Effect of Various Strength of Polymetric Preparation on Selected Physiological & Routine Variables among Volleyball Players

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• Abstract

Volleyball is considered a very explosive and fast-paced sport in which polymeric training is widely used. Our purpose was to review the effects of polymeric training on volleyball players' performance. A systematic search was conducted according to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines using SPORT Discus, Medline, Scopus, Academic Search Complete, CINAHL and Web Science for articles published no later than December 2018. Any criteria were imposed for the included sample. The search focus was on interventional studies in which athletes underwent a plyometric program. To the 1831 articles found, another five were added, identified through other sources. Duplicated files were removed, titles and abstracts were screened, which left 21 remaining studies for extensive analysis. Results showed that the vertical jump (15 studies) was the major ability studied in plyometric training interventions, followed by strength (four studies), horizontal jump (four studies), flexibility (four studies) and agility/speed (three studies). In addition, it was observed that young (under 18 years old) female athletes were the most studied. The included studies indicated that plyometric training seems to increase vertical jump performance, strength, horizontal jump performance, flexibility and agility/speed in volleyball players. However, more studies are needed to better understand the benefits of Polymetric training in volleyball players' performance.

Keywords: plyometrics, performance, jump, strength, flexibility, agility

• Introduction

Volleyball is an intense anaerobic sport that combines explosive movements (i.e., in both vertical and in horizontal directions) with short periods of recovery. Therefore, explosive strength, which

is defined as the ability of an individual's neuro-muscular system to manifest strain in the shortest possible time, is considered a fundamental aspect of successful athletic performance (e.g.,). In fact, when speed and agility are combined with maximum strength, power is the outcome. Muscular power enables a given muscle to produce the same amount of work in less time, or a greater magnitude of work in the same time, which is important for sprinting, jumping and quick changes of direction. Indeed, studies have shown strong relationships between power measures and vertical jump performance (e.g.,), suggesting that power influences vertical jumping performance.

A vertical jump is a complex movement that requires the coordination of several muscles in the trunk, arms and legs. Knowing that each player performs more than 250 jumps in a volleyball match of five sets, jumping ability has been identified as one of the key determining factors of high performance in volleyball.

In fact, several studies have shown that vertical jump test results are indicative of the performance level of an athlete (e.g.,). For example, Smith found that vertical jump performance during spiking and blocking was greater in Canadian national volleyball players compared to the Canadian university volleyball players. Also, Ziv and Lidor , in a review concerning vertical jump in female and male volleyball players, noted that better-performing teams were comprised of players with high vertical jumps.

Jump training is commonly associated with plyometric training and, in particular, with drills that stress the musculotendinous unit. In fact, de Villarreal found that a combination of bodyweight plyometrics, including countermovement jumps, depth jumps and squat jumps, resulted in a 4.7% to 15% increase in vertical jump height. Nevertheless, this type of training increases neuromuscular coordination through training the nervous system, thus allowing the stretch-shortening cycle (SSC)—which is a lengthening movement (i.e., eccentric) quickly followed by a shortening movement (i.e., concentric)—to react faste. Additionally, because this training includes muscle lengthening, it may also improve flexibility, increase the amount of stored elastic energy in the muscles, stimulate more muscle units, result in higher (neural) firing frequency and improve joint proprioception.

According to the concept of training specificity, the effective transfer of training adaptations occurs when the training exercises match the task (e.g., testing, competition;. In volleyball, plyometric training involves jumping, hopping and bounding exercises as well as throws that are performed quickly and explosively. Those movements are also related to the development of agility. This capability is thought to be a reinforcement of motor programming through neuromuscular conditioning and the neural adaptation of muscle spindles, Golgi tendon organs and joint proprioceptors.

In addition, the athlete's age and sex should be considered when planning strength training programs. For instance, during adolescence, the changes that occur in muscular, neuronal and hormonal systems due to the development related to puberty (namely the growth spurt) influence adolescents' abilities to execute movements. Moreover, the female growth spurt occurs approximately two years earlier than the male growth spurt and reaches its plateau at 15–16 years of age, whereas males continue their growth spurt up to the age of 19–20 years. Due to these changes in adolescence, it was found that female athletes had weaker quadriceps and hamstring muscles (even when normalized for body weight) in the adult stage when comparing to their male counterparts. Those dissimilarities reflect the different ability to produce strength, influencing jumping performance and is reflected in the different motor pattern showed by the two sexes.

Although plyometric training has been widely used in volleyball, little scientific information is available to determine its possible benefits on the different components of performance. Following this, the aim of this systematic review was twofold: (i) To evaluate the efficacy of plyometric training programs on both male and female volleyball players, and (ii) to understand the effect of those programs based on players' age.

- ## Literature Search Strategy

A systematic literature search was carried out in PubMed, SPORTDiscus, MEDLINE, Scopus, CINAHL Plus, Academic Search Complete, Web of Science and SciELO. The search was limited to original articles written in English published online no later than December 2018, which is when the search was conducted.

The words used in databases combined terms related to plyometric training (strength training OR power training OR plyometric training OR resistance training OR weight training OR complex training OR weight-bearing exercise OR eccentric training) and volleyball.

- **Selection Criteria**

The process for screening articles followed the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines. The inclusion criterion included interventional studies which provided a plyometric strength program in volleyball team sports and which used statistical analyses to quantify the association between the training implemented and its benefits regarding performance. No restrictions were imposed on the participant sample in terms of age, sex, playing level, playing experience, etc. Literature reviews, overviews, conference proceedings and both master's and Ph.D. thesis were excluded.

The abstracts of all the articles found were screened against the predefined selection criteria by the authors of the present study. Cases of disagreement were discussed among the researchers until a consensus was established. The same process was used to screen the full-text version of each article. Furthermore, a few relevant articles that were not found in the first literature search—possibly due to discrepancies in the terminology used to describe plyometric training—were included.

A risk of a bias within the studies was independently assessed by the two reviewers considering the topics of (i) a bias in selecting participants into the study; (ii) a bias in classifying interventions; (iii) a bias due to departures from intended interventions; (iv) a bias from missing data; (v) a bias in measurement of outcomes; and (vi) a bias in reporting outcomes selectively. Studies with a risk of bias in all categories were excluded from the review. Agreement between reviewers was tested using the Kappa index test that revealed a value of 0.89, suggesting a very good agreement.

- **Assessment of Methodological Quality**

Methodological quality was assessed using the STROBE Statement, which is a 22-item checklist considered essential for the accurate reporting of observational studies. This checklist includes a

link between the title of the article and its abstract (item 1), introduction (items 2 and 3), methods (items 4 to 12), results (items 13 to 17) and discussion (items 18 to 21) sections, and any other information (item 22). From those, 18 items are common to all three designs, while four (items 6, 12, 14 and 15) are design-specific, with different versions for all or part of the item. For some items (indicated by asterisks), the information should be given separately for cases and controls in case-control studies, or for exposed and unexposed groups in cohort and cross-sectional studies. Each article was classified based on the sum of the points for all 22 items (one point was counted for an item if the criteria was achieved), and the result was divided by the maximum possible point total of 22 (e.g., if an article had 11 points, the value arrived at was 0.5).

- ## Conclusions

The majority of the studies included (n = 13) focused on young players, and most of them (n = 12) observed only women players. However, a lack of information about the players' maturation was noticed, which could have influenced the effectiveness of the programs. The similarities between vertical jump test and the movements conducted during the training programs seem to explain the higher number of studies (n = 15) and the greater improvements when comparing to horizontal jumps. Nevertheless, future studies should provide more information about the characteristics of the training programs. Studies also showed that the typical plyometric training component, the SSC, promote the necessary stimulus to improve strength, as well as flexibility. This fact is justified by coordination improvements through a great muscle unit firing, in the first, and by the required lengthening movement (eccentric), in the second. Likewise, agility/speed performance was investigated in only three studies but also seems to be improved through plyometric training, possibly due to the resultant increases in muscular force output and movement efficiency, which include the faster recruitment of the motor units and increased velocity in nerve conduction. Nevertheless, more studies should be conducted to better understand the benefits of this type of training for volleyball players' overall performance.

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