

## The impact of post activation potentiation during warming-up on muscular ability and the reactive agility for female volleyball players

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### **Research Summary :**

The current study aimed to know the effect of post activation potentiation during warm-up using the vertical drop jump on both the muscular ability of the lower extremities and the reactive agility of female volleyball players. The study sample consisted of 15 female players from the Aviation Club first – team (age:  $21,96 \pm 1.80$  years), (body mass:  $68.96 \pm 8,13$  kg), (height:  $172,35 \pm 4,39$  m). The experimental method with a single experimental group was used with a measurement design (pre- and post-test). The vertical drop jump test using the Axon jump was used to measure the muscular ability of the lower extremities, and the test (9, 3, 6, 3, 9) to measure reactive agility. The measurements were carried out in two parts: the first part was the pre-test, in which the values of the two tests under study were determined, And the second part, in which the post-test was carried out after applying the post activation potentiation in 5 m and after the pre-test in 48 hours. The results showed positive sharp muscle activation in improving the muscular capacity values of the lower extremities represented by the jump height in addition to the improvement in speed in the interactive agility test.

**Keywords** Post activation potentiation, lower extremity muscular ability, reactive agility, vertical drop jump.

## تأثير التنشيط الحاد للعضلات أثناء الإحماء باستخدام الوثب العميق العمودي علي كلاً من القدرة العضلية للأطراف السفلي والرشاقة التفاعلية للاعبات الكرة الطائرة

### ملخص الدراسة:

هدفت الدراسة الحالية إلي معرفة تأثير التنشيط الحاد للعضلات أثناء الإحماء باستخدام الوثب العميق العمودي علي كلاً من القدرة العضلية للأطراف السفلي والرشاقة التفاعلية للاعبات الكرة الطائرة. تكونت عينة الدراسة من لاعبات فريق الدرجة الأولى من نادي الطيران وبلغ عددهم ١٥ لاعبة (العمر: ١٨،٠٠±٢١،٩٦ سنة)، (كتلة الجسم: ٦٨،٩٦±٨،١٣ كجم)، (الطول: ١٧٢،٣٥±٤،٣٩ م). وتم استخدام المنهج التجريبي ذو المجموعة التجريبية الواحدة بتصميم القياس (القبلي - البعدي). وتم الإستعانة باختبار الوثب العميق العمودي باستخدام Axon jump لقياس القدرة العضلية للأطراف السفلي، واختبار (٩، ٣، ٦، ٣، ٩) لقياس الرشاقة التفاعلية. وقد تمت القياسات علي جزئين: الجزء الأول في القياس القبلي وتم فيه تحديد قيم الاختبارين قيد الدراسة، والجزء الثاني وتم فيه القياس البعدي بعد تطبيق التنشيط ب ٥ق وبعد القياس القبلي ب ٤٨ ساعة. وأظهرت النتائج إيجابية التنشيط الحاد للعضلات في تحسين قيم القدرة العضلية للأطراف السفلي متمثلة في إرتفاع الوثب بالإضافة إلي تحسن السرعة في اختبار الرشاقة التفاعلية.

**الكلمات المفتاحية** التنشيط الحاد للعضلات، القدرة العضلية للأطراف السفلي، الرشاقة التفاعلية، الوثب العميق العمودي.

## The impact of post activation potentiation during warming-up on muscular ability and the reactive agility for female volleyball players

### Introduction of the study

Muscular ability is one of the physical requirements that an athlete must have, as it is necessary to perform many motor skills such as running, jumping, throwing, kicking and other basic skills in team and individual sports, and it is important for the player to reach the highest level of muscular

ability during performance, starting from Preparing and preparing the player during the warm-up phase that precedes the training unit or competition, and here the importance of a good warm-up before performance becomes clear.

The warm-up is a transitional stage to prepare the player's body for all the mechanical and physiological changes of the training unit or competition, which affects the level of skill and planning performance. (Young & Behm, 2002; Shellock & Prentice, 1985) indicated that the warm-up is divided into a general warm-up, which aims to raise the degree of readiness of the body for physical effort through general exercises, and a special warm-up aimed at focusing on the muscles most used. In training or competition.

Several studies have dealt with warm-up with a new perspective, with the aim of developing the methods and techniques used to prepare the player by increasing the contractility and elasticity of the muscle before training or competition, where many studies have shown that the use of physical exercises of maximum or near maximum intensity for a short period of time enables to raise the efficiency of the performance of the neuromuscular system and enhances the contractile capacity of the muscle by increasing neuromuscular conduction, which is what Recently known as post-activation potentiation, abbreviated as (PAP), it is a high intensity exercises performed by the player before the main activity, which leads to an increase in the speed of nerve conduction to the muscles and thus improves the performance of explosive power, ability and interactive agility during training or competition. Which contributes to the development of the performance of both speed, strength and muscular ability, which are the elements that greatly affect the improvement of the level of skill performance, which is the mainstay for scoring points in volleyball matches.

There are many methods used in acute muscle activation, including activation using the deep jump, where a study (Chen et al., 2013) showed a positive effect on the jump height of volleyball players, and the results of the study (Okuno et al., 2013) confirmed that activation using vertical jump During warm-up improves the performance of repetition of speed with and without changing the direction in handball players, while the results of studies that used strength and weight exercises by (Iacono, Padulo, & Seitz, 2018; Harmancı & Karavelioglu, 2017) confirmed that acute muscle activation Using half-squat strength exercises (50%-80%) of the football players' maximum strength, it positively affected the repetition speed (7x30m).

### **Problem of the study**

After reviewing previous studies, scientific periodicals and reference survey, it became clear to the researcher the strong trend in the developed countries in sports activities in general and volleyball in particular towards the use of modern methods and methods in the warm-up phase (post activation potentiation) to raise the level of physical abilities very significantly in The warm-up stage and before the start of the competitions, which may be one of the reasons for the superiority of the teams of those countries so that the player begins training or competing at the highest level of physical abilities, Through the reference survey in the Arab environment, it was shown the scarcity of research that dealt with this type of activation during the warm-up in volleyball. Muscularity, in particular, about the players of the teams in the Egyptian Premier League (A) for women, and given the importance of the muscular ability variable, as it contributes significantly to the effectiveness of the performance of various offensive skills such as smashing, blocking and overwhelming serve, as volleyball depends on scoring points on those skills, which are Skills that depend largely on the muscular ability of the legs (jumping up), The idea of this study came about the possibility of using acute activation of the muscles of the lower extremities of volleyball players of the first degree in the Aviation Club, due to the fact that the researcher is a former player in the team, which facilitates obtaining the sample for the application in order to identify the extent of its effectiveness in improving the muscular ability and thus improving the order of the teams for the better.

### **Objectives of the Study**

The research aims to identify the effect of using acute muscle activation during warm-up using vertical deep jump on each of:

- 1- The muscular ability of the lower extremities of female volleyball players.
- 2- Interactive agility for female volleyball players.
- 3- The level of the components of the jump (jump height - flight time - contact time - expended energy).

### **Hypotheses of the Study**

- 1- There are statistically significant differences between the two measurements (before and after) in the level of muscular ability of the lower extremities in favor of the dimensional measurement of the experimental research group.

2- There are statistically significant differences between the two measurements (pre- and post-test) in the level of interactive agility in favor of the post-measurement of the experimental research group.

3- There are statistically significant differences between the two measurements (before - after) in the components of the jump (jump height - flight time - contact time - expended energy) in favor of the dimensional measurement of the experimental research group.

## **Procedures of the Study**

### **I. Methodology**

The researcher used the experimental method, using one of the experimental designs, which is the experimental design with a single group, using the method of measurement (pre- and post-test) in order to suit the nature of the research.

### **II. Sample**

The research sample was chosen in a deliberate way from the players of Aviation Club first-team from the Premier League (A) who are registered with the Egyptian Volleyball Federation for women for the sports season 2021-2022, and their number is (15) players.

### **III. Tools and Data Collection Methods**

#### **Devices and tools used for measurement:**

- 1- (Axon Jump) device for measuring the muscular power of the lower extremities (through the components of the jump “jump height, flight time, contact time”, and the muscular ability index (exhausted energy).
- 2- A rheostat for measuring length.
- 3- A medical scale to measure weight.
- 4- Stopwatch 1/100th of a second.
- 5- Jumping box 30 cm high.
- 6- tape measure.
- 7- A computer.
- 8- A form for recording data and measurements for the sample under study.

#### **Tests used:**

- 1- A test (9-3-6-3-9) to measure reactive agility (forward and backward movement).
- ٢- Vertical drop jump test to measure muscular power using (Axon Jump).

### **IV. Experimental application procedures:**

The experiment was applied to three visits and took place as follows:

**The first visit:** in which the physical tests (reactive agility - muscular ability) of the research sample were measured.

**The second visit:** In which post activation potentiation was applied, using the vertical drop jump from above a box of 30cm height, then jumping with the feet straight from above 3 hurdles with a height of 20cm, 5 repetitions, then a passive rest for 5s, then the (9-3-6-3-9) test was measured for interactive agility.

**The third visit:** in which post activation potentiation was applied and then 5 minutes of rest was given, then the test (vertical drop jump using Axon jump) was measured for muscular endurance.

#### IV. Statistical treatments:

- 1- Arithmetic mean.
- 2- The standard deviation.
- 3- The “intra class correlation” and “coefficient of variation” indicators for studying the relative and absolute stability of muscular ability after making sure that there are no statistically significant differences.
- 4- One-way analysis of variance.
- 5- Pearson correlation coefficient.
- 6- For advanced statistics "Post hoc statistical analysis" will use LSD fisher test

## Results

**Table (1)**  
**The arithmetic mean, standard deviation, and sequences**  
**of the variables under study**

N (15)						
Variables	Measure unit	Mean	Median	Standard deviation	Sequences	Kurtosis
<b>Anthropometric variables</b>						
Age	Month	21.96	21.00	1.80	1.93	4.75
Height	C.M	172.35	172.00	4.39	-0.02	-0.80
Weight	K.G	68.96	69.00	8.13	0.83	2.39
Training age	Year	13.04	14.00	3.52	-0.85	0.21
<b>Physical variables</b>						
(9,3,6,3,9) Test	Second	11.47	11.50	0.32	-0.36	-1.39

## Muscular power test for lower extremity

TC	Second	0.56	0.57	0.03	0.10	-1.03
FT	Second	0.53	0.49	0.06	0.01	-2.03
H	C.M	38.77	38.90	1.01	-0.98	0.60
P/KG	Unit/K.G	28.73	28.60	0.95	-0.36	-0.90
RSI	C.M/Second	0.67	0.65	0.10	-0.16	-0.91

It is clear from the previous table (1) that:

The sequences of the group in the tests under study was confined between (+3, -3), which indicates the moderation of the frequency distribution (homogeneity of the community).

Table (2)

Arithmetic averages, standard deviations, and improvement ratios (for the experimental group) between the pre and post measurements of the physical variables under study

N (15)

Physical variable	Measure unit	Pre-test		Post-test		Improvement rate
		$\mu$	$\sigma$	$\mu$	$\sigma$	
(9.3.6.3.9) test	Second	11.48	0.33	9.86	0.29	14.09%
<b>Muscular power test for lower extremity</b>						
(TC) time contact	Second	0.56	0.03	0.49	0.02	13.17%
(FT) flight time	Second	0.53	0.06	0.58	0.01	10.69%
(H) height	C.M	38.74	1.08	41.75	1.02	7.78%
(P/KG) power/kilogram	Unit/K.G	28.70	1.00	30.96	1.06	7.88%
(RSI) reactive strength index	C.M/Second	0.67	0.11	0.87	0.04	29.65%

It is evident from Table (2) the arithmetic averages and standard deviations between the pre and post-tests of the physical variables under discussion, and the improvement rates ranged between (29.65%, 7.78%)

The researcher attributed the positive results in developing and improving the muscular capacity of the lower extremities to the post activation potentiation using the protocol under study, which is consistent with the study of both:

The results of the current study agreed with many studies that showed that post activation potentiation of the lower extremities has a positive effect on

speed exercises performed at high intensity in a short time. (Ambosaidy, 2018) ; (Vrcić et al, 2017; Iacono et al. 2017; Chen et al, 2013)

A study (Ambosaidi, 2018) showed that acute muscle activation during warm-up using the vertical deep jump improves the height of the vertical jump for handball players, compared with the warm-up without the deep jump and the warm-up with the horizontal deep jump.

Which is consistent with the first hypothesis: that there are statistically significant differences between the two measurements (before and after) in the level of interactive agility in favor of the dimensional measurement of the experimental research group.

**Table (3)**

**The significance of the differences between the pre and post-tests of the experimental group for the physical variables under study**

**N (15)**

Variables	Measure unit	Signal direction	N. of ranks	Rank average	Total ranks	Value Z	Level of significance
(9.3.6.3.9) Test	Second	-	15	8.00	120.00	*3.408	.001
		+	0	0.00	0.00		
		=	0				
<b>Muscular power test for lower extremity</b>							
(TC) time contact	Second	-	15	8.00	120.00	3.415*	.001
		+	0	.00	.00		
		=	0				
(FT) flight time	Second	-	2	2.00	4.00	*2.759	.001
		+	10	7.40	74.00		
		=	3				
(H) height	C.M	-	0	.00	.00	*3.414	.001
		+	15	8.00	120.00		
		=	0				
(P/KG) power/kilogram	Unit/K.G	-	0	.00	.00	*3.411	.001
		+	15	8.00	120.00		
		=	0				
(RSI) reactive strength index	C.M/Second	-	0	.00	.00	*3.409	.001
		+	15	8.00	120.00		
		=	0				

It is clear from Table (3) that there are statistically significant differences between the tribal and remote measurements of the experimental group in the variables under consideration, using the Wilcoxon LA barometric



test, and the significance level reached (0.001), which are levels less than the significance level of 0.05, which was accepted by the researcher as a condition for accepting the differences, and therefore the differences were accepted in favor of dimensional measurements.

The researcher attributed the positive results in developing and improving interactive agility and jumping components to the post activation potentiation using the protocol under study, which is consistent with the study of both:

The study (Harmancı & Karavelioglu, 2017) compared the effects of 3 types of warm-up represented in I) acute muscle activation warm-up using jumping from a back squat position, II) warm-up with stationary stretches, III) classic warm-up. The results of this study showed that acute muscle activation during warm-up improved the indicators of maximum power and average ability to perform repetitions of speed without changing direction (6 x 35 m).

In the study (Gotas et al., 2016) that relied on acute muscle activation of the upper extremities using weights (Bench Press) and of the lower extremities using squats, the researchers explained that the use of weights for the upper and lower extremities with intensity ranging from (80-130%) of muscle strength Maximum positively affects the performance of throwing, pushing and slinging activities in basketball, athletics and luge.

This is consistent with the second and third hypotheses: that there are statistically significant differences between the two measurements (before - after) in the level of interactive agility in favor of the dimensional measurement of the experimental research group.

## Conclusions

**In light of the study results and their discussion, the researcher reached the following conclusions:**

- 1- Acute muscle activation during warm-up using the deep vertical jump has a positive effect on the muscular endurance indicators of the lower extremity.
- 2- Acute muscle activation during warm-up using the vertical deep jump has a positive effect on the reactive agility indicators.
- 3- Acute muscle activation during warm-up using the vertical deep jump has a positive effect on the components of the jump (jump height, flight time, contact time, muscular endurance index “exhausted energy”).

## Recommendations

**In light of the study results, the researcher recommends the following:**

- 1- Urging the coaches of team and individual games to use acute muscle activation by using the vertical deep jump during the warm-up in order to raise the level of the maximum muscular ability.
- 2- Urging the coaches of team and individual games to use acute muscle activation by using the vertical deep jump during the warm-up in order to raise the level of interactive agility.
- 3- Urging the coaches of team and individual games to use acute muscle activation using the deep vertical jump during the warm-up in order to raise the level of the components of the jump (jump height, flight time, contact time, muscular ability index “exhausted energy”).
- 4- Conducting more studies on acute muscle activation during warm-up using vertical deep jumps of different intensities and for different sports.
- 5- Conducting studies aimed at developing codified programs for the use of acute muscle activation throughout the sports season.

## References

- 1- Acsm. (2012). ACSM Guidelines for Exercise Testing and Prescription, 8th Edition. Medicine & Science in Sport & Exercise.(37)
- 2- Borba, D. D. A., Gomes, L., & Coelho, M. (2016). Rev Bras Centropomid Hum in Athletics: a systematic review, 128–138.
- 3- Chen, Z., Wang, Y., Peng, H., Yu, C., & Wang, M. (2013). The Acute Effect of Drop Jump Protocols With Different Volumes and Recovery Time on Countermovement Jump Performance. Journal of Strength and Conditioning Research, 27(1), 154-158.
- 4- Faigenbaum, A. D., Bellucci, M., Bernieri, A., Bakker, B., & Hoorens, K. (2005). Acute Effects of Different Warm-Up Protocols on Fitness Performance In Children. Journal of Strength and Conditioning Research, 19(2), 376-381.
- 5- Gołaś, A., Maszczyk, A., Zajac, A., Mikołajec, K., & Stastny, P. (2016). Optimizing post activation potentiation for explosive activities in competitive sports. Journal of Human Kinetics, 52(1), 95-106.
- 6- Harmancı, H., & Karavelioğlu, M. B. (2017). Effects of different warm-up methods on repeated sprint performance. Journal of Biomedical Research (India), 28(17), 7540–7545.
- 7- Iacono, A., Padulo, J., & Seitz, L. D. (2017). Loaded hip thrust-based PAP

- protocol effects on acceleration and sprint performance of handball players: Original Investigation. *Journal of Sports Sciences*, 36(11), 1269–1276.
- 8- Nelson, A. G., & Kokkonen, J. (2001). Acute Ballistic Muscle Stretching Inhibits Maximal Strength Performance. *Research Quarterly for Exercise and Sport*, 72(4), 415-419.
  - 9- Okuno, N. M., Tricoli, V., Silva, S. B. C., Bertuzzi, R., Moreira, A., & Kiss, M. A. P. D. M. (2013). Post activation potentiation on repeated-sprint ability in elite handball players. *Journal of Strength and Conditioning Research*, 27(3), 662–668.
  - 10- Shellock, F.G., & Prentice, W. E. (1985). Warming-up and stretching for improved physical performance and prevention of sports-related injuries. *Sports Med*, 2(4), 267–27.
  - 11- Young, W. B., & Behm, D. G. (2002). Should Static Stretching Be Used During a Warm-Up for Strength and Power Activities. *Strength and Conditioning Journal*, 24(6), 33.