



ANALYZING THE EFFECT OF POST ACTIVATION POTENTIATION ON VERTICAL JUMP HEIGHT IN VOLLEYBALL PLAYERS

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Abstract:

The aim of the study was to find the effect of post activation potentiation (PAP) on jump performance in volleyball players and to compare its effects between males and females. Forty volleyball players were randomly divided into control and experimental group. The experimental group performed a PAP protocol consisting of 3 sets of 10 repetitions at 50% of 10 RM, 75% of 10 RM, 100% of 10 RM (repetition maximum) back squats. At the end of the last set of squats subjects performed 3 successive vertical jumps. Control group subjects performed only warm up for 10 minutes prior to assessment of jump performance. Results showed highly significant difference ($p=0.0002$) between the pre and post values of vertical jump height in males and significant difference ($p=0.0008$) in females. The findings of the present study also vivid that there were statistically significant difference ($p=0.0130$) between the post values of vertical jump height in males as compared to females. This study illustrate that stronger athletes have a greater potentiation, which is due to an ability to become more fatigue resistant as strength level increase and post-activation potentiation effect shows enhancement of on jump performance in volleyball players. This protocol might be helpful for the athletes as well as athletic trainers, coaches to formulate an effective training protocol for the athlete who will enhance their acute performance.

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1. Introduction

Volleyball is a team sport played at all competitive levels (youth, Olympic, and professional) and places an emphasis on explosive movements such as jumping, hitting, and blocking (Marques, M. C., et al., 2006; Marques et al., 2008). New roles in attack and defense have conditioned the need for more intensive study of volleyball players' skills, especially the ability of explosive force of leg muscles that in volleyball terminology it refers to vertical jump. Explosive strength of legs is very important during the vertical jump and speed of movement in area given that the explosive force can only be achieved with high-intensity work, which does not last long, it is clear that its energy resources are mainly anaerobic mechanism (Leka, L. et al. (2014).

Post-activation potentiation (PAP) is defined as an increase in muscle performance after a conditioning contraction. The conditioning contraction could be a maximal voluntary contraction (Hanada et al., 2000), an evoked tetanic contraction (post tetanic potentiation) (Desmedt and Hainaut, 1968) or a series of evoked twitches (Sale, 2002). The heavy resistance exercise is hypothesized to induce PAP, thus increasing the acute performance of the bodyweight exercise, with the prospect of superior chronic neuromuscular adaptations. (Sygulla, K. S., & Fountaine, C. J. (2014))

The principles of PAP have been applied by practitioners to enhance athletic performance and optimize training. Some coaches advocate that athletes should perform heavy resistive exercise prior to competing in events that require high power outputs (Scott, S. L., & Docherty, D. (2004)). Jumping exercises are often chosen because of their similarity to sports movements and because of their relatively low complexity. Studies by Gourgoulis et al., 2003, Young et al., 1998, and Gullich and Schmidtbleicher (1996) all used back squats involving various types of loading and rest periods to initiate PAP, and all of these methods appeared successful in eliciting PAP. There is handful literature available regarding the effect of post-activation potentiation on sprint performance but to the best of our knowledge there are very less studies focused on its effect on vertical jump height in volleyball players. So, the purpose of present study was to find the effect of Post-activation potentiation on jump performance in volleyball players.

2. Methodology

2.1 Subjects

This was an experimental study done at Guru Nanak Dev University, Amritsar. Which conducted on 40 volleyball players of inter university and the level above volunteered aged between 18-25 years to participate in the study. Players were included by random sampling technique. They were divided into 4 groups: Group A (experimental male) -

10, Group B (control male) - 10, Group C (experimental female) - 10, Group D (control female) - 10.

2.2 Procedure

The procedure was explained to the players and duly signed informed consent was taken from each player. The players completed a physical activity Readiness-Questionnaire (PAR-Q) before participation. Body weight and height were measured using weighing machine and stadiometer. After warm up the subjects were randomly allocated into experimental group and control group. Prior to performing the experimental protocol baseline measurements were recorded for the 10RM Back Squat. Subjects rested for 2 minutes between each successive stage. Players were asked to jump and vertical jump height was measured using Sergeant jump test. The dynamic warm-up protocol was done regularly by players which consisted of (in specific order): 20 high knees, 20 buttock kickers, 20 lunges, 20 karaoke, 20 A-skips, 20 side shuffle, 30 s of line hops (both feet), 15 s of line hops (one set each leg), 10 broad jumps, 10 squat hops, 10 leg sweeps (hamstring warm up), 20 reverse lunges, 20 walking quad/hamstring stretch, 20 straight leg bounding, 10 leg swings, 10 medium arm circles, and 10 large arm circles. Along with this PAP protocol was added which consists of following and 2 min rest was included between each successive sessions.

Table 1a: PAP protocol given to the experimental males and females volleyball players groups

Set	Amount of weight	Repetitions
1	50% of 10RM	10
2	75% of 10 RM	10
3	100% of 10 RM	10

Control Group: No PAP treatment and only warm up and were then assessed.

3. Result & Discussion

The comparison between parameters of the study was assessed using mean and standard deviation. The performance of subjects pre and post data was assessed by using the paired sample *t*-test and unpaired *t*-test.

Table 1b: Demographic and anthropometric characteristics of experimental and control group of the volleyball players

Group	Group A (male experimental)	Group B (male control)	Group C (female experimental)	Group D (female control)
Age (yrs)	20.25±1.165	20.5±1.773	20.63±1.923	19.88±1.808
Height (m)	172.25±5.548	174.63±7.539	162.00±9.621	163.50±7.348
Weight (kg)	68.38±7.689	65.38±5.069	54.00±7.131	55.38±7.800
BMI (kg/m ²)	23.19±3.513	21.54±0.952	20.44±2.044	20.53±1.374

The mean and standard deviation values of age, height, weight and BMI of the 4 groups that are group A (experimental-male), B (control-male), C (experimental-female) and D (control-female) of volleyball players.

Table 2: Pre and post mean values in group A (experimental) male of volleyball players

Paired T Test	Group A	
	Vertical Jump Height	
.	Pre	Post
Mean	262.13	272.39
S.D.	4.651	4.551
Number	10	10
Mean Difference	10.26	
Paired T Test	7.232	
P value	0.0002	
Table Value at 0.05	2.37	
Result	Significant	

Table 2 shows statistically significant difference in pre and post values of vertical jump height of Group A (experimental) male of volleyball players. Findings of present study showed significant improvement in post values as compared to pre values in experimental male. The present study is in agreement with (McCann and Flanagan et al., 2010) who found that a back squat enhanced vertical jump performance in NCAA Division I male and female volleyball players. The present study is in agreement with the result of present study is in affirm to the results of study done by (Radclife and Radcliffe 1996, Young, Jenner and Griffiths 1998 and Gourgoulis et al., 2003), with jump performance significantly improving by 1.5%, 2.8% and 2.39% respectively. These were multifarious studies that analyzed the effect of PAP response on vertical jump performance.

Graph 1: Pre and post mean values in group A (experimental) male volleyball players

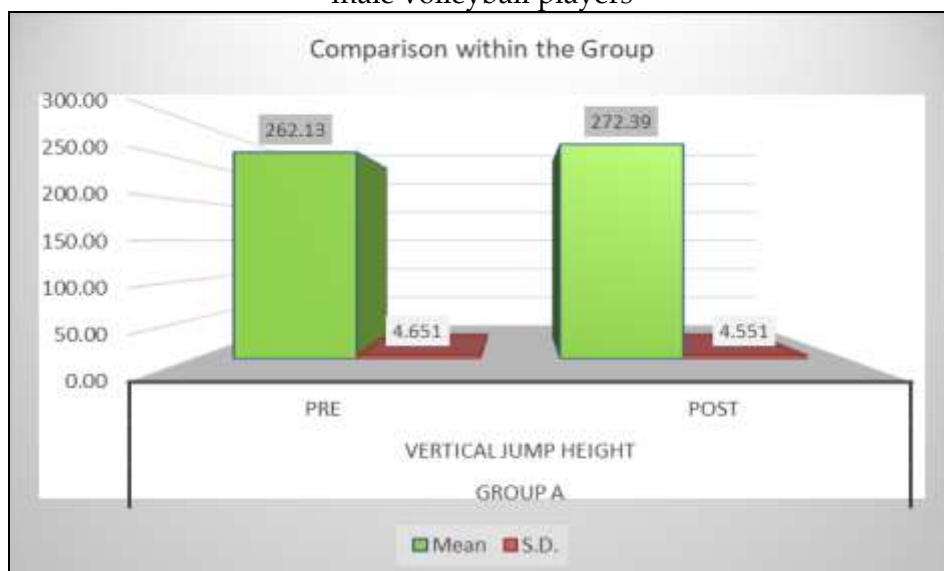


Table 3: Pre and post mean values in group B (control)
 male of volleyball players

Paired T Test	Group B	
	Vertical Jump Height	
.	Pre	Post
Mean	264.14	264.30
S.D.	10.105	9.403
Number	10	10
Mean Difference	0.15	
Paired T Test	0.375	
P value	0.7185	
Table Value at 0.05	2.37	
Result	Not-Significant	

Table 3 shows statistically, non-significant difference in pre and post values of vertical jump height of group B (control) male of volleyball players.

Graph 2: Pre and post mean values in group B (control)
 male volleyball players

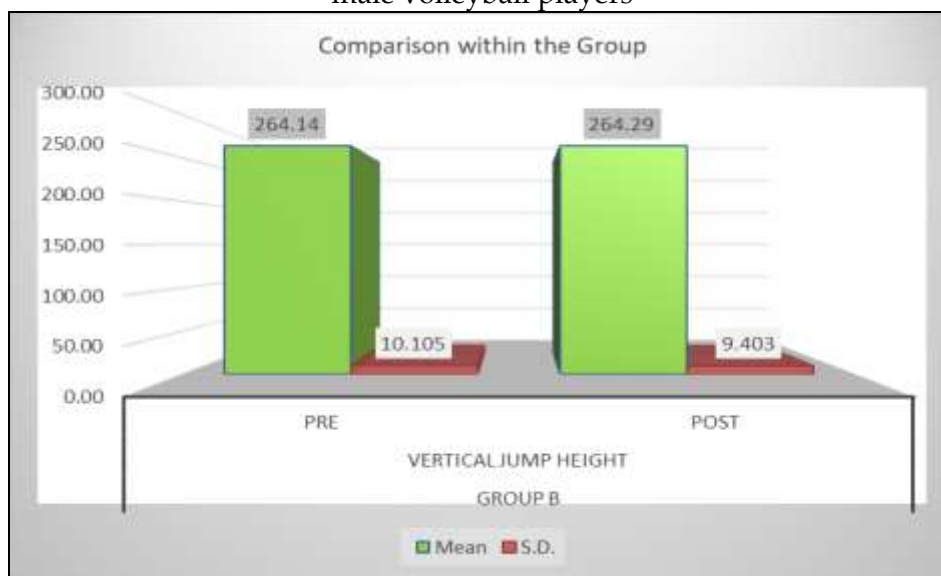


Table 4: Pre and Post mean values in Group C (experimental)
 female volleyball players

Paired T Test	Group C	
	Vertical Jump Height	
.	Pre	Post
Mean	247.55	258.90
S.D.	14.868	12.631
Number	10	10
Mean Difference	11.35	
Paired T Test	5.636	
P value	0.0008	
Table Value at 0.05	2.37	
Result	Significant	

Table 4 shows statistically, significant difference in pre and post values of vertical jump height of (group C) experimental females. The result of current study vivid that there was significant improvement in post values as compared to pre values in experimental females. (McCann 2010) conducted study on the PAP and vertical jump height and found that the complex training variables which includes 5 repetitions of either the back squat or hang clean (midthigh) with a load equal to their 5 repetition maximum (5RM) will increase VJ height, thus acutely enhancing athletic performance. Minimal research exists on female athletes as a whole let alone the PAP response, therefore comparisons and potential conclusions are somewhat limited.

Graph 3: Pre and Post mean values in Group C (experimental) female volleyball players

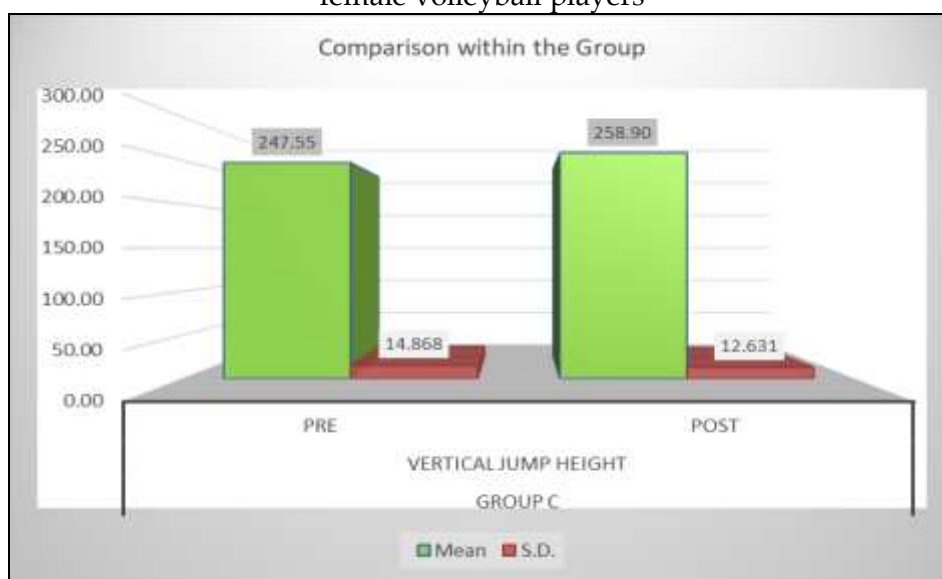


Table 5: Pre and post mean values of group D (control) female volleyball players

Paired T Test	Group D	
	Vertical Jump Height	
	Pre	Post
Mean	244.30	245.55
S.D.	8.367	7.996
Number	10	10
Mean Difference	1.25	
Paired T Test	1.852	
P value	0.1064	
Table Value at 0.05	2.37	
Result	Not-Significant	

Table 5 shows statistically, non-significant difference in pre and post values of vertical jump height of Group D (control) female.

Graph 4: Pre and post mean values of group D (control) female volleyball players



Table 6: Comparison of post mean values of group A (experimental-post male) group C (experimental-post female) volleyball players

Unpaired T Test	Vertical Jump Height	
	Post	
	Group A	Group C
Mean	272.39	258.90
S.D.	4.551	12.631
Number	10	10
Mean Difference	13.50	
Unpaired T Test	2.843	
P value	0.0130	
Table Value at 0.05 df 14	2.15	
Result	Significant	

Table 6 shows statistically very highly significant differences were found in post values vertical jump height of male experimental group A. The challenge to consistently elicit the PAP response stems from a careful balance of the training status of the athlete, the level of strength attained by the athlete, the intensity of the conditioning activity, and the period of time following the potentiating activity (Sale D. G. et al., 2002; Wilson J. M. 2013). Previous research provides evidence that stronger athletes have a greater potential to potentiate, (Baker D. et al., 2003; Young W. B. et al., 1998) which is hypothesized to be due to an ability to become more fatigue resistant as strength levels increase.

Graph 5: Comparison of post mean values of group A (Experimental-Post-Male) group C (Experimental-Post-Female) volleyball players



When comparison done between performances of males and females, males showed higher mean values as compared to females. Previous studies have found the PAP response to highly individualized thus the results of present study clearly mirror this trend.

4. Conclusion

This study concluded that significant differences were observed between pre and post values of vertical jump height of experimental males and experimental females groups. Significant differences were found between the post values of vertical jump height in males as compared to females.

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