separate coordination abilities. Some authors (Liakh & Vitkovskij, 2010) advise to use also different synthetic exercises (special games, game tasks, circular

training and etc.). The authors note that in the process of these exercises two or more coordination abilities are improved.

Other authors (Hirtz et al., 2009; Sadovskij, 2003) note that training of specific coordination abilities (especially at the stage of specialized basic training and further stages of many years' perfection) will be effective only in conditions of definite kind of sports. Optimal training effect will be achieved, when coordination complexity will increase from one exercise to other. It will permit to avoid automation and coordination barrier in fulfillment of different motor actions.

### Conclusions

The fulfilled factorial analysis of female volleyball players' coordination fitness permitted to mark out 5 factors, which noticeably influence on formation of technical-tactic sportsmanship. Their contribution to general dispersion of sample was 75.7%. First factor is ability to quick coordination of movements and kinesthetic differentiations (24.5%). Second factor is ability for quick reconstruction of motor actions (19.8%). Third factor is vestibular stability (12.1%). Forth factor is space orientation (10.5%). Fifth factor is ability for reacting (8.9%).

The conducted correlation analysis showed that interconnections between indicators of female volleyball players are mainly absent.

Perfection of specific coordination abilities of female volleyball players in this age period it is purposeful to realize with the help of targeted training means. With it, it is recommended to use game exercises and circular training. Such approach will permit to improve two or more coordination abilities.

Training of female volleyball players' coordination abilities at stage of specialized basic training it is purposeful to realize with the help of training means, containing volleyball technique elements.

### Conflict of interests

The author declares that there is no conflict of interest.

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