

## EFFECTS OF GAME-BASED CONDITIONING TRAINING ON VOLLEYBALL SKILL ACCURACY IN JUNIOR PLAYERS

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Original scientific paper

### Abstract

*In recent years, an approach called game-based training has been developed. The aim of our research is to determine the effects of game-based training on accuracy in adolescent volleyball players. Forty two adolescent volleyball players (16,26±1,01 years) participated in this study. Players were randomly allocated into a small-sided games group (n = 22) and a control group (n = 20). Each player participated in a 8-week training program that included 3 organized court training sessions per week. Participants were tested for passing, setting, serving and serving under fatigue accuracy. Both groups made significant increases in serving accuracy (p < 0.05) after 8 weeks of training. However, significant interaction effect between the groups was not found for all variables. Control group was involved in traditional instructional training induced significant improvements in forearm passing, setting and serving accuracy. To conclude, game-based training appears to have similar effects with instructional training in improving skill accuracy in junior volleyball players.*

**Key words:** volleyball training, adolescent players, skill-based training, effects

### Introduction

Volleyball is an intermittent sport that requires players to compete in frequent short bouts of high-intensity exercise, followed by periods of low-intensity activity (Gabbett et al., 2006). However, while well-developed physiological capacities are important for team sports, athletes are also required to have well-developed technical skill and decision-making ability. In addition, athletes are often required to demonstrate these qualities under high levels of pressure and fatigue (Gabbett & Georgieff, 2006). In recent years, an approach called game-based training has been developed in order to combine the skill and conditioning elements in a coordinated approach (Gabbett, 2002; Gabbett, 2003; Gamble, 2004; Nurmekivi et al., 2002; Sassi, Reilly, & Impellizzeri, 2004). It is an important consideration to optimize skill development in volleyball while still obtaining appropriate conditioning levels. Simply put, according to Magill, (2001) transfer of practice to the game environment depends on the extent to which practice or training resembles the game. In order to expose players to the intensity, decision making, speed and skill execution required in the competition setting, practice sessions need to replicate actual game events and phases of play. The use of game-based conditioning games as training drills allows the simulation of movement patterns of team sports, while maintaining a competitive environment in which athletes must perform under pressure and fatigue (Gabbett, 2002). Game-based training offers an additional challenge to team-sport athletes not normally present in non-skill related conditioning activities (Farrow, Pyne, & Gabbett, 2008). Studies have assessed the specificity of game-based conditioning games in a limited number of team sports

(e.g., volleyball, soccer, rugby league, and rugby union). Gabbett (2008) showed that skill-based conditioning games that simulate the physiological demands of competition in junior elite volleyball players offer a specific training stimulus. Gabbett, et al., (2006) have concluded that skill-based volleyball training improves speed and agility performance, spiking, setting, passing accuracy, spiking and passing technique, but has little effect on the physiological and anthropometric characteristics of players. They also stated that skill-based training programs should be supplemented with an appropriate amount of energy system training to enhance the physiological and anthropometric characteristics of talented junior volleyball players. Trajković, Milanović, Sporis, Milić & Stanković (2012) examined the effects of pre-season game based conditioning training in semi-professional volleyball players. The authors stated that selected program does not offer a sufficient stimulus for semi-professional volleyball players due to the fact that there were no significant differences between pre training and post training for lower-body muscular power and agility. According to author's findings and experience, game-based training could be a part of training programs in younger volleyball players where the intensity of training is not as high as in professional and elite volleyball players. However, studies investigating the effectiveness of game-based training are limited, with many of the suggested advantages and disadvantages of game-based training. Therefore, more research is needed in order to confirm this theory. The aim of our research is to determine the effects of game-based training on accuracy in adolescent volleyball players.

**Methods**

*Subjects*

Forty two adolescent volleyball players participated in this study. They were randomly assigned to game-based group (22 players) and control group (20 players). All players were members of the teams that finished in best eight youth and junior teams in Serbia for the past few years.

Two participants were in the under-16 National team which finished first in the world youth championship in Italy, and two of them were candidates for National junior squad. Descriptive characteristics are presented in Table 1.

All subjects received a clear explanation of the study, including the risks and benefits of participation, and written parental or guardian consent was obtained before players were permitted to participate. The protocol of the study was approved by the Ethical Committee of the Faculty of sport and physical education, University of Nis, and according to the revised Declaration of Helsinki. The mean  $\pm$  SD sporting experience of all subjects was 5  $\pm$  1 year (range: 2–9 year), corresponding to 2-hour training sessions, and at least 1 competition per week.

Table 1. Descriptive characteristics of the subjects

	Mean $\pm$ SD (n=42)	Mean $\pm$ SD Experimental (n=22)	Mean $\pm$ SD Control (n=20)
Age (years)	16,26 $\pm$ 1,01	16,36 $\pm$ 1,03	16,16 $\pm$ 0,98
BH (cm)	182,15 $\pm$ 7,44	184,18 $\pm$ 8,62	180,13 $\pm$ 5,46
BW (kg)	68,99 $\pm$ 10,79	70,84 $\pm$ 10,45	67,14 $\pm$ 10,97

*Procedures*

Beside the results, basic anthropometric parameters (body height and body weight) were registered in the study protocol. The initial testing took place before the beginning of the pre-season period while the final testing was performed after 8 weeks of intervention with the game-based training method. All study procedures took place at a school athletic facility. All participants took part in one introductory session during which time proper form and technique on each test were reviewed and practiced. During this session research assistants demonstrated proper testing procedures and participants practiced each test. Participants were asked not to perform any vigorous physical activity the day before or the day of any study procedure.

The same researchers tested and trained the same participants and the tests were performed in the same order with identical equipment, positioning, and technique. Before each testing, the participants performed a standard 20-minute warm-up and 15-minute specific warm up. Standard warm up protocol consisted of 10 min of warm up running and 10 min of dynamic stretching and 5 x 30m of running exercises.

*Passing*

The passing ability of the players was evaluated by determining their ability to return a pass to a target positioned at the net, 2 m from the right-hand sideline. The target dimensions were 1.6 m long and 2.3 m wide. A coach, positioned in the service position, approximately 1 m above the ground and 10 m from the receiving player, threw an overhead pass to the receiving player. Players were required to pass (dig) the ball to another player standing with arms extended above their head, in the target area. Players were awarded 2, 1 and 0 points if a pass did not reach either of the target areas. The aggregate from 6 trials was recorded as the player's accuracy score. More detailed explanation of the test could be found in Gabbett & Georgieff (2006).

*Setting*

The setting ability of players was evaluated by determining their ability to set to a target positioned next to the net at net height, 5.5 m from the setting player. This location was chosen because it represents the approximate position at which a receiving player would stand when preparing to spike the ball during a match. A coach, positioned approximately 5 m from the setting player, threw an overhead pass to the setting player. Players were required to set the ball to a target that was 80 cm in diameter. Players who successfully set the ball through the target were awarded 3 points. Balls that hit the outside edge of the target but did not go through the target were awarded 2 points. Players who set the ball within 2.3 m of the net (and therefore 1.5 m of the target) were awarded 1 point. Balls that did not reach the target areas were awarded no points. The aggregate from 6 trials was recorded as a player's accuracy score (Gabbett & Georgieff, 2006).

*Serving*

*Service Accuracy in a Rested Condition.* Players were asked to hit 10 consecutive serves to designated areas in the opposite court. Players could choose their preferred position behind the service line. Serves were performed individually, and each serve was supplied to the server by another player. Players were allowed 8 seconds to hit each serve. This interval time for preparation of the serve

*Service Accuracy Immediately After Physical Exertion.*

Players were allowed 5 sets of 2 consecutive serves (for a total of 10 serves) in which to hit to the designated areas on the opposite court. Each 2-serve set was performed following an effort designed to elevate the heart rate (HR). The physical exertion consisted of a block at the net, followed by a dig at the 3-m line, both performed twice, and again a block at the net. The players performed a block, dig, block, dig, and block. The HR of the players was measured (using Polar M31; Polar Electro Oy, Vantaa, Finland) immediately after completion of the physical exertion. Players could choose their preferred position behind the service

line, but it had to be identical to the position at which they hit the serves at the rested condition. Serves were performed individually, and the ball for each serve was supplied to the player by another player. Players were allowed 8 seconds to hit each serve (16 seconds for each set). The points for each serve were allotted according to the designated areas. More detailed explanation for both tests could be found in Lidor, Arnon, Hershko, Maayan, & Falk (2007).

*Training program*

One cycle of eight weeks was analyzed in pre-season (2013/14). The schedule of the performed program is shown in Table 2. The goals of the game-based program were to increase the intensity of sport-specific training, and attention was given to volleyball drills and skills. Two weeks before the training program players performed the general conditioning in order to level the conditioning of players after the break during off season. None of the players was performing any additional resistance or aerobic training outside of the 3 game-based sessions. The duration of training sessions was recorded, with sessions typically lasting 80-100 min. During the 8-week follow-up, the team played 4 friendly pre-season matches. For this purpose game-based conditioning exercise were selected based on previous experience and pilot studies in which mean exercise

intensity responses of traditional drills is suggested by previous authors (Gabbett, 2008; Gabbett, et al., 2006). In the first part of sessions players were involved in technical drills and after that more complex, game-based conditioning exercises were used (2 vs. 2, 3 vs. 3, 4 vs. 4 and competition drills 6 vs. 6). Although the duration of each individual rally in this drills was not controlled by the coach, total duration of the drill can be recorded to assist in inter and intra-session planning. The total repetitions can be easily quantified by summing the total points played in the rally, then multiplying by the number of rallies per point (Sheppard & Borgeaud, 2009).

The coach create an emotionally intense environment by implementing a scoring system (e.g., team that wins 2 out of the 3 rallies scores one big point, 5 seconds rest) and by encouraging the players. Control group was involved in traditional instructional training sessions that were designed to develop volleyball technique and accuracy. All skills were taught by using blocked practice, so that all trials for each skill were completed before moving onto the next skill (Gabbett, 2008). A typical instructional training session consisted of players performing individual skills against a wall or to a partner in a non-competitive environment, multiple repetitions, and practice of technique in a closed-skill environment.

Table 2. Training program used between weeks 1 and 8.

Goal: game-based conditioning	
Sessions 1–24 (Monday-Wednesday-Friday)	
Exercises	
Warm up	General activity + specific warm up games with the ball (25 min)
Instructional drills for technique	20 min of drills that include low intensity movement and combine volleyball technique . Two drills were performed with 2 minute break between.
3 vs. 3, 4 vs. 4 and 6 vs. 6 game based drills	Small-sided (e.g., 3 vs. 3, 4 vs.4) games where the volleyball court was separated in two smaller (9x4.5 m) courts with additional tasks. Competition drills (6 vs. 6) with the majority of free balls to each side thrown by the coach. Both teams rotate depending of the scoring. After each rotation players take one minute break (40 min).
Stretching	5 minutes of stretching for the muscle groups mainly involved in sessions

*Statistical analysis*

SPSS (version 10.0; SPSS Inc., Chicago, IL) was used for the statistical analysis. Means and standard deviations of all variables were calculated.

The normality of the distribution was tested using Kolmogorov-Smirnov test and it showed an appropriate normality of the distributions for all the studied variables.

Training effects were analyzed using a two-way analysis of variance (ANOVA) (2 x 2) with repeated measures. Factors included training groups and time (pre- and post-training).

When the significant ANOVA interactions were found, additional independent t-tests were applied to determine inter-groups differences.

All coefficients were considered significant at a level of 95% (p<.05).

**Results**

The Kolmogorov-Smirnov test has shown that data was normally distributed. The changes in overhead and forearm passing, setting, serving and serving under fatigue accuracy are shown in Table 3. There were no significant differences (P>0.05) between the groups for passing, setting, serving, and serving under fatigue accuracy before training. Training induced significant (p<0.05) improvements in overhead passing and serving accuracy. While there was a trend for forearm pass, setting and serving under fatigue accuracy to improve with training (descriptive statistics), there were no significant differences (p>0.05) between pre training and post training in experimental group. Control group induced improvements in most of measurements of skill accuracy. However, significant differences were found only in forearm passing, setting and serving accuracy (Table 3).

Table 3. Differences between experimental and control group

	Experimental group (n=22)		Control group (n=20)	
	Initial (Mean ± SD)	Final (Mean ± SD)	Initial (Mean ± SD)	Final (Mean ± SD)
Overhead pass	5.43±1.86	6.60±2.09*	6.56± 2.19	6.9±2.02
Forearm Pass	4.56± 1.59	5.2± 1.51	5.26± 1.48	6.16±1.31*
Setting	7.96± 2.49	9.20± 3.15	9.33± 2.20	10.8±2.63*
Serving	27.86± 7.59	31.66± 6.40*	25.46± 6.59	28.80±5.35*
Serving under fatigue	27.76± 9.18	31.26± 7.40	27.9± 7.06	28.33±6.57

\* Significant difference  $p < 0.05$  between initial and final testing; †Significantly greater improvement than in control group ( $p < 0.05$ )

**Discussion and conclusion**

The present study investigated the effect of a game-based training program on skill accuracy in male junior volleyball players. Our results show that both, game-based volleyball training and control group were similarly effective at increasing most performance parameters in junior volleyball players. However, there were no significant interaction effects between the groups for all accuracy variables. In similar studies with young male subjects Gabbett et al. (10) have concluded that skill-based volleyball training improves speed and agility performance, spiking, setting, passing accuracy, spiking and passing technique, but has little effect on the physiological and anthropometric characteristics of players. In addition, Gabbett (2008) stated that skill-based conditioning games have induced improvements in speed, vertical jump, spike jump, agility, upper-body muscular power, and estimated maximal aerobic power.

Our results are similar to results found in Gabbett (2008) study. Aforementioned author stated that instructional training resulted in considerable improvements in technique and accuracy in all skill tasks, however skill-based conditioning games resulted in few improvements in technical skill and accuracy. It has been suggested that traditional technical training, which uses blocked practice, provides greater short-term improvements in skill than random practice, such as this performed by the game-based conditioning games group in our study (Shea & Morgan, 1979). However, using random practice could have longer-term performance benefits (Gabbett, 2008). Game based group showed significant improvement in overhead passing compared to control group.

Possible reasons could be found in the fact that players in game based training have more overhead passing actions due to less players on the court. Moreover, smaller court in small-sided games lead to less powerful serving, forcing players to use overhead passing. On the other hand, traditional instructional training and coaches train passers to receive high and deep balls with a

forearm pass technique rather than with the overhead pass technique. Both groups showed significant improvement in serving accuracy. This is not surprising, since both training programs use the same technique to improve volleyball skills. The only difference is that players in game-based training are involved in more stressful situations due to opponents and scoring in games. Therefore, it was expected that players in game based group would significantly improve Service accuracy after physical exertion.

However, there were no significant differences ( $p > 0.05$ ) between pre training and post training following game-based training in junior volleyball players. However, in contrast to our results Gabbett et al, (2006) found that the post training serving accuracy was not significantly different from that recorded prior to training due to wider target and greater complexity of the serving task which may led to increased number of errors. Based on previous research, it was suggested that the training-induced adaptations in this types of specific tests could occurred due to the characteristics of the drills (i.e., service, attack, and passing) and matches during training programs which have contributed significantly to the improvement of the performance in such a specific type of test (Stanganelli, Dourado, Oncken, Mancan, and da Costa, 2008). These findings provide important information on skill and skill testing in response to game-based training in junior volleyball players. However, further research is required to determine if measurable improvements in skill can be achieved following a similar training period in younger volleyball players. To conclude, game-based training appears to have similar effects with instructional training in improving skill accuracy in junior volleyball players. Volleyball coaches could use this information in the process of planning the volleyball training. In this way, the training will be more specific and the transfer of training effects to game efficiency will be faster. Many coaches do not use the approach described in this article to the training process because they fear of insufficient stimulus that game-based training could have in volleyball.

## References

- Farrow, D. Pyne, D. Gabbett T. (2008). Skill and Physiological Demands of Open and Closed Training Drills in Australian Football. International Journal of Sports Science & Coaching, 3 (4), 489-499, doi:10.1260/174795408787186512
- Gabbett, T., Georgieff, B., Anderson, S., Cotton, B., Savovic, D., & Nicholson, L. (2006). Changes in skill and physical fitness following training in talent-identified volleyball players. J Strength Cond Res 20: 29-35.
- Gabbett, T., and B. Georgieff. (2007). Physiological and anthropometric characteristics of junior national, state, and novice volleyball players. J. Strength Cond. Res. 21(3), 902-908.
- Gabbett, T. J. (2008). Do skill-based conditioning games offer a specific training stimulus for junior elite volleyball players? J Strength Cond Res, 22, 509-517.
- Gabbett, T. J., & Georgieff, B. (2006). The development of a standardized skill assessment for junior volleyball players. International journal of sports physiology and performance, 1(2), 95.
- Gabbett, T., (2003). Do Skill-Based Conditioning Games Simulate the Physiological Demands of Competition?, Rugby League Coaching Manuals, 32, 27-31.
- Gabbett, T.J., (2002). Training Injuries in Rugby League: An Evaluation of Skill-Based Conditioning Games, Journal of Strength and Conditioning Research, 16(2), 236-241.
- Gamble, P., (2004). A Skill-Based Conditioning Games Approach to Metabolic Conditioning for Elite Rugby Football Players, Journal of Strength and Conditioning Research, 18(3), 491-497.
- Lidor, R., Arnon, M., Hershko, Y., Maayan, G., & Falk, B. (2007). Accuracy in a volleyball service test in rested and physical exertion conditions in elite and near-elite adolescent players. Journal of strength and conditioning research/National Strength & Conditioning Association, 21(3), 937.
- Magill, R.A., Motor Learning and Control: Concepts and Applications, 7th Edn., 2001, McGraw-Hill, New York.
- Nurmekivi, A., Karu, T., Pihl, E., Jurimae, T., Kaarna, K. and Kangasniemi, J., (2002). Comparative Evaluation of the Influence of Small Game 4 vs. 4 and Running Load in the Training of Young Football Players, Acta Kinesiologiae Universitatis Tartuensis, 7, 77-86.
- Sassi, R., Reilly, T. and Impellizzeri, F., (2004). A Comparison of Small-Sided Games and Interval Training in Elite Professional Soccer Players (Abstract), Journal of Sports Sciences, , 22, 562.
- Shea, J. B., & Morgan, R. L. (1979). Contextual interference effects on the acquisition, retention, and transfer of a motor skill. Journal of Experimental Psychology: Human Learning and Memory, 5(2), 179.
- Sheppard, JM and Borgeaud, R. Skill Based Conditioning: A perspective from elite Volleyball, NSCA 2009. Available at: [www.nasca-lift.org/HotTopic/download/Skill Based Conditioning.pdf](http://www.nasca-lift.org/HotTopic/download/Skill%20Based%20Conditioning.pdf). Accessed 5.13.2016.
- Stanganelli, LCR, Dourado, AC, Oncken, P, Mancan, S, and da Costa, SC. (2008). Adaptations on jump capacity in Brazilian volleyball players prior to the under-19 world championship. J Strength Cond Res 22: 741-749.
- Trajković, N., Milanović, Z., Sporiš, G., Milić, V., & Stanković, R. (2012). The effects of 6 weeks of preseason skill-based conditioning on physical performance in male volleyball players. J Strength Cond Res, 26(6):1475-80.

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## UTJECAJ SITUACIJSKO-KONDIICIJSKOG TRENINGA NA PRECIZNOST KOD ODBOJKAŠA JUNIORA

### Sažetak

*Cilj istraživanja je utvrđivanje efekata osmotjednog situacijsko-kondicijskog treninga na preciznost kod adolescenata uzrasta (16,26±1,01godina). Ispitanici eksperimentalne grupe (n=22) su bili podvrgnuti eksperimentalnom tretmanu u trajanju od osam tjedana. Situacijsko-kondicijski trening je sproveden u sportskim dvoranama. Kontrolna grupa (n=20) je sudjelovala samo u redovitom, tradicionalnom tehničko-taktičkom trenažnom programu. Preciznost je procijenjena testovima koji su korišteni u ranijim istraživanjima, kao i modifikacijama istih. Kod preciznosti serviranja došlo je do podjednakog poboljšanja kod obje grupe. Nije došlo do značajne interakcije između grupa. Kontrolna grupa, koja je izvodila tehničko-taktički trening, doprinijela je poboljšanju u varijablama: prijem čekićem, dizanje i servis. Dobijeni rezultati ukazuju na slični efekt kod situacijsko-kondicijskog treninga i tradicionalnog treninga tehnike preciznosti izvođenja tehničkih elemenata kod odbojkaša adolescenata.*

**Ključne riječi:** *situacijski trening, odbojka, tehnika, snaga, mladi sportaši*

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*Received: June 15, 2016*

*Accepted: September 5, 2016*

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