DOES TRAINING ON SAND DURING OFF-SEASON IMPROVES PHYSICAL PERFORMANCE IN INDOOR VOLLEYBALL PLAYERS?

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Abstract
The aim of the present study was to assess the effects of sand volleyball training program on physical performance in young indoor volleyball players. Twenty adolescent male volleyball athletes (16±1 years) consented to participate in program and lower-body power and body composition testing. The participants performed the Attack, Block jump tests and Standing Broad jump test for lower-body power. One cycle of six weeks was analyzed during off-season (2014). Players were involved in specialized sand volleyball training program and exercise were selected based on previous experience and according to performance analysis in beach volleyball studies. There were no significant differences between pre-training and post-training for Block jump and Standing broad jump. However, there was a significant (p ≤ 0.05) improvement in Spike jump. Training program did not induced significant changes in body composition. The differences in intensity of training, training volume and sample size could be a reason of the discrepancy in results compared to previous studies. However, this kind of study could provide practical application for coaches and sport researchers.

Key words: *impact, sand, morphology, jumping ability*

Introduction

Beach volleyball is a very demanding sport which is played outdoors usually under difficult conditions such as high temperature, wind even rain The number of matches played per day (2 up to 5) during the weekend tournament and the fact that both players touch the ball in almost every phase of the game are factors of extra difficulty. Furthermore, volleyball performance (jumps, dives and other sport-specific drills) on sand makes beach volleyball more demanding than indoor volleyball (Balasas et al., 2013). Similar to indoor volleyball, Beach volleyball is a team sport characterized by its intermittent nature, fluctuating randomly from brief periods of maximal or near maximal activity to longer periods of moderate and low intensity activity (Magalhães et al., 2011). Clear understanding in this area could also contribute to improvements in training methods and provide targets for developing athletes. Beach volleyball players are forced to perform continuous actions under high temperatures and high humidity for many hours. In addition, moving on sand increases energy utilization compared to moving on solid ground (Zamparo, et al., 1992; Lejeune, et al., 1998). Magalhães, et al. (2011) analyzed the physiological and neuromuscular impact of a one 3-set beach-volleyball match and the ability of the players to recover from fatigue. Aforementioned authors stated that match induced a temporary reduction in lower limb strength and sprinting time but 3h after the match all variables with the exception of the sprinting time, were recovered.

There is significant increase in proportion of literature that has studied the performance analysis in beach volleyball (Palao, et al., 2014; Palao, et al., 2012; Giatsis, et al., 2005). Accordingly, studies that involved male games in the World Tour, showed that the players perform on average 100 jumps per set, and six jumps per rally (Pérez-Turpin et al., 2008). However, very little research exist regarding the beach volleyball training and its effects on performance. One study examined the effect of systematic beach volleyball training and competition on running economy and VO2max of indoor volleyball players (Balasas, et al., 2013). Aforementioned authors found decrease body mass and fat were after the beach volleyball period. Additionally, they indicated a significant increase in VO2max, both in absolute and relative values (Balasas, et al., 2013). It is very common for indoor volleyball players to perform beach volleyball training during summer time and participate in official tournaments in order to keep in good physique (Giatsis, 2003). However, to the authors' knowledge there are no studies that examined the influence of organized sand volleyball training on body composition in indoor players. Therefore, the aim of the present study was to assess the effects of sand off-season training program on body composition and jumping abilities in adolescent indoor volleyball players.

Methods

Subjects
Twenty adolescent volleyball players consented to participate in procedures involved in the study. Descriptive characteristics are presented in Table 1. All the participants provided written consent after being informed of the test protocol. 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. Each player had at least 4 years of training experience, corresponding to 2-hour training sessions, and at least 1 competition per week.

Table 1. Descriptive characteristics of the subjects*

Age (y)	Training experience (y)	Height (cm)	Body weight (kg)	Standing reach height (cm)
16±1	5±1	1.84 ± 0.08	69,62 ± 8. 19	232±8.48

*Data are reported as mean ± SD.

Procedures

This study was designed to address the question of how sand volleyball training affect body composition and jumping performance after a 6-week training program. Body composition measurements and jumping performance were performed before and after training program. This design enabled us to examine the impact of sand surface on muscular performance. The initial tests were completed on one day as part of a regular testing program. Before the initiation of the training program subjects were instructed about the proper execution of all the exercises that were to be done during the training period. None of the subjects had performed any strength or jump training before. They were instructed to avoid any strenuous physical activity during the experiment and to maintain their dietary habits for the whole duration of the study. The players underwent body composition and jumping performance assessment in an indoor stadium. During the testing, the air temperature ranged from 22°C to 25°C. Testing began at 10 am and finished by 1 pm. None of the participants had been injured 6 months before the initial testing as well as during the training program. There was no supplement addition to the diet of the players. Measurements were taken on Monday morning because the athletes had rested during the weekend. The participants were all tested during the off- season. Body Height was measured by portable stadiometer (Seca 214, Seca Medizinische Waagen und Messsysteme, D-Hamburg). Body composition was determined using the bioelectrical impedance method. Measurements of body composition were carried out using a Model BMC-148 body composition analyzer (Tanita, Japan).

Spike and block jump performances

For the standing reach, while wearing their normal volleyball footwear, players were requested to stand with their feet flat on the ground, extend their arm and hand, and mark the standing reach height while standing 90° to a wall. Players were encouraged to fully extend their dominant arm to displace the highest vane possible to determine their maximum standing reach height. The measurement of the standing reach height allowed for a calculation of the relative jump heights on each of the jumping tasks (absolute jump height (cm) – standing reach height (cm) = relative jump height) (Sheppard et al, 2009).

Spike and block jump performances for volleyball players depend heavily on the height at which these skills are performed above the net and are determined by not only the capacity of the athlete to raise vertically his center of gravity, but also his stature and standing reach. In this particular case, specific tests would provide a further understanding of the training-induced adaptation.

For the Spike jump, the standing reach was determined as the maximal distance between the fingertip of the attack hand and the ground, while standing 90° to a wall. The Spike jump was measured from a running lead (2- or 3-step approach) by using a basketball backboard marked with lines 1 cm apart with a 1-minute rest interval between them. For the Block jump, the standing reach was determined as the maximal distance between fingertips of the block hands and the ground, while facing the wall. The Block jump jumps started from a standing position with the hands at shoulder level and arms raised from the start position without extra swing. All tests used the same observer who was situated on a volleyball referee stand placed 2 m from the backboard. Both jumps were recorded as the best of the 3 attempts (Stanganelli, et al, 2008).

Standing broad jump was used for assessing the explosive power of the lower limbs. The players were instructed to stand behind a line and jump as far as possible allowing arm-leg countermovement. The distance was measured from behind the line to the back of the heels at landing.

Training program

One cycle of six weeks was analyzed in off-season (2014). The goals of the off-season conditioning were to increase the intensity of sport-specific training, and attention was given to volleyball skills and movement in sand. None of the players was performing any additional resistance or aerobic training outside of the 3 beach volleyball training sessions. The duration of training sessions was recorded, with sessions typically lasting 90 min. For this purpose beach volleyball exercise were selected based on previous experience and according to performance analysis in beach volleyball studies in order to set proper exercise intensity responses of traditional drills is suggested by previous authors. The schedule of the performed off-season sand volleyball training is shown in Table 2. 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.

Statistical Analyses

Data analysis was performed using the Statistical Package for Social Sciences (v13.0, SPSS Inc., Chicago, IL, USA). Descriptive statistics were calculated for all the experimental data. In addition, the Kolmogorov–Smirnov test of the normality of distribution was calculated for all variables before the analysis. Changes in body composition and lower-body muscular power of players over the training period were compared using t-tests with level of significance set at $p \leq 0.05$ and all data reported as means ± SD.

Results

Body composition

Table 3 shows descriptive parameters of body composition variables pre- and post-training. There were no significant differences ($p > 0.05$) between pretraining and posttraining in Body composition variables following the 6 week sand volleyball training.

Lower-body muscular power

The changes in Block jump, Spike jump and Standing broad jump are shown in Table IV.

Table 2. Training sessions of sand volleyball training program

Goal: Off-season sand volleyball program	
Sessions 1–18 (Monday-Wednesday-Friday)	
Exercises	
Warm up	General activity + specific warm up with the ball (25 min)
Instructional drills for technique	20 min of drills that include low intensity movement and combine beach volleyball technique. Two drills were performed with 2 minute break between.
3 vs. 3, 2 vs. 2	Small-sided (3 vs. 3) games where the volleyball court was separated in two smaller (9 x 4.5 m) courts. Competition drills (2 vs. 2) with the majority of free balls to each side thrown by the coach. Teams rotate depending of the scoring. After one team reaches 15 points players take two minute break (40 min).
Stretching	5 minutes of stretching for the muscle groups mainly involved in sessions

Table 3. Body composition of adolescent volleyball players before and after 6 weeks of training

	pretraining	posttraining	P-value
Body mass	69.62± 8.19	66.62± 7. 29	0.22
BMI	20.20± 1.84	19.30± 1.93	0.13
Fat %	14.72± 3.1	13.42± 4.1	0.26
Fat (KG)	10.05± 2,59	9.25± 1.89	0.27
Fat free mass	59.29± 6.31	60.49± 5.42	0.52
Muscle mass	30.83± 2,68	31.25± 2,46	0.60

* Significant difference p < 0.05 between initial and final testing

There were no significant differences ($p > 0.05$) between pretraining and posttraining for Block jump (p=0,07) and Standing broad jump (p=0,55). However, there was a significant ($p \leq 0.05$) improvement in Spike jump.

Table 4. Lower-body muscular power of adolescent volleyball players before and after 6 weeks of training

	pretraining	posttraining	P value
Block jump	46.36 ±3.795	48.64 ±4.031	0,07
Spike jump	55.29 ±4.890	58.57 ±5.019	0,04*
Stand. broad jump	214.93± 1.93	215.21± 0.83	0.55

***** Significant difference p < 0.05 between initial and final testing

Discussion

This study investigated the effect of a sand volleyball training program on the measurements of body composition and jumping performance in adolescent male indoor volleyball players. A significant improvement in Spike jump was observed. However, there were no significant differences between pretraining and posttraining for other jumping variables, as well for body composition.

As we stated previously, there is a lack of studies that involved sand training and its effects on performance. One study that investigated the effect of systematic beach volleyball training and competition on running economy and VO2max of indoor volleyball players included body composition measurements (Balasas, et al, 2013). Aforementioned authors found that body mass and fat were significantly decreased after the beach volleyball period. However, this was not the case in our study. Miyama & Nosaka (2004) and more recently Impellizzeri et al (2008) showed that jump training on sand induced less muscle soreness than jumping on a firm surface. Although we did not measure indirect indices of muscle damage, this must be taken into account when using jump training on sand in athletes. However, jumping on sand causes lower reuse of elastic energy and energy loss due to feet slipping during the concentric action (Miyama & Nosaka, 2004; Giatsis et al., 2004), which might induce different training effects compared to training on a firm surface. Amrinder, Sakshi, & Singh, (2014) found that fatigue index decreased in sand and flat surface groups after jump training, indicating a better endurance. However, jump training did not revealed any significant differences in endurance in both sand and grass groups. According to the aforementioned facts, one could only speculate that the intensity of training was insufficient enough for the changes in body composition. Moreover, the nutritional intake as a critical determinant of their athletic performance was not measured during the off-season program, which could significantly contribute to the results of our study. Our study showed no significant increase in block jump and standing broad jump following the off-season jump training. However, spike jump test showed significant improvement after sand training. Possible reason for the improvement in spike jump compared to block jump could be found in the similarity between spike jump test and spike during volleyball training, which led to the strong familiarization of the movement during test. Moreover, players at this level are using less block jumps during games. Impellizzeri et al (2008) found that both, sand and grass surfaces resulted in positive changes in sprinting and jumping ability. Mirzaei, et al. (2014) support the fact that increases in performance can occur after six weeks of DJ and CMJ training on sand with minimal muscle soreness and damage to lower body. According to previous research the longer contact time can induce less effective stretch shortening cycle (Saez-Saez De Villarreal, et al, 2009). Therefore, performing plyometrics on sand, could have negative effects on SSC, decrease the myotatic reflex, and increase amortization phase resulting worsens in performance (Impellizzeri, et al 2008; Miyama & Nosaka, 2004; Giatsis, et al, 2004). The role of the stretch-shortening cycle in jump performance appears to be lower for beach volleyball than other team sports.

However it is still an important component of performance. The importance of players having a high power to weight ratio is evident and should be carefully considered when designing and monitoring the sand/beach volleyball training programs *(*Riggs *&* Sheppard*,* 2009).

Conclusion

The results of this study indicate that there were no significant body composition and jumping performance. However, only spike jump showed improvement in post testing compared to pre testing following a 6 week of sand volleyball training program. It cannot be concluded that adolescent volleyball players develop distinctive performance characteristics at this age and level.

Therefore, more studies must be conducted in order to better understand the training on sand and its effects in indoor volleyball players. According to previous research and our results, clear conclusion about the effects of training in sand could not be given. The differences in intensity of training, training volume and sample size could be a reason of the discrepancy in results. However, this kind of study could provide practical application for coaches and sport researchers.

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UNAPRIJEĐUJE LI IZVANSEZONSKI TRENING U PIJESKU TJELESNU IZVEDBU DVORANSKIH ODBOJKAŠA?

Sažetak
Cilj ovog istraživanja bio je procijeniti učinke programa obuke na pijesku na fizičke performanse kod mladih dvoranskih odbojkaša. Dvadeset muških sportaša adolescenata (16 ± 1 g.) sudjelovalo je u programu i testiranju tjelesnog sastava i snage (low-power) u trajanju od jednog ciklusa od šest tjedana izvan sezone (2014). Igrači su bili uključeni u specijalizirani Program za odbojku i vježbe su odabrane na temelju prethodnog iskustva i na osnovu studije analize učinka u odbojci na pijesku. Nije bilo značajnih razlika prije i nakon treninga za blok skok i široki skok. Međutim, došlo je do značajnog (p ≤ 0,05) poboljšanja u Spike skoku. Program obuke nije izazvao značajne promjene u sastavu tijela. Razlike u intenzitetu treninga, volumenu treninga i veličina uzorka možda mogu biti razlog za razliku u rezultatima u odnosu na prethodne studije. Međutim, ova vrsta studija mogla bi pružiti praktične spoznaje za trenere i sportse istraživače.

Ključne riječi: *utjecaj, pijesak, morfologija, sposobnost skoka*

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