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EFFECT OF COMPLEX TRAINING ON CD34/CD45 STEM CELLS, CERTAIN PHYSICAL VARIABLES AND JUMP SHOOT PERFORMANCE FOR FEMALE HANDBALL

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Abstract
Complex training is a valuable tool to enhance the Handball skills. The aim of this study was to determine the effect of Complex training on cd34+/cd45 stem cells, certain physical variables and jump shoot performance for female handball.
Methods
(20) Female handball players. Divided into two groups, The experimental group comprised of (10) female handball players in the age groups of 18-22 years , all participations are members of a handball team of faculty of physical education , Helwan university. The subjects in this group underwent a Complex training program comprising of various weight and Plyometric exercises for (2) months. The control group comprised of (10) female handball players at the same age for the experimental group. Parameters assessed the high, weight, power; strength, training age and Blood Sample were collected from an antecubital vein into vacuum tubes to measure the Cd34+/Cd45 Stem Cells. All subjects were free of any disorders known to affect performance, such as bone fractures, osteoporosis, diabetes and cardiovascular disease. The participants did not report use of any anti-seizure drugs, alcohol consumption, and neither smoking cigarette. And all participants were fully informed about the aims of the study, and gave their voluntary consent before participation. The measurement procedures were in agreement with the ethical human experimentation. 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%). T test for samples was used to determine the differences in the parameters between the two groups. And Pearson correlations between all variables was used, the $p<0.05$ was considered as statistically significant.The results indicated that increased significantly between the pre and post

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measures for the experimental group in accounting of cd34+/cd45 stem cells, power, strength, and composite Skillful Performances.
Conclusions.
The results indicate that two months of the Complex training program can improve physical variables, cd34+/cd45 stem cells and jump shoot performance for female handball.
*Key words***:** Complex training – Cd34+/Cd45 Stem Cells, handball.

Introduction

Strength and power are important aspects of fitness, sport and everyday activity. However, much debate remains as to how these two qualities should be assessed. Much of the debate originates from the definition of strength and power and the different terminology used across laboratories. (Sale, 1991) defined strength as the force exerted under a given set of conditions during a maximal voluntary contraction (MVC). Sale continued to define power as the rate at which mechanical work is performed under a specified set of conditions, or the product of force and velocity.

Both definitions imply that strength and power are defined by conditions such as velocity, contraction type, and posture and movement pattern specificity. That is, strength for one task may not imply strength for another. An associated problem with this is that strength and power are quite often measured in contexts dissimilar to the environment in which functional strength and power are needed. (Fatourous, et al. 2000)

Handball is an explosive sport (E. Gorostiaga, et al. 2006). During the match, handball players must be physically prepared for continuous sprints (R. Clanton & MP. Dwight, 1997). Jumps, changes of direction . (Cuesta, 1991), and explosive ball throwing (Mario, 2010).

The game includes body contact as the defenders try to prevent opponents from approaching the goal. Contact is only allowed when the defensive player frontally opposes the offensive player, that is, between the offensive player and the goal. Furthermore, because these actions must be performed over long periods, muscular endurance is also important to maintain high performance levels (Mario, 2010). Thus, handball players need to develop power to apply their skills plus muscular endurance to maintain high levels of application throughout the entire game.

Coaches and athletes have modified training method in an attempt to develop explosive power; some researchers showed that combining Plyometric with weight training could have more effect. More specifically, Complex training alternates biomechanically similar high load weight training exercises with Plyometric exercises, set for set, in the same workout.

More recently, a number of researchers and practitioners have advocated the use of complex training (CT) techniques, a term credited to Verkhoshansky. 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 (David, et al. 2004).

Complex training protocols offer a novel exercise sequence based on the principle that exercise for the development of reactive ability can be fulfilled in a background of heightened CNS excitability, brought about by preliminary fulfillment of exercise requiring greater power.

Repeated bouts of structured bodily exertion requiring energy expenditure above resting levels result in the occurrence of multiple molecular and cellular events leading to several functional changes and providing countless health-related benefits. The disruption of the dynamic equilibrium of body homeostasis is the sine qua none of the exercise-induced adaptations at the level of the cardiovascular and neuromuscular systems.

Skeletal muscle is a dynamic tissue able to adapt to various physiological conditions. The ability of skeletal muscle to regenerate is mainly due to small mononucleated cells, called the satellite cells, located between the basal lamina and the sarcolemma of muscle fibers. Satellite cells are considered as skeletal muscle stem cells as they can reenter the cell cycle to generate differentiated cells and new undifferentiated myogenic precursor cells, allowing the renewal of their own population (Hawke, 2005).

Exercise is one of the most powerful nonpharmacological strategies, which is able to affect nearly all cells and organs in the body. In this context, a new research avenue focusing on the action of exercise on adult stem cells has emerged during the last decade. Changes in the behaviour of adult stem cells from different regions including skeletal muscle and the cardiovascular system have been shown to occur in response to exercise training. Through its action on adult stem cells, exercise may act on the regenerative potential of tissues by altering the ability to generate new stem cells and differentiated cells that are able to carry out tissue-specific functions. (Kadi, & Thornell.2000)

The aim of this study was to determine the effect of Complex training on cd34+/cd45 stem cells, certain physical variables and jump shoot performance for female handball.

Material and Methods

Experimental Approach to the Problem

Two groups (experimental and control) performed a pre and post training designed intervention in which Standing Long Jump Test (SLJ), Seated Medicine Ball Throw (SMBT) , leg strength (LS) back strength (BS) by the dynamometer , Dynamic strength test (DST) and jump shoot Performance (JSP) were recorded. The experimental group (EG) (10 female handball players) trained 1 hour per day 3 times a week on Complex training drills for eight weeks. The control group (10 female handball players) 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 (SLJ), (SMBT), (LS), (BS), (DST) , (JSP) and CD34/CD45 stem cells.

Methods.(20) Female handball players. Divided into two groups, The experimental group comprised of (10) female handball players in the age groups of 18-22 years , all participations are members of a handball team of faculty of physical education , Helwan university. The subjects in this group underwent a Complex training program comprising of various weight and Plyometric exercises for (2) months. The control group comprised of (10) female handball players at the same age for the experimental group. Parameters assessed the high, weight, power, strength, training age and Blood Sample were collected from an antecubital vein into vacuum tubes to measure the Cd34+/Cd45 Stem Cells. All subjects were free of any disorders known to affect performance, such as bone fractures, osteoporosis, diabetes and cardiovascular disease. The participants did not report use of any anti-seizure drugs, alcohol consumption, and neither smoking cigarette. And all participants were fully informed about the aims of the study, and gave their voluntary consent before participation. The measurement procedures were in agreement with the ethical human experimentation.

Training Protocol. The 8-weeks 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 an 8-week training program Tests followed a general warm-up that consisted of running, calisthenics, and stretching

Static strength test (LS)(BS)

A 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.

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 are used, with the 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 stands 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 (two 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.

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(Legs Push).

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

Jump shoots Performance (JSP)

The subject Run slowly towards the goal and quickly jump and shoot whilst in mid-air. Continue to do this until you are confident in your timing, and accuracy of your shooting. The subject can gain an advantage in a jump shot if you wrong-foot the defender, so try and fool them into thinking you are moving in another direction, are about to pass, or about to attempt a different type of shot.

Blood Samples:

During the rest period, blood drawn by venipuncture and used the Flow cytometry for counting and examining microscopic particles, such as CD34/CD45

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%). T test for samples was used to determine the differences in the parameters between the two groups. And Pearson

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correlations between all variables was used, the $p<0.05$ was considered as statistically significant.

Results

Table 1. Complex training protocol.

Complex	Exercise	Reps	Rest/Set
Station 1	**Squats**	3 × 12RM	60 seconds
Station 2	Vertical Jumps	3 × 10	90 seconds
Station 3	**Bench Press**	3 × 12RM	60 seconds
Station 4	Medicine ball chest pass	3 × 10	90 seconds
Station 5	**Barbell Lunge**	3 × 12RM	60 seconds
Station 6	Step Jumps	3 × 10	90 seconds
Station 7	**Lat Pull down**	3 × 12RM	60 seconds
Station 8	Medicine ball overhead pass	3 × 10	90 seconds
Station 9	**Abdominal crunches**	3 × 12RM	60 seconds
Station 10	Medicine ball sit up and throw	3 × 10	90 seconds
Station 11	**Decline press**	3 × 12RM	60 seconds
Station 12	Zigzag drill	3 × 10	90 seconds

Table 2. Mean ±SD in (SLJ), (SMBT), (LS), (BS), (DST), (JSP) and CD34/CD45 stem cells for the control and experimental groups

Variables	Unit	Control			Experimental			T test between two groups
		pre	post	T test	pre	post	T test	
SLJ	Cm	199.23 ± 3.62	202.11 ± 4.07	Not Sign	200.65 ± 3.27	210.23 ± 5.32	Sign	Sign
SMBT	Meter	6.25 ± 0.37	6.62 ± 0.45	Not Sign	6.27 ± 0.14	6.96 ± 0.54	Sign	Sign
LS	Kilogram	79.26 ± 3.57	80.29 ± 3.99	Not Sign	79.21 ± 3.55	84.86 ± 4.11	Sign	Sign
BS	Kilogram	54.34 ± 3.91	56.03 ± 3.52	Not Sign	55.09 ± 3.11	59.74 ± 3.72	Sign	Sign
DST	Kilogram	83.11 ± 6.34	83.56 ± 5.61	Not Sign	81.81 ± 5.48	87.90 ± 5.55	Sign	Sign
JSP	Second	4.55± 0.21	4.89 ± 0.33	Not Sign	4.54± 0.34	5.34 ± 0.21	Sign	Sign
CD34/CD45	Count(N)	10.98± 1.17	11.11 ±1.67	Not Sign	11.07± 1.21	13.75 ± 1.62	Sign	Sign

Table 2. Shows the mean scores and differences significant on (SLJ), (SMBT), (LS), (BS), (DST), (JSP) and CD34/CD45 stem cells for the control and experimental groups. The t-test showed a significant changes between pre-and post-training scores for all variables ($P\leq 0.05$) for experimental group .however no significant differences was shown between pre-and post-training scores for all variables for control group($P\geq 0.05$) .

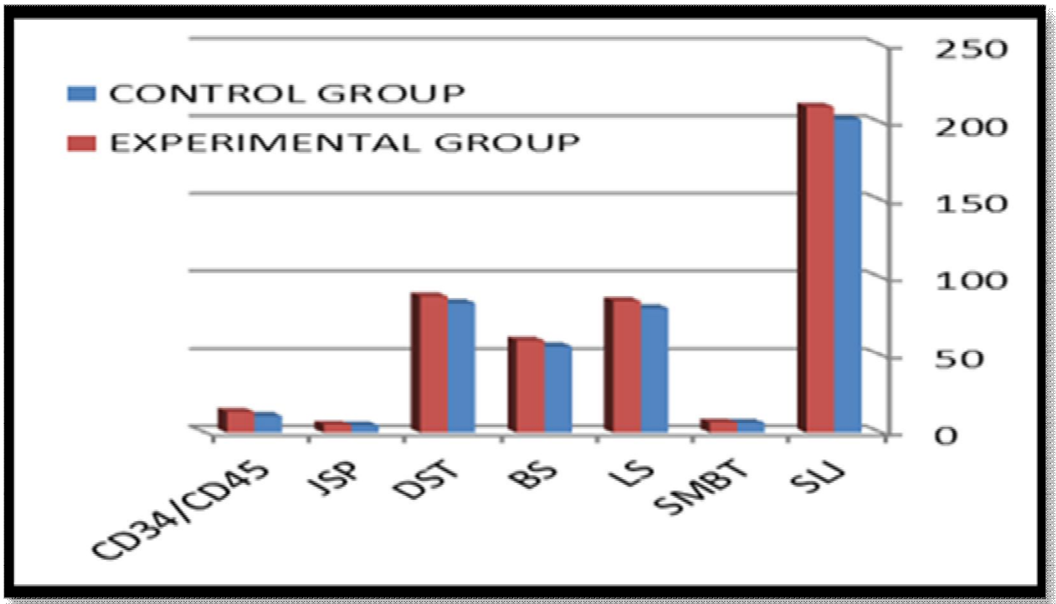

Fig 1. Explain the percentage changes for on (SLJ), (SMBT), (LS), (BS), (DST) , (JSP) and CD34/CD45 stem cells for the control and experimental groups

Discussion

The purpose of this study was to determine if Complex training s can enhance SLJ), (SMBT), (LS), (BS), (DST) (CSP) and CD34/CD45 among female handball players

The results indicate that Complex training s is capable of improving the physical - skill variables and counting of CD34/CD45 stem cells.

There are a number of potential explanations for these findings.

In the fact that Complex training s 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. (D. Chu, 1998). Furthermore, resistance training increases motor neuron excitability and reflex potentiation, which may lead to better training conditions for subsequent Plyometric exercises (Ebben, & Watts, 1998); 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, & Blackard, 1998)

Another explanation, the muscles was 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. (. Hamza, 2008)

According to 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 s , 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 have a more significant effect.

A number of studies demonstrate the effectiveness of Plyometrics compared to non-exercising control groups. (J. Blakey & D. Southard 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 (Adams, et al., 1992; J. Vossen, et al., 2000). The evidence indicates that the combination weight training and Plyometrics are effective.

the Muscles will best respond to Complex training when utilized through their full range of motion, this is also beneficial to the handball practitioner as techniques are executed through their full range of motion and therefore the training program consider to train in this manner .

Research has found the Complex training can be beneficial to athletic performance Comyns, et al. 2007; Evans, et al. 2000).

The results of this investigation are in accordance with previous studies (Adams, et al. 1992; DSale, 1991), showing that a combined program of weight lifting and Plyometrics can significantly increase the power and strength.

In his article 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 young fencers.

Studies have shown increases in contraction speed when weight training was used in conjunction with sport skill practice (Dengel, et al.1987). Improved sprint performance subsequent to weight training demonstrates the application of strength to speed production . Delecluse, 1997).

Another important result of our study is the significant reduction in the CD34/CD45 stem cells secretions after the training program; these findings show the quality of the training program design.

Several mechanisms may contribute to increase of CD34/CD45 stem cells followed 8- weeks of the Complex training s program. Concerning the adaptations to strength and power training, (A. Ferrauti, et al. 2001) main factors are referred to in the literature: neural and hypertrophic. and resistance training is more likely to be associated with increases in fiber cross-sectional area.

A number of studies have shown that exercise improves the function and regeneration of the cardiovascular system and skeletal muscle by activating and mobilizing organ-resident stem cells (Crameri, et al. 2007; Petrella, et al. 2006)or by recruiting blood-circulating stem or progenitor cells (Adams, et al. 2004).

Kadi, & Thornell. (2000) suggest that physical exercise can exert powerful effects on different stem cell niches by altering their microenvironment. Currently, the mechanisms behind the maintenance of a quiescent state within each stem cell niche as well as the exact signals leading to the proliferation of stem cells following exercise are not fully understood.

Conclusions and Practical Applications

Upper and lower body explosively levels of female handball players can be improved with a combined program of Plyometrics and resistance training. These power level improvements are usually seen as essential in handball 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 jump shhot level and CD34/CD45 stem cells.

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