Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
Vol. XIII, ISSUE 1, 2013, Romania
The journal is indexed in: Ebsco, SPORTDiscus, INDEX COPERNICUS JOURNAL MASTER LIST, DOAJ DIRECTORY OF OPEN ACCES JOURNALS, Caby, Gale Cengace Learning

January 2013, 13 (1): 16 -21
Original article

EFFECT OF COMPLEX TRAINING WITH LOW-INTENSITY LOADING INTERVAL ON CERTAIN PHYSICAL VARIABLES AMONG VOLLEYBALL INFANTS (10-12 AGES)

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Abstract

Purpose. Complex training involves the completion of a resistance exercise prior to a plyometric exercise. A classic example is to perform vertical jumps or depth jumps after the completion of a back squat exercise. The term 'complex training' is credited to Verkhoshansky et al. (1973). The present study was conducted to assess the outcome of complex training with low-intensity loading interval on certain physical variables among volleyball infants (10-12 ages).

Methods. The sample was twelve volleyball girls at sport Aphrodite club. were classified by two group (experimental group ten girls and control group ten girls), the experimental group was participated in complex exercises to nine weeks , three time weekly, the control group participated in the traditional training.

Results. Baseline results showed that: the experimental group had significantly higher than the control group in physical abilities and Significant improvements were observed in power and strength for the experimental group when comparative with the control group.

Conclusions. complex exercises with low-intensity loading interval are safe and benefit for power & speed. Recent research suggests that it may be necessary to allow three or four minutes rest between the weight training and Plyometric conditions.

Key words: Complex Training, Volleyball, power.

Introduction

Children involved in sports should be encouraged to participate in a variety of activities and develop in a wide range of skills. The success of young children can serve as a powerful inducement for others to follow. Most Olympic sports have selection processes that attempt to identify future champions and initiate specialized training at the younger age. This means that preparation for competition at the highest level is starting for many sports persons in their early teens and many of them achieve high standards of performance reaching finals or even the victory rostrum. This suggests that growing children can accept training loads compatible with performances, required for success at world level (Anderson, 2000).

Power is determined from work per unit of time and considered to be a fundamental aspect of successful athletic performance, especially in sports that require speed, agility, and explosive actions (Chu, 1998). Volleyball is a dynamic, fast-paced game. requires a variety of physical attributes (speed, power, flexibility, strength and balance) and specific playing skills. Therefore, participants need to train and prepare to meet at least a minimum set of their requirements to cope with the demands of play**.** (Erin2001). At the elite level, players train for 30+ hours per week. Training includes skill, strength and conditioning programs. The purpose of strength training for volleyball is not to build big muscles, but to develop the physical attributes necessary to improve a player's performance. Strength training is very important to volleyball and should not be developed independently from other abilities such as agility, quickness and endurance. Power refers to the state of applying force. When quickness (speed) is integrated with maximum strength, power is the outcome. Power is a determinant quality that is required in any type of jumping or quick change of direction. Consequently the optimal training techniques to maximize power and the transfer of Power to athletic performance have received considerable attention from researchers and sport conditioning coaches. More recently, a number of researchers and practitioners have advocated the use of complex training (CT) techniques, a term credited to Verkhoshansky & TETYAN, 1973. Although the term has been used to describe slightly different approaches to training, CT generally involves the execution of a resistance-training exercise using a heavy load (1–5RM) followed relatively quickly by the execution of a biomechanically similar Plyometric exercise. The combination of Plyometric training and weight training are thought to be useful for developing athletic power. More specifically, complex training alternates biomechanically similar high load weight training exercises with Plyometric exercises, set for set, in the same workout. An example of complex training would include performing a set of squats followed by a set of jump squats. Anecdotal sources have described the application of complex training (Chu, 1998; Ebben & Blackard, 1998; Fees, 1997; Fleck &Kontor, 1986; Reddin, 1999; Roque, 1999). A number of studies demonstrate the effectiveness of Plyometrics compared to non-exercising control groups (Blakey & Southard, 1987; Diallo et al. 2001; D.J. Gehri et al. 1998). Other studies demonstrate an enhancement of motor performance associated with Plyometric training

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combined with weight training or the superiority of Plyometrics, compared to other methods of training (Adams et al.,1992; Delecluse, et al., 1995; Duke & D. BenEliyahu,1992; Fatourous, et al., 2000; Ford, et al., 1983; Lyttle, et al.,1996; McLaughlin, 2001; Potteiger, et al. 1999; and Vossen et al 2000). The evidence indicates that the combination weight training and Plyometrics are effective. One way to combine the two forms of training is complex training or the contrast method.

Jones, et al. 1999, compared the effects of maximum concentric acceleration training versus traditional upper-body training on the development of strength and power. Power was tested with a seated medicine ball throw and a force platform plyometric push-up. While all participants (n = 30), completed the identical training program, the control group were required to perform their exercises with routine concentric velocity. The experimental group accomplished the concentric phase of each repetition as fast as possible. Previous studies had shown that as long as the participants attempted to accelerate the bar during contraction, training would increase strength over a wide range of testing velocities.

While no significant group effects were found for any of the tests in the study of (Jones, et al. 1999) substantial training by group contact indicated that the experimental group increased significantly more than the control group. Their percentage increases were over two times more in both the 1-RM bench press (+ 9.4 versus + 2.8) and the seated medicine ball throw (+ 8.6 versus + 3.8), than the control. These results confirm previous research for improving strength and power was correct and that the intent to maximally accelerate concentrically with heavy weights may be better than slower heavy weight training.

Unfortunately, many people mistakenly believe that strength training is an inappropriate and unsafe activity for youth. Conceptually, this does not make sense. If strength training is safe and effective for your frail elderly clients, it is even better for healthy young people with full movement capacity and plenty of energy. Indeed, no serious injury has ever been reported in any prospective study on youth strength training. Not only is strength training safe for kids, but it may actually help reduce the number of injuries they sustain during other physical activities. According to the American College of Sports Medicine (ACSM), 50 percent of preadolescent sports injuries could be prevented, in large part, by enrolling kids in youth strength and conditioning programs (ACSM l993). On a more anecdotal front, we have personally conducted regular strength training classes for children 6 to 12 years old for the past 17 years without experiencing a single injury. however there are still problems with the list linked to the process of training that require practical solutions is the responsibility of trainers and specialists in the game of volleyball as required by the search for means and methods of modern scientific enhanced tests help to raise the level of physical performance and skills of the players, especially Among novices to receive training in physically intensive sport-specific, as it found that the training weights is primarily intended for the development of muscle strength as well as achieve its advantages have been confirmed to be effective in achieving this purpose and then to raise the level of performance skills, and training Plyometric has been designed also to achieve the development directly to the ability of muscle and then to the level of performance in the various activities.

Fleck & Steven, 2000, observed that extensive studies are also needed to examine the response of females, children and men to parodied resistance training programs and also to parodied models other than the conventional resistance or power training model. T. Burger, et al 2000, also reported that complex training is just as effective if not more effective as conventional training in a 7 week study.

Faigenbaum, et. al. 1999, revealed that children can experience similar gains in upper body strength and endurance within 8 weeks of training using conventional strength training and complex training.

Here summed up the problem of search in the possibility of using a vehicle training (weightlifting and Plyometric) in a manner interval load being one of the styles characteristic of the development of more than ability at one time. The present study was conducted to assess the outcome of complex training with low-intensity loading interval on certain physical variables among volleyball infants (10-12 ages).

Materials and Methods

Experimental Approach to the Problem

Two groups (experimental and control), performed a pre and post- training designed intervention in which Vertical Jump Test (VJ),Standing Long Jump Test (SLJ), Seated Medicine Ball Throw (SMBT), Quadrant Jump Test (QJ) and 30 Second Endurance Jump(EJ) were recorded. The experimental group (EG) (10 girls) trained 3 times a week on complex training for nine weeks. The control group (CG) (10 girls) continued their normal training, while the experimental group completed a complex training program to see whether this type of training modality would have a positive or negative or no effect on physical tests.

Samples:The sample was twenty volleyball girls at sport Aphrodite club were classified by two group (experimental group ten girls and control group ten girls) , (11 ± 1.36 years old; 143 ± 4 cm height; and 41 ± 5 kg weight), Training experience of all the participants ranged from 1 to 2 years. Subjects were required to read and complete a health questionnaire and informed consent document; there was no history of coronary heart disease, diabetes or recent surgery.

Training Protocol: The 9-weeks in-season training program consisted of a set of resistance exercises followed by a series of Plyometric exercises with low - volume interval . All sets of the weights exercise with a recovery of 100 seconds/set. This is followed by a four minute rest before performing all sets of the matched Plyometric exercise with a recovery of 120 second/set.

Testing Procedures

Subjects were assessed before and after an 9-weeks training program Tests followed a general warm-up that consisted of running, calisthenics, and stretching.

Vertical Jump Test (VJ)

The subject stands side on to a wall and reaches up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded. This is called the standing reach height. The athlete then stands away from the wall, and leaps vertically as high as possible using both arms and legs to assist in projecting the body upwards. Attempt to touch the wall at the highest point of the jump. The difference in distance between the standing reach height and the jump height is the score. The best of three attempts is recorded.

Standing Long Jump Test (SLJ)

The subject stands behind a line marked on the ground with feet slightly apart. A two foot take-off and landing is used, with swinging of the arms and bending of the knees to provide forward drive. The subject attempts to jump as far as possible, landing on both feet without falling backwards. Three attempts are allowed.

Seated Medicine Ball Throw (SMBT)

The subject sits with their back to a wall, on a mat facing the area to which the ball is to be thrown, and with the feet extended and slightly apart. The ball is held with the hands on the side and slightly behind the center. The ball is brought to the chest, and then thrown vigorously out as far as possible. The back should remain in contact with the wall at all times. Three attempts are allowed. The distance from the wall to where the ball lands are recorded. The measurement is recorded to the nearest 10 cm. The best result of three throws is used.

Quadrant Jump Test (QJ)

This is a non running type agility test, measuring the ability to move around in a small space with maximum speed, while maintaining balance and control (coordination). A quadrant is marked out on the floor, as illustrated in the diagram (3 feet is about 90 cm). Mark the starting line and number each quadrants. The subject stands with both feet together at the starting line. On the command 'go', they jump ahead across the line into the first quadrant, then in sequence successively into quadrants 1, 2, 3, 4, 1, 2, etc. This pattern is continued as rapidly as possible for 10 seconds. After a rest repeat the trial. The subject's score is the number of correct jumps less a penalty deduction. One point is awarded each time the subject lands with both feet entirely within the correct quadrant during the 10 second trial, with a penalty of 0.5 point subtracted each time the subject touches a line and for each time the subject lands with one or both feet in an incorrect quadrant.

30 Second Endurance Jump (EJ)

The subject Stand comfortably with both feet flat on the ground, perpendicular to the hurdle. The timing starts from the first movement. The athlete jumps off both feet and lands on both feet on the other side of the hurdle, then back again. The test continues for 30 seconds, with the total number of jumps counted. The total number of completed jumps in the time period is recorded

Statistical analysis

All statistical analyses were calculated by the SPSS statistical package. The results are reported as means and standard deviations (SD). Differences between two groups were reported as mean difference ±95% confidence intervals (mean-diff ± 95% CI).Student's t-test for independent samples was used to determine the differences in fitness parameters between the two groups. The $p<0.05$ was considered as statistically significant.

Results

Table 1. Complex training protocol.

Complex	Exercise	Reps	Rest/Set
Complex 1	**Squats**	3 × 12RM	100 sec.
	Vertical Jumps	3 × 10	120 sec.
Complex 2	**Bench Press**	3 × 12RM	100 sec.
	Medicine ball chest pass	3 × 10	120 sec.
Complex 3	**Barbell Lunge**	3 × 12RM	100 sec.
	Step Jumps	3 × 10	120 sec.
Complex 4	**Lat Pull down**	3 × 12RM	100 sec.
	Medicine ball overhead pass	3 × 10	120 sec.
Complex 5	**Abdominal crunches**	3 × 12RM	100 sec.
	Medicine ball sit up and throw	3 × 10	120 sec.
Complex 6	**Decline press**	3 × 12RM	100 sec.
	Zigzag drill	3 × 10	120 sec.

Table 2. Age, anthropometric characteristics and physical variables of the experimental group (Mean ±SD)

Variables	Mean	Standard Deviation	coefficient of skewness
Age [years]	11.06	1.36	0.89
Height [cm]	143.25	4.00	0.77
Weight [kg]	41.32	5.21	-0.93
Training experience	2.11	.05	0.84

Table 2 shows the age ,anthropometric characteristics and physical variables of the subjects. There were no significant differences were observed in the anthropometric characteristics.

Table 3. Pre – Post measurements of physical variables and performance level for control group

Variables	Pre – measurements	Post – measurements	change%	T sign.
	Mean ± SD	Mean ± SD		
SMBT	4.21 ± 0.39	4.38 ± 0.47	4.04	**No Sign.**
SLJ	126.23 ± 3.68	129.11 ± 4.15	2.28	**No Sign.**
VJ	21.14 ± 3.11	22.77 ± 2.64*	7.71	**Sign.**
QJ	7.11 ± 0.91	7.59 ± 0.38*	6.75	**Sign.**
EJ	18.14 ± 2.5	19.15 ± 2.3	5.57	**No Sign.**

Baseline results showed that: The post tests had significantly higher than the pre tests in VJ and QJ , no significant differences were observed in high SMBT , SLJ and EJ , adding the high Significant improvements were observed in VJ 7.71% and less Significant improvements were observed in SLJ 2.28%.

Table 4. Pre – Post measurements of physical variables and performance level for experimental Group

Variables	Pre – measurements	Post – measurements	change%	T sign.
	Mean ± SD	Mean ± SD		
SMBT	4.23 ± 0.16	4.52 ± 0.54	6.86	**Sign.**
SLJ	127.65 ± 3.54	133.23 ± 4.32	4.37	**Sign.**
VJ	22.25 ±2.31	24.16 ± 2.12	8.58	**Sign.**
QJ	7.14 ± 0.98	8,07 ± 0.64	13.02	**Sign.**
EJ	18.41 ± 2.5	21.24 ± 2.6	15.37	**Sign.**

Baseline results showed that: The post tests had significantly higher than the pre tests in physical abilities and high Significant improvements were observed in EJ 15.37% and QJ 13.02% and less Significant improvements were observed in SLJ 4.37%.

Table. 5 Mean ±SD and the significant for (SMBT), (SLJ), (VJ), (QJ) and (EJ) between the control and experimental groups

Variables	Control group	Experimental group	Sig.
SMBT	4.38 ± 0.47	4.52 ± 0.54	Sig.
SLJ	129.11 ± 4.15	133.23 ± 4.32	Sig.
VJ	22.77 ± 2.64	24.16 ± 2.12	Sig.
QJ	7.59 ± 0.38	8,07 ± 0.64	Sig.
EJ	19.15 ± 2.3	21.24 ± 2.6	Sig.

Baseline results showed that: The experimental group had significantly higher than the control group in physical abilities and Significant improvements were observed in power and strength for the experimental group when comparative with the control group.

Discussion

The present study was conducted to assess the outcome of complex training with low-intensity loading interval on certain physical variables among volleyball kids (10-12 year). In fact that complex training stimulates the neuromuscular system. That is, it activates both the muscular fibers and the nervous system, so that slow-twitch fibers behave like fast-twitch fibers. (Chu, 1998). Furthermore, resistance training increases motor neuron excitability and reflex potentiation, which may lead to better training conditions for subsequent Plyometric exercises , higher EMG activity was discovered in the hamstring muscles during depth jumping indicates that more fast-twitch fibres were being recruited, which in time could have provided more propulsive power. This fact may have contributed to the increments observed in the present study. It is postulated that the resistance exercise will have a performance enhancing effect on the Plyometric activity. (Ebben & Watts, 1998).These results are Consistent with previous studies demonstrate an enhancement of motor performance associated with Plyometric training combined with weight training or the superiority of Plyometrics, compared to other methods of training (Adams, et al.,1992; Clutch, et al.,1983; Delecluse, et al., 1995; Duke & BenEliyahu,1992; Fatourous, et al., 2000; H.T. Ford et al., 1983; Lyttle et al.,1996; McLaughlin, 2001; Potteiger, et al. 1999; and Vossen et al, 2000). The evidence indicates that the combination weight training and Plyometrics are effective. one study compared the effects of strength training and complex training in boys and girls (8.1 ± 1.6 years). Results demonstrate that children attain similar gains in upper-body strength and endurance using either strength or complex training programs (Faigenbaum, et al., 1999). In addition to studies using children as subjects, other training studies examined the effects of a three-week complex training program with seven division I college female basketball players. Pre and post test results reveal improvement in the 300 m shuttle, 1 mile run, VO2 max, 20 yd dash, pro agility run and the t-test, reverse leg press and back squat. The data show that the complex training program was effective in eliciting statistically significant improvement in the 300-meter shuttle.

To explain the relation between leg power and performance level the previous studies have reported significant differences in the electromyographic (EMG) activity of the gastrocnemious and quadriceps muscle groups between trained and untrained athletes Schmidtbleicher & Gollhofer, 1985; Neubert, et al., 1998). The hamstring muscles are activated immediately after first contact and immediately after the feet leave the ground (Viitasalo, et al ., 1998).

Duke & BenEliyahu, 1992, conducted similar study and suggested that it would be logical to combine resistance training, plyometrics and speed training in the same session to increase power. Anecdotal evidence suggests that this is the optimal method for maximum power conversion. Gemar (1998) reported that resistance training and plyometric training on high school children showed significant differences in the performance of vertical jump, standing broad jump and 30 meters sprint. Zepeda & Gonzalez (2000) reported that plyometric training enhances speed within 3 to 8 weeks period and resembles the training effect produces as a result of 30 to 50% of 1RM of three weeks.

Conclusions

Finally, complex exercises with low-intensity loading interval are safe and benefit for power & speed. Recent research suggests that it may be necessary to allow four minutes rest between the weight training and Plyometric conditions. And the kids should practice the complex training in form of funny and games not form of competition to avoid the injury .

References

Adams K., O’shea, J. P., O’shea K.L. and Climstein, M.The effect of six weeks of squat, plyometric and squat-plyometric trianing on power production. Journal of Applied Sports Science Research, 1992, 6(1), 36- 41.

Blakey J. B. & Southard D. The combined effect of weight training and plyometrics on dynamic leg strength and leg power. Journal of Applied Sports Science Research, 1997, 1, 14-16.

Burger T., Boyer-Kendrick T. and Dolny D. Complex training compared to a combined weight training and plyometric training program. Journal of Strength and Conditioning Research, 2000, 14(3): 360 -361.

Chu D.A. Jumping into plyometrics. 2nd ed. Human Kinetics, Champaign, Ill. 1998.

Clutch D., Wilton M., Mcgown C. And Bryce, G.R. The effect of depth jumps and weight training on leg strength and vertical jump. Research Quarterly, 1983, 54, 5-10.

Diallo O., Dore E., Duche P. and Van Praagh, E. Effects of plyometric training followed by a reduced training programme on physical performance in pre-pubescent soccer players. Journal of Sports Medicine and Physical Fitness, 2001, 41(3), 342-348.

Delecluse C.,Van Coppenoll H., Willems E., Van Leemputte, M., Diels R. and Goris M. Influence of high resistance and high velocity training on sprint performance. Medicine and Science in Sport and Exercise, 1994, 27(8), 1203-1209.

Duke S. and Beneliyahu D. Plyometrics: Optimizing athletic performance through the development of power as assessed by vertical leap ability: an observational study. Chiropractic Sports Medicine, 1992, 6(1), 10-15.

Ebben W. P., Watts P. B., Jensen R. L.& Blackard, D. O. EMG and kinetic analysis of complex training exercise variables. Journal of

Strength and Conditioning Research, 2000, 14(4), 451-456.

Ebben W.P.& Blackard D. Paired for strength: A look at combined weight training and plyometric training with an emphasis on increasing the vertical jump. Training and Conditioning, 1998, 8(3), 55-63.

Ebben W.P. & Watts P.B. A review of combined weight training and plyometric training modes: Complex training. Strength and Conditioning, 1998, 20(5),18-27.

Erin C. Spiking injuries out of volleyball: a review of injury countermeasures, monash university accident research centre, Report No. 181, 2001.

Faigenbaum A.V., O'connell J., La Rosa R., and Westcott W. Effects of strength training and Complex Training on upper-body strength and endurance development in children. Journal of Strength Conditioning Research 1999, 13(3), 424.

Faigenbaum A.V., O'connell J., La Rosa R. and Westcott W. (1999). Effects of strength training and complex training on upper-body strength and endurance development in children. Journal of Strength Conditioning Research, 13(3): 424.

Fatourous I.G., Jamurtas A.Z., Leontsini D., Taxildaris K., Aggelousis N., Kostopoulos N. and Buckenmeyer P. Evaluation of Plyometric exercise training, weight training, and their combination on vertical jump and leg strength. Journal of Strength Conditioning Research, 2000, 14(4),470-476.

Fees M.A. Complex Training. Athletic Therapy Today January, 18.1997.

Fleck S. & J. Steven. Periodised strength training a critical review. Journal of Strength and Conditioning Research, 2000,13: 424.

Fleck S. and Kontor, K. Complex Training. National Strength Conditioning Association Journal, 1986, 8(5), 66-68.

Ford H.T., Puckett, J.R., Drummond, J.P., Sawyer, K., Gnatt K. and Fussell, C. Effects of three combinations of Plyometric and weight training programs on selected physical fitness test items. Perception and Motor Skills 1983, 56, 919-922.

Gehri D.J., Ricard M.D., Kleiner D.M. and Kirkendall, D.T. (1998). A comparison of plyometric training technique for improving vertical jump ability and energy production. Journal of Strength Conditioning Research, 1998, 12(2), 85-89.

Gemar J. A. The Effects of Weight Training and Plyometric Training on Vertical Jump, Standing Broad Jump and 30 Meters Fly Run. Physical Education and Sports Journal, 1998, 12(2): 22-26.

Lyttle A.D., Wilson G.J. and Ostrowski, K.J. Enhancing performance: Maximal power versus combined weights and plyometric training. Journal of Strength Conditioning Research, 1996, 10, 173-179.

Mclaughlin E.J. A comparison between two training programs and their effects on fatigue rates in women. Journal of Strength Conditioning Research, 2001, 15(1), 25-29.

Neubert A., Schwirtz A. and Buehrle M. Muscular activity in the stretch-shortening cycle (SSC): not only maximization but optimization is necessary. In H. Riehle and M.Vieten (Eds.), Proceedings 1/ of XVI Isas Symposium, 56-58, UVK Universitatsveralag Konstanz, Germany, 1998.

Potteiger J.A., Lockwood R.H., Dolezal M.D, Almuzaini K.S., Schroeder,J.M. and Zebas. C.J. Muscle power and fiber characteristics following 8 weeks of plyometric training. Journal of Strength Conditioning Research, 1999, 13(3), 275-279.

Reddin D. Complex training for power development. Faster, Higher, Stronger, 1999, 3, 24-25.

Roque E. Complex training: combining strength exercise with plyometric work pays off. Volleyball, 1999, 10(7), 60-65.

Schmidtbleicher D., Gollhofer A. Einflussgroessen und Leistungsdiagnostic des' reaktiven Bewegungsverhaltens.: Thorwesten, L.lJerosch.J.lNicol, R.(Hrsg), 1985.

Verkhoshansky Y.& Tetyan V. Speed-strength preparation of future champions. Legkaya Athletika, 1973, 2, 12-13.

Viitasalo Jt. Salo A, Lahtinen J. Neuromuscular functioning of athletes and non-athletes in the drop jump, Eur. J. Appl. Physiol. 1998, 78, 432-440.

Vossen J.F., Kramer J.F., Burke D.G. and Vossen D.P. Comparison of dynamic push-up training and plyometric push-up training on upper body power and strength. Journal of Strength Conditioning Research, 2000, 14(3), 248-253.

Zepeda P. & Gonzalez J. Complex training: Three weeks pre-season conditioning in division I female basketball players. Journal of Strength and Conditioning Research, 2000, 14(3): 372.