

The Effect of Post Activation Potentiation (PAP) on improving Performance of male sprinter

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Abstract: Post activation Potentiation (PAP) is a phenomenon by which the force exerted by a muscle is increased due to its previous contraction. The purpose of the study was to investigate the effects of PAP on performance (Physical abilities, Physiological, health and Fitness variables). 15 male sprinter, aged (18-22y) were subjected to PAP training program for 8 weeks, 3 training units per week, The unit lasted for 90 min. Physical, physiological, health and fitness properties were reported pre-post PAP training Program. The parameters detected by coulter counter, Eliza technique, pulse meter, Accusport, instruments for Physical detection. Results indicated a significant differences in all parameters for the favor of the post training program, and improving performance, due to the positive effect of the program. In conclusion: The findings reveal an improved performance of the athletes related to physical, physiological, health and fitness properties

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Key words: Post Activation Potentiation, Performance, Physical, physiological, health, fitness.

1. Introduction:

Athletes are looking for new ways to get stronger in an effort to better perform, they have turned to science to discover the best way to train. One of these scientific based training methods is one known as complex or contrast training which is alternating lifting heavy and light loads with the goal of improving power output. Several scientific studies have found this complex training method to be beneficial for gains in strength compared to other traditional training method. The physiological concept believed to describe complex training as PAP. The theory behind this is that muscle has a greater explosive capacity after undergoing maximal or sub maximal contraction. Docherty et al (2004) reported enhanced motor neuron excitability as the working behind PAP, which results from enhanced motor unit recruitment, better motor unit synchronization, increased central input to the motor neuron and less presynaptic inhibition. This theory is supported by McBride et al (2005) and Gourgoulis et al (2003). They added that more neurotransmitters are released in afferent nerves as a result of complex training.

Ebben and Watts (1998) listed neuromuscular, hormonal metabolic, myogenic and psychomotor factors contribute to PAP.

Adaptation occur in the different systems of the body due to training programs, the positive changes occurring in the muscles and mitochondria plus the circulatory system is a positive effect that help the player to develop and progress.

Daniel (2011) stated that improving strength and power in the athlete is a central focus of the sports

physical therapist, particularly in the terminal phases of rehabilitation. High load strength training and power training through plyometric exercises are two key components of performance enhancement programs.

Neale Tillin and David (2009) reported the factors modulating PAP and its effect on performance through muscular strength, fiber type distribution, training level and power- strength ratio.

Digby (2002) showed that PAP plays a possible role in human performance and that it may offset fatigue in endurance exercise, increase rate of force development and thus improve speed and power performance. Brad (2006) stated that to reach high performance, scientists tried new training methods that possess positive effect and the complex training is one of them.

The capacity to maximize muscular power is critical to successful outcomes in a number of athletic events, such as track and field. Several authors have demonstrated that muscle postactivation potentiation (PAP) is a phenomenon that can acutely increase muscular power and performance. Chiu et al (2003). Short – term gains in power after heavy muscle preloading are thought to result from phosphorylation of myosin regulatory light chains and increased recruitment of higher motor units (Jo et al, 2010).

A great deal of research has attempted to identify methods to elicit PAP through a variety of conditioning activities during warm up routine (Cochrane et al, 2010 and Farup and Sorensen 2010)

The Problem of this study is a trial to increase performance through an up date method to attain the

most important item in sport to retard the sensation of fatigue and reach the highest performance through natural method a away from doping and illegal process. The researcher goal will be stressed upon the track and field players to use PAP training and its influence on performance through determination of Physical abilities, physiological, Fitness and health variables.

Aim of the study:

The Purpose of the study aims to investigate the effect of PAP training on some physical abilities, physiological, health, fitness variables.

Research Hypothesis:

- There are significant differences between pre-post PAP program in some physical abilities for the favor of post program.
- There are significant differences between pre-post PAP program in some physiological variables for the favor of post program.
- There are significant differences between pre-post PAP program in some Health properties for the favour of post program
- There are significant differences between pre-post PAP program in some fitness changes for the favour of post program.

2. Research Procedure:

Methods:

The researcher used the experimental of pre-post measurements of one group that is reliable with the nature of the research.

Venous Blood sample was withdrawn for laboratory estimation of cortisol, lactate, CPK, Hemoglobin, Rbcs Wbc, Together with pulse rate and Vo2 max (fitness) and for physical abilities speed endurance, strength speed, transient speed, Muscle endurance, flexibility and vertical jump.

Pre-measurement of all parameters were 1/12/2013 and Post measurements 1/2/2014 were done after 8 weeks of PAP exercises in Al Ahly club.

The training unit was composed of:

- 1- Warming up (10 min)
- 2- Main training of PAP of plyometric and weight training
- 3- Cooling down (5 min)

The equipment used:

- Coulter counter for blood analysis
- Cortisol assay using Eliza method
- Stop watch, measure scale
- Ice box, refrigerator
- Cones,
- Pulse meter
- Ergometer bicycle, Astrand nomogram

Table (1) Basic measurements N= 15

Variables	M	SD	Skewness
Age (y.)	22.6	3.5	0.34
Height (cm)	179	8.9	-0.12
Weight (Kg)	78.51	11.3	-0.25
BMI (Kg/m ²)	22.94	2.3	-0.61

Skewness (-0.61-0.34) were between (+3) meaning that the samples possess homogeneity.

Methods of measurement:

- 1- Blood count was measured using coulter counter of the blood containing EDTA
- 2- Cortisol was measured using Kit and Eliza method
- 3- Pulse rate using pulse meter
- 4- Vo2 max using bicycle ergometer and Astrand nomogram
- 5- Lactate by Accusport
- 6- CPK using Spectro photometer
- 7- Physical abilities using the methods of (Mohamed Sobhi, 2004)
 - Speed endurance
 - Strength speed
 - Transient speed
 - Blowing strength
 - Muscle endurance
 - Flexibility

The Main study steps:

- Period of training PAP (60 days)
- 8 Weeks period
- 3 Training units/Week
- Period of training Unit (90 min)

Principles of PAP program

- Taking Care for individual variation
- PAP exercise and age and growth development
- Taking care of the responses of each player
- Distribution of the training Units
- Flexibility of the PAP program
- Suitable loads in the training
- The progress of the program
- Load dynamics
- Warming up and cooling down
- Adaptation and Shape, direction of training

loads

Statistical data analysis

SPSS program was used

- Arythmatic Mean
- Standard deviation
- Skewness
- T test

Table (2) Physical abilities pre- post PAP

Variables	Pre		Post		"T"
	M	SD	M	SD	
Speed endurance (s)	45.01	2.33	40.14	1.8	9.34
Strength Speed (m)	43.67	5.9	57.74	9.76	18.39
Transient Speed (S)	4.62	0.21	3.96	0.17	22.7
Muscle endurance (No)	26.19	4.81	33.11	4.63	23.9
Flexibility (cm)	8.71	4.37	10.83	3.62	7.1
Blowing strength (cm)	2.26	0.17	2.61	0.14	16.8

$P < 0.05$; $T_t = 2.145$

Table (3) Physiological changes before and after the PAP program

Variables	Pre		Post		"T"
	M	SD	M	SD	
Cortisol $\mu\text{g/dl}$	13.4	1.2	8.5	1.1	5.6
Lactate m mol/L	1.7	0.4	1.1	0.3	2.9
CPK IU/L	140	6.2	121	5.3	9.8

$P < 0.05$ T_t 2.145

There were statistical differences between before and after PAP program for the sake of post program

Table (4) Health Variables before and after the PAP program

Variables	Pre		Post		"T"
	M	SD	M	SD	
Hemoglobin g/dl	13.2	1.4	14.5	1.3	4.3
Rbcs Mil/mm ³	4.6	,6	5.1	,4	3.3
Wbcs T./mm ³	6.7	,8	7.5	,6	3.1

$P < 0.05$ T_t 2.145

There were statistical differences for the sake of Post program

Table (5) Fitness changes before and after the PAP program

Variables	Pre		Post		"T"
	M	SD	M	SD	
Pulse Rate Stroke /m.	72	4.8	66	3.5	9.8
Vo ₂ max ml/K/M.	51.4	3.2	56.2	4.3	8.7

$P < 0.05$ T_t 2.145

There were statistical differences for the sake of Post program

4. Discussion:

1st hypophesis: There are significant differences between pre-post PAP program in some physical abilities for the favor of Post program.

Table (2) indicated a significant changes post PAP program in physical abilities [Speed endurance, strength speed, Transient speed, Muscle endurance,

flexibility, vertical jump). The improvement was related to the positive effect of PAP program.

These results are in accordance with those of Andi et al (2009), Digby (2002) and Ebben et al (2000), They stated that the training program increased calcium levels which inturn increased ATP which affect speed strength and improve physical

abilities, also Duke (2002) reported an increased muscle power due to weight and plyometric training. Donald Chu (1996) reported better results after mixing weight and plyometric training. Leena et al (1999) states that explosive – strength training improves running time by improving running economy and muscle power.

The preceeded discussion denotes that the 1st hypothesis has been realized.

2nd hypothesis: There are significant difference between Pre-post PA P program in some physiological variables for the favor of Post program.

Table (3) indicated a significant changes in physiological variables (Cortisol, Lactate, CPK), which indicated an improvement due to the Positive effect of PAP program, leading to less stress subjected to participant, increased mitochondria size and numbers and less lactate concentration also less muscle damage proved by a decreased CPK concentration. Aboeella (2003) reported that there are a correlation between strength training and physiological parameters linked to muscle or nerve attachment leading to muscle hypertrophy and better physiological adaptation. Also Kamal Darwich et al (1998) stated that the level of performanace is affected by biological, physiological and morphological variables. Bahaa salama (1999) agree that training increased energy for the sake of demand of skeletal muscle, nervous system and stress hormones.

This indicate that the 2nd hypothesis has been realized.

3rd hypothesis: There are significant differences between Pre-post PAP program in some health properties for the favor of Post program.

Health properties (Table 4) indicated significant changes post PAP program (Hb, Rbcs, Wbcs) which indicated that the program affected the participants Positively by increasing oxygen transport through Hb and Rbcs and affecting fatigue also the increased wbcs affect immunity and health leading to better performance. This is in accordance with Jacobeeet al (2013) they reported that PAP is a phenomenon that can increase muscle power and performance through the effect on energy production and strength of muscle.

Tillin and Bishop (2009) reported that the efficacy by which a conditioning activity can stimulate PAP mechanisms and enhance muscular performance depend on the balance between fatigue and potentiation. Banister et al (1999) provided a 2 factor mathematical theory on human performance, that a athlete should be viewed as a system that receives input in the form of training and produces output in the form of performance.

The preceeded discussion indicated that the 3rd hypothesis has been realized.

4th Hypothesis: There are significant differences between Pre-post PAP program in some fitness changes for the favor of Post program.

Table (5): Indicated that PAP training program affected positively Pulse rate and Vo2 max of the participants, which induce a better fitness change.

This result is in agreement with Bianca et al (2011) they revealed that PAP affect positively fitness test. This was also in accordance with the study of Franchini et al (1998). Also Noakes (1990) and Green and Patla (1992) have suggested that Vo2 max may be limited to central factors related to O2 uptake (Vo2) but also by muscle power factors affected by an interaction of neuromuscular and anaerobic characteristics.

The increased Vo2 max and decreased Pules rate play an important role in fitness as they decrease fatigue and provide the skeletal muscle with the sufficient o2 for ATP production. The preceeded discussion denotes that the 4th hypothesis has been realized.

Conclusion:

It may be concluded that PAP training affects performance through:

- 1- The improvement of physical abilities
- 2- Some physiological variables improvement
- 3- Health and immunity improvement
- 4- Fitness improvement

Recommendation:

It is recommended to benefit of the results of the study in rationing training loads on scientific basis in different sport specialties.

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