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EFFECTS OF COMPLEX TRAINING ON CERTAIN PHYSICAL VARIABLES AND PERFORMANCE LEVEL OF LANDING IN FLOOR EXERCISE

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Abstract
The main purpose of this study was to examine the effects of 12 – week of complex training on strength, power of legs and leaping ability in young gymnasts. Two groups, an experimental group consisting of (7) elite gymnasts, and control group consisting of (4) elite gymnasts. Using the pre-and post tests. Results showed improvement in both of strength, power and leaping ability for the experimental group comparing with the control groups.
Key words. complex training, leaping, elite gymnasts.

Introduction

The most important and crucial part of a gymnastics routine is the dismount, since it provides the final impression for its evaluation to the judges, and also signifies the termination of the exercise.

Training of the gymnast rightly occupies the majority of time involvement in the sport of gymnastics. Long gone are the days when coaches believed resistance exercises only added unnecessary bulk to the athlete, hindering their ability to execute skill. Gymnasts train tirelessly to perfect their skill and technique. But technique can only be applied within the limits of an athlete's strength, making its development equally important. So, Strength training has become an essential component in a gymnastics training program. As a rule, most gymnasts do not do much, if any, traditional strength training. The bodyweight training in the gym is generally sufficient for creating the strength needed for the sport.

Strength is an attribute often associated with superior performance in sport. C. Bret et al., 2002, M.H. Stone et al., 2003, Several of the characteristics associated with strength (e.g. peak force, rate of force development (RFD), velocity, and power generating capacity) have been identified as underlying mechanisms related to sports performance; particularly in the vertical jump. U. Wisloff et al., 2004, R.F. Reiser et al., 2006, According to several authors, success in sport depends upon the development of strength as well as power both of which contribute to vertical jump performance. D. Baker, 1996, M.D. Peterson, et al., 2006.

Previously, W.P. Ebben, P.B. Watts, 1998, reviewed the complex training literature and described the effectiveness of combining weight training and Plyometrics. These authors offered suggestions for designing complex training programs.

A number of studies demonstrate the effectiveness of plyometrics compared to non exercising control groups. J.B. Blakey et al., 1987, O. Diallo et al., 2001, other 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 K. Adams et al., 1991, E.J. McLaughlin, 2001, J.F. Vossen et al., 2000. The evidence indicates that the combination weight training and plyometrics are effective.

Children have become increasingly involved in athletic training at younger ages, especially those competiting in female gymnastics. To learn and perform the complex gymnastics skills and to reach the top level of performance in gymnastics, it is obvious that girls have to begin intensive training at very young age. (J. Kums et al., 2005)

The use of strength training in younger athletes is still controversial. The controversy focuses on three areas: Are children capable of making significant strength gains and increases in muscle mass in response to resistive strength training? Do these gains in strength improve athletic performance or increase the resistance of the child's tissue to injury? Do children have an unacceptable risk of injury from resistive strength? Training that negates any potential benefits from the technique? (J.M. Lyle, 1990)

Hence, the purpose of this study was to examine the effects of 12 – week of complex training on strength, power of legs and performance level in elite gymnasts.

Material and Methods

Experimental Approach to the Problem

Two groups (experimental and control) performed a pre and posttraining designed intervention in which Vertical Jump Test (VJ), Seated Medicine Ball Throw (SMBT) , leg strength (LS) back strength (BS) by dynamometer , Dynamic strength test (DST) and Performance levels of landing in floor exercise (LFE) were recorded. The experimental group (EG) (10 young gymnasts) trained 1 hour per day 3 times a week on complex training besides the gymnasts training for twelve week. The control group (10 young gymnasts) 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 (VJ), (SMBT), (LS) and (PLL).

Samples

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The sample consisted of 20 young gymnasts (11 ± 1.36 years old; 135 ± 4 cm height; and 31 ± 5 kg weight), , members of the Sporting Club. Training experience of all the participants ranged from 4 to 6 years. Subject's parents and coaches were required to read and complete a health questionnaire and informed consent document; there was no history of injuries, diabetes or recent surgery.

Training Protocol

The 12-week in-season training program consisted of a set of resistance exercises followed by a series of plyometric exercises. All sets of the weights exercise with a recovery of 60 seconds/set. This is followed by a three minute rest before performing all sets of the matched plyometric exercise with a recovery of 90 second/set. Load intensity was ranged between 50-60% .The complex training program is described in Table 1.

Testing Procedures

Subjects were assessed before and after a 12-week of complex training program All measurements were taken one week before and after training at the same time of day. 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

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.

Static strength test (LS) (BS)

A Takei leg and back dynamometer was used to measure the static leg strength. The subjects stood on the dynamometer platform and crouched to the desired leg bend position, while strapped around the waist to the dynamometer. At a prescribed time they exerted a maximum force straight upward by extending their legs. They kept their backs straight, head erect and chest high. 3 trials were allowed to the subjects and the best score was taken. Subjects had a rest between the trials (Jensen & Fisher).

Dynamic strength test (DST)

A barbell and free weights were used to measure dynamic strength. A suitable starting weight, close to, but below the subject's estimated maximum lifting capacity was selected. If one repetition was completed, the experimenter added weight to the barbell until the subject reached his maximum capacity. Both legs were tested.

The weight increments were usually 5, 2 and 1kg during the period of measurement.

Performance levels of landing in floor exercise, Floor exercise routines last up to 90 seconds. The routine is containing 8 landing. Evaluation the Performance levels of landing by a committee contains 3 judges, the judge was assessed from 1 to 10 degree, consider that allowed to take one step back into a lunge without a deduction when the younger performed the skill .

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 (meandiff ± 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	60 seconds
	Vertical Jumps	3 × 10	90 seconds
Complex 2	**Bench Press**	3 × 12RM	60 seconds
	Medicine ball chest pass	3 × 10	90 seconds
Complex 3	**Barbell Lunge**	3 × 12RM	60 seconds
	Step Jumps	3 × 10	90 seconds
Complex 4	**Lat Pull down**	3 × 12RM	60 seconds
	Medicine ball overhead pass	3 × 10	90 seconds
Complex 5	**Abdominal crunches**	3 × 12RM	60 seconds

	Medicine ball sit up and throw	3 × 10	90 seconds
Complex 6	**Decline press**	3 × 12RM	60 seconds
	Zigzag drill	3 × 10	90 seconds

Table 2. Shows Mean, sum of rank and Z score in (VJ), (SMBT), (LS) and (PLL) for the Experimental and control groups. The Z- score showed a significant change between pre-and post training scores for all variables n both groups ($P \leq 0.05$)

Table 2.Mean, sum of rank and Z score in (VJ), (SMBT), (LS) and (PLL) for the Experimental and control groups

Variables	Experimental					Control				
	Difference		mean rank	Sum of ranks	Z	Difference		mean rank	Sum of ranks	Z
	Dir.	Nu.				Dir.	Nu.			
VJ	-	0	0	0	-2.14*	-	0	0	0	-2.24*
	+	7	3.5	21		+	4	3.5	21	
	=	0				=	0			
SMBT	-	0	0	0	-2.25*	-	0	0	0	-2.26*
	+	7	3.5	21		+	4	3.5	21	
	=	0				=	0			
LS	-	0	0	0	-2.218*	-	0	0	0	-2.214*
	+	7	3.5	21		+	4	3.5	21	
	=	0				=	0			
PLL	-	0	0	0	-2.229*	-	0	0	0	-2.20*
	+	7	3.5	21		+	4	3.5	21	
	=	0				=	0			

Table 3. Shows Mean, sum of rank and U score in (VJ), (SMBT), (LS) and (PLL) between posttests for the Experimental and control groups. The U- score showed a significant change between post training scores for all variables in both groups ($P \leq 0.05$) for Experimental group.

Table 3.Mean, sum of rank and U score in ((VJ), (SMBT), (LS) and (PLL) between post tests for the Experimental and control groups

Variables	Experimental group		Control group		U
	mean rank	Sum of ranks	mean rank	Sum of ranks	
VJ	6.33	53	4.17	24	5.00*
SMBT	8	55	4	22	3.00*
LS	9.33	56	3.42	22	2.00*
PLL	8.42	56.5	3.21	21.5	0.35*

Discussion

The main findings from this study were the significant Increases in the height of (VJ), the distance of the (SLJ), (SMBT), and in Performance levels of leaping, which proved the Complex training efficacy.

Complex Training studies have produced increases in neural drive (IRFD) associated with adaptations in contractile strength of skeletal muscle. (P. Agaard et al., 2002) 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. (W.P. Ebben, P.B. Watts, 1998)

Furthermore, athletes that are found to be more explosive, which may be strongly related to their nervous system capabilities, are often found to possess high levels of strength. (M.H. Stone et al., 2004) Thus, maximum strength appears to be an important underlying factor that influences of jumping. M.H. Stone et al. 2003, M.D. Peterson, et al., 2006, Though not directly measured in the current investigation previous literature indicates additional considerations must be given to mechanisms involving a shorter amoritization phase10, producing larger forces over the course of the jump9, and simply being able to better overcome the additional load. (M.H. Stone et al., 2003) M.D. Peterson, et al. (2006) It is possible that

maximum strength levels influence these mechanisms in a positive manner

Another explanation, the muscles were involved in a very rapid switch from the eccentric phase to the concentric phase (Stretch-shortening cycle). This SSC decreases the time of the amortization phase that in turn allows for greater than normal power production. (A. Hamza, 2008). According to R. Rahimi, Behpur, 2005 In the SSC the muscles undergo transition energy (from eccentric to concentric muscle action), so that to train and enhance this transition phase requires a complex training, such as the programs used in this study.

Thereby, weight training increases muscular strength and plyometric training exploits the SSC; therefore, the strength acquired by the weight training protocols will be used in this cycle (SSC) to produce a more forceful concentric muscle action and increase anaerobic power. The results of this study showed that complex training has a more significant effect.

These results are in accordance with previous studies that have been shown as being equally effective. K. Adams et al. 1991, G. Ioannis et al. (2000). Resulting in increased power output, and increased efficiency of the SSC behavior. Enhanced of leaping performance level.

Research has found the complex training can be beneficial to athletic performance A.K. Evans et al (2000). T.M. Comyns. et al.(2007) . While the opposite has also been reported. P. Jones, A. Lees, (2003).

According to A. Hamza, (2008) suggested that a greater muscular power may be related to a more effective and contributing to the improvement in the lung technique for fencers.

Practical Applications

Upper and lower body explosivity levels of young gymnasts can be improved with a combined program of plyometrics and resistance training. These power level improvements are usually seen as essential in gymnastics performance. The use of complex Training which contain of both resistance and plyometric training in the same workout is an adequate strategy of training process organization, having highly positive effects on practice of leaping.

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