Original Research Article

EFFECTS OF TWO WARM UP PROTOCOL ON VERTICAL JUMP PERFORMANCE IN MINI-VOLLEYBALL PLAYERS

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ABSTRACT

Warm-up exercises are necessary before performing of explosive movement in any sporting event especially to improve performance as well as injury prevention in forceful jumping. The aim of this study was to compare effects of routine static stretch and newly dynamic movement as warm up protocols on jumping performance. Fifty seven male mini volleyball players (10.84 ± 1.24 yrs) participated in warm up exercise protocol in 2 consecutive weeks, three sessions for static stretch warm up and three other sessions for dynamic warm up every other nonconsecutive day. Static stretch consists of seven movements hold 12 seconds; relaxing 8 seconds and 12 seconds for each lower limb. Dynamic warm up includes 12 movements lasting 8 minutes. After each movement vertical jump test was performed, while Paired t test used to determine differences between two applied warm up exercise protocols. Significant increase has shown in vertical jump following dynamic warm up comparing to static stretch ($p<0.05$). Due to results, performing dynamic movement may be more effective to prior to perform high power and explosive skills such as jumping.

Keywords: Warm up, Dynamic movement, Static Stretch, Mini volleyball, jumping

INTRODUCTION:

Volleyball has grown to be one of the three most popular sports in the world and now is played by many groups from primary school children to older adults [1]. Children participating in volleyball, as a power sport, need to have great jumping ability because better performance of techniques such as Spike and Block are dependent to the amount of height reach which players can achieve also in order to prevent injuries [2]. Thus most of the training programs are concentrated on jumping. Before performing powerful physical activities such as jumping, some types of warm-up are recommended [3]. Warm-up is considered as a critical factor and is regularly used in sports to avoid injuries and to improve performance during training and competition [4,5]. Increase of muscle temperature, muscular blood flow and physiological responses are fundamental purposes of warm-up before any physical exercise [4]. Commonly, Warm-up consists of two parts: a general and a specific one. The general part focuses on increase of the core and muscle temperature, cellular metabolism and joint range of motion, the specific part focuses on the reinforcement of the motor programs [5]. In powerful and dynamic movements such as jumping, there is high neuromuscular activation and optimal musculotendinus stiffness [6,7]. Being prepared to

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jump better, without injury a well-designed warm up protocol is important. Traditionally, a routine warm-up program consists of moderate aerobic exercise followed by static stretching. Static stretching will improve flexibility by modifying both the mechanical [8] and neurological [9] characteristics of the muscle-tendon unit, enhance performance, reduce muscle tension [10,11] and risk of injury [3]. Although convincing scientific evidence documenting the injury-reducing and performance-enhancing potential of static stretching is limited, static stretching has become a generally accepted as a popular method of warming body up [10]. In spite of being a safe physical activity and great benefits [10], over the past few years, there is a newly trend toward other methods of warming up especially low intensity movements while static stretching have been challenged [11,12]. Negative effects of static stretching on strength, power and high speed performance have been reported in adults as well as children [3,11,13-18]. McNeal et al. (2003) and Faigenbaum et al. (2005) showed that an acute bout of static stretching can impair jumping performance in teenagers [3,17]. Siatris et al. (2003) also demonstrated a significant decrease in running speed of young gymnasts after static stretching [18]. Collectively, these findings suggest that static stretching before training has the potential to adversely affect muscle strength and power production.

Recently, there has been a great interest in warm up procedures that involve the performance of low-intensity dynamic movements such as skipping, hopping and bouncing, designed to elevate core body temperature, enhance motor unit excitability, improve kinesthetic awareness, and maximize active ranges of motion [3,7,17-20]. Comparing to static stretch, dynamic warm up including plyometrics, heavy-load resistance exercise, or maximum voluntary contractions have been shown to positively influence muscle strength and power production in adults [11,21]. Although replacement of low- intensity dynamic warm up with static stretch is suggested in some studies [20], but further researches are needed especially for children involving in power sports such as volleyball. Results of this study would be useful for physical education teachers and children coaches who typically encourage children to engage in some type of warm-up prior to training. The purpose of this investigation was to compare effects of two different warm-up protocols, static stretching and low intensity dynamic movements, on jumping performance in mini volleyball players. We hypothesized that performing static and dynamic stretch will have different effects on vertical jump records in mini volleyball players.

METHODS

This study was designed to determine the effects of two different Warm Up methods, consisted of (a) static stretching, (b) dynamic exercises, on vertical jump performance in mini volleyball players. Study procedure was executed in 2 consecutive weeks, in 6 nonconsecutive training session, three sessions for static stretch warm up and three other sessions for dynamic warm up every other day. Following each warm-up routine, subjects performed vertical jumps tests designed to measure lower-body power. All the participants as well as their parents were informed about all the procedures involved with the study, and informed consent was obtained at the beginning of the study. The Helsinki declaration was abided by throughout the study.

Subjects:

Fifty seven male mini volleyball players, with no history of surgery and chronic skeletal injuries which may affect the results, take part in this study. Their mean age, height and body mass (mean ± SD) were 10.84 ± 1.24 (years old), 157.51 ± 7.32 (cm) and 45.89 ± 3.91 (kg), respectively. All subjects had a background of participating in volleyball training for 6 month and 3 sessions in each week. The procedure of warm–up protocols was explained briefly for the subjects. Warm up protocols were executed under supervision of 3 volleyball coaches. Static Stretch protocol consisted of 3 minutes jogging and 1 minutes walking, Seven Static

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Stretch focusing on lower limb (table 1) were executed. Subjects performed each stretch in a slow and comfort manner. Each stretch was hold for 12 seconds, relaxed for 8 seconds and repeated for another 12 seconds. The same protocol was executed for the other leg. General flexibility recommendations were observed for designing static stretch protocol. Protocol of Dynamic warm up consisted of walking around the volleyball court in 30 seconds, 5 to 8 minutes jogging while performing dynamic movement on an 18 m distance and slow jogging on a 10 m distance, repeating two times around the volleyball court. Total numbers of movement were 12; all the subjects during performing dynamic stretch run 12 paces. The main purpose of dynamic movement was targeting lower limbs muscles because they are widely used in vertical jump of volleyball players. After a 2 minutes rest interval as comfortable walking each subject performed three vertical jump tests.

Table 1- Static Stretch (3)

1. Adductor stretch: In the seated position with an erect spine, keep feet together, bend knees, and allow knees to drop.
2. Modified hurdlers stretch: In a seated position with one leg straight, place the other leg on the inside of the straight leg and reach forward.
3. Hip rotator stretch: In a supine position, cross one leg over the other, forming a figure 4, and flex both hips to or past 90° by pulling on the uncrossed leg.
4. Bent-over toe raise: From a standing position with the heel of one foot slightly in front of the toes of the other foot, dorsiflex front foot towards shin while leaning downward with upper body.
5. Quadriceps stretch: In the standing position with an erect spine, bend one knee and bring heel towards buttocks while holding the foot with one hand.
6. Calf stretch: In a standing position with feet staggered about 2 or 3 feet from a wall, lean against the wall with both hands, keeping the back leg straight and the front leg slightly bent.
7. Hamstring stretch: The subject sits on the ground with both legs straight out in front, and bends forward while keeping the back straight.

Table 2- Dynamic movements (3)

1. High-knee walk: While walking, lift knee towards chest, raise body on toes, and swing alternating arms.
2. Straight-leg march: While walking with both arms extended in front of body, lift one extended leg towards hands then return to starting position before repeating with other leg.
3. Hand walk: With hands and feet on the ground and limbs extended, walk feet towards hands while keeping legs extended then walk hands forward while keeping limbs extended.
4. Lunge walks: Lunge forward with alternating legs while keeping torso vertical
5. Backward lunge. Move backwards by reaching each leg as far back as possible.
6. Light skip. While running with a slight skip, the knees are raised slowly with arms swinging in rhythm.
7. Light butt kicks: While running, the heels are raised to touch the buttocks, with arms swinging in rhythm.
8. Back pedal: While keeping feet under hips, take small steps to move backwards rapidly.
9. Lateral shuffle: Move laterally quickly without crossing feet
10. Carioca: The subject runs sideways while crossing both feet in front of each other. This is repeated in both directions.
11. High-knee run: Lift knee toward chest and arm swing while moving forward quickly
12. Hopping: At the star position, each subject perform double leg hopping slowly in a comfort manner up to the end line.

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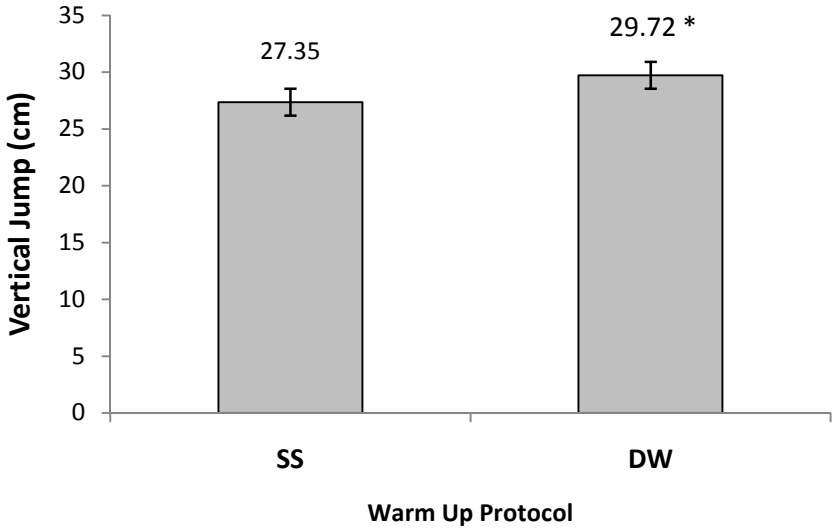
Vertical jump performance**:** jumping (CMJ) height was measured using a scaled board. Subjects began from a standing position, performed a crouching action followed immediately by a jump for maximal height. Each subject completed three trails with 30 seconds of rest between every trial. The best of three was considered as the record of the subject in the warm up protocol and because subjects participated in each warm up protocol for 3 non consecutive sessions, mean average of the records was considered for further analysis.

Statistical analysis:

Descriptive analysis (mean ± SD) was used to calculate age, height, weight, and vertical jump variables. KS test was used to identify normality distribution of variables and pair t-test was used to analyze differences between vertical jump records following two different warm up protocol, static stretch and dynamic warm up at $p \leq 0.05$. All analyses are carried out using SPSS 18.0.



SS: static Stretch, DW: Dynamic Warm up

* Significant difference ($p<0.05$)

Figure 1- Vertical Jump performance following two different warm up protocol

RESULTS:

Results of vertical jump following static stretch and dynamic stretch are shown in Figure 1. With regards to the jump records of mini volleyball players, using dynamic warm up improve vertical jump (8.66%) significantly. It would appear that dynamic warm up has a positive effect on vertical jump performance of mini volleyball players.

DISCUSSION:

The aim of this study was to compare effects of static stretch and dynamic warm up protocols on vertical jump performance of mini volleyball players. Jumping performance include more than 85% of achieved points in a volleyball game [1], thus it seems that the players spend most of their training time to improve this technique and many of trainers concentrate on jumping ability. It's noticeable that before beginning of a formal volleyball match each team has maximum 20 minutes to be prepared for the match, thus finding new

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methods of warming up with the least time range is of the major concerns for trainers and volleyball players. The most important finding of this study was related to significant increase of vertical jump following dynamic warm up comparing to routine static stretch.

Our study demonstrate that jumping records followed by mild intensity jogging and static stretch was lower than dynamic warm up which is in consistent with other studies on children [3,17,18] and also in adults [3,11,13-18]. McNeal et al. (2003) studied the effect of static stretch on drop jump test in gymnast girls and found this method would cause decrease jumping performance even to 10% [17]. Faigenbaum et al. (2005) in a similar investigation as our study compared the effect of separate static stretch and dynamic movements on physical fitness parameters of children. The results showed better performance of jumping using dynamic movement (6%) than static stretch [3]. Although results of our study are in agreement with Faigenbaum et al. but jumping performance following dynamic movements in our study showed greater increase (8.6% comparing 6%), perhaps because the differences in protocol and subjects. Also, Siatras et al. (2003) reported that static stretch would also affect negatively on some fitness parameters such as running speed in children engaged in gymnastic training [18]. Cornwell et al. (2001) reported that pre-event static stretching significantly reduced jump height by about 4.4% [15] and similar observations were made by young and Behm (2002) who reported significant differences in explosive force and jumping performance following static stretching [11]. Although the acute mechanism responsible for these findings has been unknown yet, it has been stressed that biomechanical properties of contractile elements and neuromuscular function are two main reasons.

Static stretch would change biomechanical structure of muscle tendon, making it more compliant and thus decreasing the speed of power production which causes delays in muscle activation as well as impairment in jumping performance [3,8,14]. Stiff muscle-tendon unit transmit generated power more accurately during contraction comparing to compliant one [13]. Being stiff for a muscle-tendon unit has the advantage to enhance the capacity of power production by optimizing muscle length and contraction speed [16,22]. Decrease of jumping performance in this study may be partly due to changes in musclotendinous unit stiffness, result of less optimal condition for rapid and strong force generation. Jumping performance is affected by elastic energy stored in eccentric phase while expanding and power produced during concentric phase. Perhaps after static stretch less energy is stored in eccentric phase, decreasing elastic recoil of stretch shortening cycle and finally decreasing jumping performance [15,16].

Perhaps significant increase in jumping performance of mini volleyball players after dynamic warm up could be explained by neural mechanisms. Appropriate force production may be optimized by neuromuscular function called “Post Activation Potentiation” (PAP). It has been suggested that PAP would increase rate of force development [23,24]. Maybe effects of dynamic warm up protocol would highlight role of fast twitch fibers by improving their excitability and thus causing significant effects on explosive skills such as jumping [24,25,26]. Also, performing light to moderate explosive movement in warm up like hopping or high knee may activate additional neural pathways and enhanced jumping performance to a greater extend [3].

Although using dynamic warm up is more beneficial than static stretch in jumping performance of mini volleyball players but further investigations are needed to identify the most effective study dynamic warm up protocols with different intensities.

CONCLUSION:

Dynamic warm up based on low intensity movement would be beneficial to improve jumping performance in explosive sports such as volleyball and volleyball players, especially children engage with would be more successful in jump related techniques.

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