Journal of Advanced Research in Psychology & Psychotherapy
Volume 2, Issue 1 - 2019, Pg. No. 3-11
Peer Reviewed & Open Access Journal

Research Article

# Effect of Mental Imagery Coupled with Plyometric on Vertical Jump and Agility

Kanika Taneja[1], Kalpana Zutshi[2], CS Ram[3], Anuradha Solanki[4]

[1]Research Student, Physiotherapist Sir Ganga Ram Hospital, New Delhi, India.
[2]Assistant Professor/ Incharge Rehabilitation Centre, Department of Rehabilitation Sciences, Jamia Hamdard, Hamdard University, New Delhi, India.
[3]Director, Department of Physiotherapy, ITS College Uttar Pradesh, India.
[4]Sports Psychologist, Sports Authority of India, New Delhi, India.
**DOI:** https://doi.org/10.24321/2581.5822.201902

## I N F O

**Corresponding Author:**
Kalpana Zutshi, Department of Rehabilitation Sciences, Jamia Hamdard, Hamdard University, New Delhi, India.
**E-mail Id:**
zutshi.kalpana@gmail.com
**Orcid Id:**
https://orcid.org/0000-0002-3494-5665
**How to cite this article:**
Taneja K, Zutshi K, Ram CS et al. Effect of Mental Imagery Coupled with Plyometric on Vertical Jump and Agility. *J Adv Res Psychol Psychother* 2019; 2(1): 3-11.

Date of Submission: 2018-08-29
Date of Acceptance: 2018-11-15

## A B S T R A C T

*Background:* Among the extensive research done, there are many studies on imagery use by athletes. These studies have looked at athletes imagery use under a number of different conditions except its use clubbed with physical training which has less available evidences.[1,29,35]

The additional advantage being in the case of acute injuries, when actual training is not possible, imagery training is believed to be extremely beneficial without causing any further exertion to the injury.

The objective of the study is to study the efficacy of a program combining mental and physical practice with the efficacy of a program composed of only plyometric training or only mental practice on vertical jump and Agility.

*Methods:* A total of 36 healthy male volunteers participated in the study from Hamdard University and Darbari Lal D.A.V. Model School. It was a different subject experimental study with a Pre-Test – Post Test design. They were randomly assigned between three groups. Main outcome measure was vertical jump using Stand and reach test and Agility t-test for Agility.

The data was analyzed with the help of statistician using SPSS 15.0 version.

Paired-t test was used to see the within Group analysis of both the outcome measures as vertical jump and Agility t-test. Results of training from pretesting to post testing were analyzed using a one-way ANOVA and compared across three groups. When a significant F-ratio was found, a Bonferoni's post-hoc test was used to determine differences between mean values across the three groups. Alpha was set at .05 to achieve statistical significance for all analysis.

*Results:* It was seen that all the three groups i.e. combination (plyometric and mental imagery) group C, mental imagery training (group B) and plyometric training (group A) has yielded significant improvements on both the outcome after training for 6 weeks. Combined training

significantly improved performance in agility test and vertical jump as compared to plyometric and imagery alone(p-value=0.000 for difference VJ and p-value=0.000 for difference test at p 5% significance).

*Conclusion:* It was concluded through the study that combination of mental imagery training with plyometric yields better and added effects than the intervention involving plyometric and mental imagery training alone.

**Keywords:** Agility, Mental Imagery, Plyometric, Vertical Jump

## Introduction

The famous psychologist William Jones wrote that "the greatest discovery…is that human beings by changing the inner attitudes of their minds, can change the outer aspects of their lives".[55]

According to Linda Warner, if you close your eyes and imagine yourself standing in a swimming pool, you are using mental imagery. You can mentally practice a physical skill, such as doing the backstroke across a swimming pool, by visualizing yourself doing it. Various researchers shows that, Mental imagery has been used as a technique for influencing physical components in various disciplines.[1,29,35,38]

In recent years the study of mental imagery has sparked the interest of many scholars in the field of sport psychology. It is now recognized that, in general, imagery is used by most people. In addition, many athletes and coaches have realized the important role that imagery plays and have incorporated its use into their training regimens.[38]

In general, imagery is defined as "those quasi-sensory and quasi-perceptual experiences of which we are self-consciously aware and which exist for us in the absence of those stimulus conditions that are known to produce their genuine sensory or perceptual counterparts".[49]

There are several reports about mental imagery and mental practice being used in sports training[11,16,17,48,1,29] and for neurological rehabilitation.[3,12,44,51,52] From a sports medicine perspective, imagery is seen as a key component in mental training programs for athletes.[38] In application, imagery is a form of simulation used by athletes most often for improving skill acquisition, motivation and performance[38]. Individual asked to imagine they performing skilled, serial movements of the digits manifested increased cerebral blood flow in non-primary motor regions of the cerebral cortex without evidence of activating the primary motor cortex.[50]

Mental imagery practice has been proposed as an alternative mode of exercise therapy that bears little cost and has no safety risks. Its positive effects on motor performance and skill, especially when combined with physical practice, have not been well established.[60]

The present study was meant to examine the use of imagery in the Sports Physical therapy. The use of imagery by athletes has been researched extensively in a number of different capacities.[38,19]

Of particular interest, have been that the mental practice may be used as a noninvasive complement to physical therapy to improve performance in terms of agility and vertical jump. Mental imagery has been studied to be benefited on various psychological factors as self efficacy, anxiety, confidence, attention or concentration[9,32] but not much research is being done in correspond to physical performance factors.

Could a similar effect be achieved by using the plyometric training to enhance vertical jump and agility?

## Material and Methods

A total of 36 healthy male volunteers participated in the study for 6 weeks from Hamdard University and Darbari Lal D.A.V. Model School. A written informed consent was obtained from those volunteers who fulfilled the Inclusion and exclusion criteria.

### Inclusion criteria: Healthy Collegiate athletes

- Age group: 18-25 years
- 10 single leg squats in 15 seconds
- 10 single leg step ups in 15 seconds
- Have strength base level to lift 1.5 -2.5 x body weight in free squat

### Exclusion criteria: Current participation in any lower limb training program

- Prior history of lower limb pathology
- Gross instability
- Taking regular mental imagery or any psychological training

They were randomly assigned between three groups as: Group A (Plyometric Training), Group B (Mental training) and Group C (Combination of Plyometric and Mental Training). It was a different subject experimental study with a Pre-Test–Post Test design used to find out effects of Mental Imagery training combined with Plyometric Training on Vertical Jump and Agility. Interventions divided

**ISSN: 2581-5822**
**DOI: https://doi.org/10.24321/2581.5822.201902**

as 12 subject received Plyometric training (Group A), 12 underwent Mental imagery training (Group B) and 12 received combination of both plyometric training and Mental Imagery training (Group C) training was given for 6 weeks with frequency of 2 days per week.

Subjects were identified, informed consent was taken and randomly assigned to three group's. Prior to pre-test recordings and familiarization with the test was done. Familiarization included practicing of vertical jumps and Agility T-Drill with proper instructions. Constant feedback was given to rectify any errors when performing them.

The Movement Imagery Questionnaire was filled by Group B (mental imagery) and Group C (combination of plyometrics and imagery) to know what type of imagers they were.

Baseline measurement by vertical jump height and agility test was measured by Stand and Reach test and T-Drill. The mental imagery and plyometric training lasted for six weeks with two sessions of both every week. During the imagery sessions, the participants was told to imagine jumps and Agility T-Drill according to the described instruction repeatedly for 1.5 minutes followed by a 30s rest period. This was repeated four times. It was done in the form of audio tapes using mp3 player and headphones.

Plyometric training was followed as per the protocol[5]. Post intervention Outcome measures vertical jump and agility test were again measured as average of three readings and recorded for analysis.

## Data Analysis

A total of 36 subjects participated in the study with their demographic data was analyzed by comparing means of descriptive. They have their mean age±S.D as 21.5±2.23, 21.5±2.2 and 21.0 ±2.1 for Group A, B and C respectively.

The mean height recorded for each Group was 159.2±6.9 (Group A), 159.3 ±4.12 (Group B) and 164.4 ±8.2 (Group C)

The average weight of the subjects included in study was recorded as 58±4.59, 57±6.08 and 59±5.7 for Group A, B and C respectively.

The 'p' value and f value for each age, height and weight was found out to be Age (p-value.813, f=.208), Height (p-value.115, f-value2.314) and Weight (p-value.698, f-value.364). Each of these indicates that there is insignificant difference between these parameters.

The 'p' value and the f-value for baseline pretest values of vertical jump and Agility t-test was also found to be 'p' value .408 and f value .922 and p value .773 and f value .259 respectively indicating the insignificant difference between them, hence allowing them to be compared in the study.

## Within Group results

It was done using Paired sample t-test on each Group and with each outcome measure

The comparison for within Group significance was done using Paired sample t-test which was conducted to see difference between vertical jump pre and vertical jump post in each Group

## Vertical Jump

It was found that on comparing vertical jump pre and vertical jump post the p and t-values (p-value .000 and t-value is 9.513) shows it to be significant.

For group B, Paired sample t-test was conducted to see difference between vertical jump pre and vertical jump post in each group. It was found that (p-value was .000 and t-value 5.211) which shows it to be significant.

**Table 1(1).Descriptive analysis of demographic factors**

| | Group A Mean ±S.D | Group B Mean ±S.D | Group C Mean±S.D | f-value | p-value |
|---|---|---|---|---|---|
| Age | 21.5±2.23 | 21.58±2.23 | 21.0±2.1 | .208 | .813 |
| Height | 159.28±6.9 | 159.3±4.12 | 164.4±8.2 | 2.314 | .115 |
| Weight | 58±4.59 | 57±6.08 | 59±5.7 | .364 | .698 |
| Vertical jump Pre-test | 26.84±7.05 | 30.8±6.6 | 29.1±7.96 | .922 | .408 |
| Agility t-test Pre-test | 13.51±1.12 | 13.25±1.28 | 13.5±1.03 | .259 | .773 |

| | Vertical Jump Pretest value Mean±SD | Vertical Jump Posttest value Mean±SD | t-test | |
|---|---|---|---|---|
| | | | t | p |
| Group C | 29.15±7.96 | 35.97±7.17 | 16.845 | .000 |

**Table 1(2).Vertical jump difference for Group A**

| | Vertical Jump Pretest value Mean±SD | Vertical Jump Posttest value Mean±SD | t-test | |
|---|---|---|---|---|
| | | | t | p |
| Group A | 26.84±7.05 | 30.91±6.53 | 9.513 | .000 |

**ISSN: 2581-5822**
**DOI: https://doi.org/10.24321/2581.5822.201902**

**Table 1(3).Vertical jump difference for Group B**

| | Vertical Jump Pretest value Mean±SD | Vertical Jump Posttest value Mean±SD | t-test | |
|---|---|---|---|---|
| | | | t | p |
| Group B | 30.85±6.67 | 32.95±6.22 | 5.211 | .000 |

**Table 1(4).Vertical jump difference for Group C**

| | Vertical Jump Pretest value Mean±SD | Vertical Jump Posttest value Mean±SD | t-test | |
|---|---|---|---|---|
| | | | t | p |
| Group C | 29.15±7.96 | 35.97±7.17 | 16.845 | .000 |

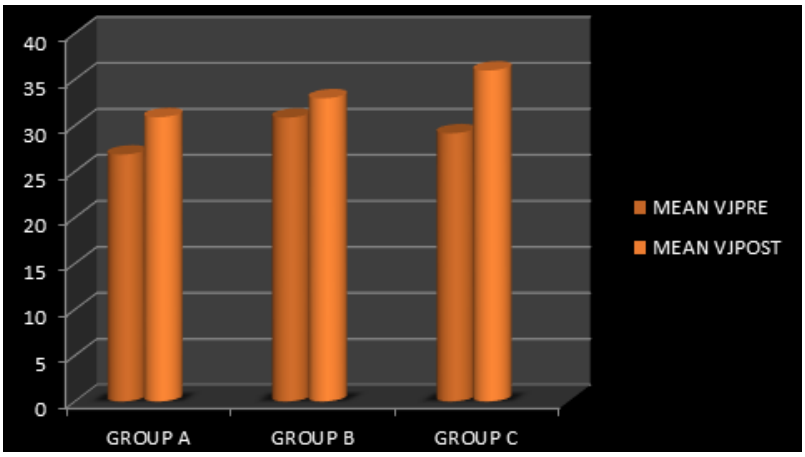


**Figure 1(1).Within Group for Vertical jump Pre test and Post test**

In group C, 'p' value ('p' value .000 and t-value 16.845) for vertical jump pretest and post test comparison which found out the result to be significant.

## Agility t-test

For within group results, Agility t-test was the outcome measures and its effect on each group was studied.

It was seen that the agility t-test pre and agility t-test post (p-value.000 and t=9.423) seen all through in Group A and were seen as significant.

The result when compared by agility t-test pre values and Agility t-test post values in Group B and seen, p-value .000 and t value 6.552 showing the result found was significant.

The result when compared by agility t-test pre values and Agility t-test post values in Group C and seen p-value .000 and t-value 14.524 showing that the result found was significant.

## Between Group Analysis

Since the baseline characters of subjects in three groups were comparable, the outcome variables i.e. vertical jump and agility scores were compared across the three groups using one way ANOVA followed by post hoc, Bonferroni test was used.

Between group analysis shows that 'p' value for difference in Vertical Jump was .000 and f-value=31.65 showing it to be significant. The differences in agility test scores indicate significant results with p-value.000 and f-value 59.96 at 5 % significance level.

The mean±S.D values allow giving the difference with which both the outcomes vary in each group.

Considering Vertical Jump as outcome measure, it was seen that mean±S.D of vertical jump difference is 4.22±1.53, 2.10±1.39 and 6.81±1.40 for Group A, B and C respectively, indicating greatest gain in Group of 6.81±1.40.

When Agility t-test was compared between three groups it was seen that the values of mean±S.D for each, it was seen that mean±S.D of Agility test scores was .95±.34, .54±.21and 2.1±.21 for Group A, B and C respectively, indicating greatest gain in Group C indicating better results and signifying the differences with which improvement has occurred.

With multiple comparisons done using Bonferroni, for difference in Vertical Jump outcome measure, when Group A is compared to Group B, p-value .003 which shows statistically significant difference was seen. When Group B and C are compared. p-value is seen as .000 which was statistically significant. With comparison between Group C and Group A, p-value .000 which was statistically significant differences.

**ISSN: 2581-5822**
**DOI: https://doi.org/10.24321/2581.5822.201902**

**Table 1(5).Difference of Agility t-test in group A**

| | Agility t-test Pretest value Mean±SD | Agility t-test Posttest value Mean±SD | t-test | |
|---|---|---|---|---|
| | | | t | p |
| Group A | 13.51±1.12 | 12.56±0.97 | 9.423 | .000 |

**Table 1(6)Difference of Agility t-test in group B**

| | Agility t-test Pretest value Mean±SD | Agility t-test Posttest value Mean±SD | t-test | |
|---|---|---|---|---|
| | | | T | p |
| Group B | 13.25±1.28 | 12.70±1.24 | 6.552 | .000 |

**Table 1(7).Difference of Agility t-test in group C**

| | Agility t-test Pretest value Mean±SD | Agility t-test Posttest value Mean±SD | t-test | |
|---|---|---|---|---|
| | | | T | p |
| Group C | 13.57±1.03 | 11.38±0.77 | 14.524 | .000 |

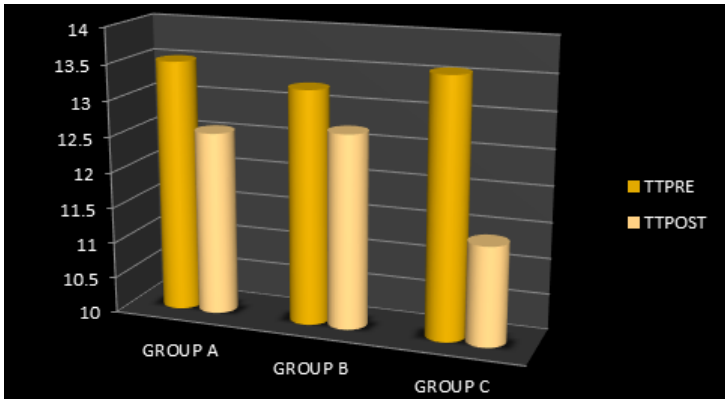


**Figure 1(2).Within group for Agility t-test Pre and Post-test**

**Table 1(8).Between Group comparison of difference of Vertical Jump and Agility t-test**

| | Group A Mean±SD N=12 | Group B Mean±SD N=12 | Group C Mean±SD N=12 | ANOVA | | Post hoc analysis (LSD) | | |
|---|---|---|---|---|---|---|---|---|
| | | | | F | 'p' | A v/s B 'p' | A v/s C 'p' | B v/s C 'p' |
| Vertical Jump Diff | 4.22±1.53 | 2.10±1.39 | 6.81±1.40 | 31.65 | .000 | .003 | .000 | .000 |
| Agility t-test Diff | .95±0.34 | .54±0.21 | 2.1±0.52 | 59.96 | .000 | .046 | .000 | .000 |

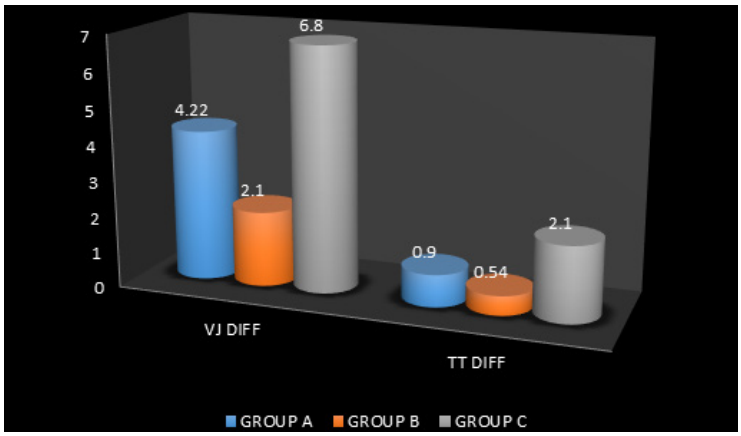


**Figure 1(3).Between groups of both the outcome measures**

ISSN: 2581-5822
DOI: https://doi.org/10.24321/2581.5822.201902

Considering the difference in Agility t-test scores, comparison between Group A and Group B shows p value .046 and with comparison between Group B and C, p-value .000 and on comparing Group C and Group A shows 'p' value to be .000 showing the good significance level.

The Independent t-test was used to state difference for male and female and found equivocal showing insignificant effects in Group A and B. But in Group C which showed statistical significant variation for Agility t-test scores as 'p' value of .003

## Results

The result to the study was that after the six weeks of intervention, all the three groups i.e. combination (plyometric and mental imagery) group C, mental imagery training (group B) and plyometric training (group A) has yielded significant improvements on the outcome measures. It was also seen that the combination of plyometric training and mental imagery training has provided with superior results than the intervention of plyometrics and mental imagery training alone. Considering Vertical Jump as outcome measure, it was seen that mean±S.D of vertical jump difference is 4.22±1.53, 2.10±1.39 and 6.81±1.40 for Group A, B and C respectively, indicating greatest gain in group C of 6.81±1.40.When Agility T test was compared between three groups it was seen that the values of mean±S.D for each, it was seen that mean±S.D of Agility test scores was 0.95±0.34,0.54±0.21 and 2.1±0.21forGroupA,B and C respectively, indicating greatest gain in group C indicating better results and signifying the differences with which improvement has occurred.

## Discussion

### Within Group analysis

The analysis for within Group comparison has yielded the results showing each Group has significantly improved on both the outcome measures.

### Effects of Plyometrics on Vertical jump

The enhanced vertical jump with plyometrics was also in agreement with study by Matavulj[14] and Brown.[7] It was found that increase was associated with an increase in both maximum voluntary force of hip extensors and rate of force development in knee extensors. It supported the findings on improvement with concerning the elastic loading of muscle.[7]

### Effectiveness of Mental imagery

It was seen that Group B intervention of mental imagery has significantly improved both the outcome measures but its effectiveness is less in comparison to other two groups. A well supported study by Olsson et al[11] found that intervention of mental imagery showed 50 % greater gain than in the control Group suggesting that internal imagery training program helped to improve the bar clearance component of high jump.

### Between group analysis

Our main result was obtained by contrasting effects of intervention used for three different groups and it was seen that combination (Group C) gives superior results than plyometric (Group A) and imagery (Group B) alone. It was seen that the values for mean for 1 st outcome measure vertical jump was 6.8 cm in Group c and 4.2cm and 2.1 cm in Group a and Group c respectively. On the timings for agility test, Group C outperformed (2.1 sec) by 0.9 sec and 0.5 sec in Group a and b respectively.

The timings for T test for agility measures was improved significantly in Group C (2.1 secs) which underwent combination training and 0.9 sec s in Group A which underwent plyometric training and 0.5 secs in Group B with mental imagery intervention.

The Group C being better than the other two groups could be explained on the basis of the additive effects of plyometric training and imagery training leading to enhanced effects when used together.

### Group C effectiveness

#### Coupled effects with combination

Combined training significantly improved performance in agility test and vertical jump as compared to plyometrics and imagery alone ('p' value=.000 for difference Vertical Jump and 'p' value=.000 for difference Agility t-test at p=5 % significance)

#### Limitations of the study

Lack of funds and infrastructure, many resources like measuring heart rate along cannot be utilized in the study.

Larger sample would have brought more clarity to the research.

Due to lack of research assistant, blinding in observations trends was not possible.

## Conclusion

It was concluded through the study that combination of mental imagery training along with plyometrics yields better and added effects on vertical jump and agility than plyometrics and mental imagery training alone.

## Acknowledgment

My parents, my grandmother, my sister and my husband have always been there as support system for me, also constant motivation from my friends have indeed been the great factor.

**Conflict of Interest:** None

**ISSN: 2581-5822**
**DOI: https://doi.org/10.24321/2581.5822.201902**

## References

1. Christakou A, Zervas Y. The effectiveness of imagery on pain, edema, and range of motion in athletes with a grade II ankle sprain. *Physical Therapy in Sport* 2007; 8(3): 130-140.
2. White A, HardyL. Use of different imagery perspectives on learning and performance of different motor skills. *British Journal of Psychology* 1995; 86(Pt 2): 169-180.
3. Butler A J, Page SJ. Mental Practice With Motor Imagery: Evidence for Motor Recovery and Cortical Reorganization After Stroke. *Arch Phys Med Rehabil* 2006; 87(12 Suppl 2): S2-11.
4. Baechle, T.R. Essentials of Strength and Conditioning: Strength Cond. Assoc. Champaign, IL: Human Kinetics. 1994.
5. Bartholomew S.A. Plyometrics and vertical jump training. Unpublished master's thesis, university of North Carolina at Chapel Hill 1985.
6. Bosco C, Komi PV, Ito A. Prestretch potentiation of human skeletal muscle during ballistic movement. *Acta Physiol Scnnd* 1981; 111(2): 135- 140.
7. Brown ME, Mayhew JL, Boleach, LW. Effects of plyometric training on vertical jump performance in high school basketball players. *Journal of Sports Medicine and Physical Fitness* 1986; 26(1): 1-4.
8. Olsson CJ, Jonsson B, Larsson Anne et al. Motor Representations and Practice Affect Brain Systems underlying Imagery: An fMRI Study of Internal Imagery in Novices and Active High Jumpers. *The Open Neuroimaging Journal* 2008, 2: 5-13.
9. Callow N, Hardy L. Types of imagery associated with sport confidence in netball players of varying skill levels. *Journal of Applied Sport Psychology* 2001; 13(1): 1-17.
10. Sanders CW, Sadoski M. Comparing the effects of physical practice and mental imagery rehearsal on learning basic surgical skills by medical students. *American Journal of Obstetrics and Gynecology* 2004; 191(5): 1811-4.
11. Olsson CJ, Jonsson B, Nyberg L. Internal imagery training in active high jumpers. *Scandivian journal of psychology* 2008; 49(2): 133-140.
12. Crosbie JH, McDonough S M, Gilmore DH et al. The adjunctive role of mental practice in the rehabilitation of the upper limb after hemiplegic stroke: A pilot study. *Clinical Rehabilitation* 2004; 18(1): 60-68.
13. Cumming J, Hall C. Athletes' use of imagery in the off-season. *The Sport Psychologist* 2002; 16: 160-172.
14. Matavulj D, Kukolj M, Ugarkovic D et al. Effects of plyometic training on jumping performance in junior basketball players. *J Sports Med Phys Fitness* 2001; 41(2): 159-64.
15. Smith D, Holmes P. The effect of mental imagery modality on golf putting performance. *Journal of Sport and Exercise Psychology* 2004; 26(3): 385-395.
16. Chaiwanichsiri D, Tangkaewfa S. Janchai S et al. Effects of Imagery-Weight Exercise. *J Med Assoc Thai* 2006; 89(8): 1260-4.
17. Golomer E, Bouillette A, Mertz C et al. Effects of Mental Imagery Styles on Shoulder and Hip Rotations During Preparation of Pirouettes. *Journal of Motor Behavior* 2008; 40(4): 281-290.
18. Fansler CL, Poff CL, Shepard KF. Effects of mental practice on balance in elderly women. *Phys Ther* 1985; 65(9): 1332-8.
19. Feltz DL, Landers DM. The effects of mental practice on motor skill learning and performance: a meta-analysis. *Journal of Sport Psychology* 1983; 5: 25-57.
20. Markovic G. Does plyometric training improve vertical jump height? A meta-analytical review. *British Journal of Sports Medicine* 2007; 41(6): 349-355.
21. Decety J. The neurophysiological basis of motor imagery. *Behavioural Brain Research* 1996; 77(1-2): 45-52.
22. Jeannerod M. Mental imagery in the motor context. *Neuropsychologia* 1995; 33(11): 1419–1432.
23. Williams JG, Odley JL, Callaghan M. Motor Imagery boosts Proprioceptive Neuromuscular Facilitation in the attainment and retention of range-of-motion at the hip joint. *Journal of Sports Science and Medicine* 2004; 3(3): 160-166.
24. Shaji J, Isha S. Comparative Analysis of Plyometric Training Program and Dynamic Stretching on Vertical Jump and Agility in Male Collegiate Basketball Player. *Al Ameen J Med Sci* 2009; 2(1): 36-46.
25. Johnson BL, Nelson JK. Practical measurements for evaluation in physical education (2nd ed.). Minneapolis, MN: Burgess. 1974.
26. Jones L 6a: Uses of mental imagery in athlete App Rev Pshych 1997, 6, 101.
27. Kubo K, Morimoto M, Komuro T et al. Effects of Plyometric and Weight Training on Muscle-Tendon Complex and Jump Performance. *Med Sci Sports Exerc* 2007; 39(10): 1801-1810.
28. Lang PJ. A bio-informational theory of emotional imagery. *Psychophysiology* 1979; 16(6): 495-512.
29. Jones L, Stuth G. The uses of mental imagery in athletics: an overview. *Applied & Preventive Psychology* 1997; 6(2): 101-115.
30. Wang LI. The kinetics and stiffness characteristics of the lower extremity in older adults during vertical jumping. *Journal of Sports Science and Medicine* 2008; 7(3): 379-386.
31. Vargas LFA. Evaluation of Four Vertical Jump Tests: Methodology, Reliability, Validity, and Accuracy. *Measurement in physical education and exercise science* 2000; 4(4): 215-228.

**ISSN: 2581-5822**
**DOI: https://doi.org/10.24321/2581.5822.201902**

32. Behncke L. Mental Skills Training For Sports: 12 A Brief Review. *Athletic insight March* 2004; 6(1): 1-19.
33. Evans L, Hare R, Mullen R. Imagery Use During Rehabilitation from Injury. *Journal of Imagery Research in Sport and Physical Activity* 2006; 1(1): 1932-0191.
34. Maarten F. Robbert why countermovment jump height is greater than squat jump height?. *Med Sci Sports Exerc* 1996; 28(11): 1402-1412.
35. Louis M. Effect of Imagined Movement Speed on Subsequent Motor Performance. *Journal of Motor Behavior* 2008; 40(2): 117-132.
36. Markovic G, Jukic I, Milanovic D et al. Effects of sprint and plyometric training on muscle function and athletic performance. *J Strength Cond Res* 2007; 21: 543-9.
37. Farah MJ. The neural bases of mental imagery. *Trends Neurosci* 1989; 12(10): 395-9.
38. Martin KA, Moritz SE, Hall C. Imagery Use in Sport: a literature review and applied model. *The Sport Psychologist* 1999; 15(3): 245-268.
39. Gregg M, Hall C, Butler A. The MIQ-RS: A suitable option for examining movement imagery ability. *Evid Based Complement Alternat Med* 2010; 7(2): 249-257.
40. Miller MG, Cheatham CC, Porter AR et al. Chest- and Waist-Deep Aquatic Plyometric Training and Average Force, Power, and Vertical-Jump Performance. *International Journal of Aquatic Research and Education* 2007; 1: 145-155.
41. Miller MG, Herniman JJ, Richard MD. The effect of a 6 week plyometric training program on agility. *Journal of Sports science and Medicine* 2006; 5: 459-465.
42. Morris T, Spittle M, Watt AP. Imagery in Sport. Champaign, IL: Human Kinetics. 2005.
43. Murphy KR, Davidshofer CO. Psychological testing: Principles and applications. 3rd ed. Englewood Cliffs, NJ: Prentice Hall 63, 1994.
44. Page SJ, Levine P, Sisto S et al. Mental practice combined with physical practice for upper limb motor deficit in subacute stroke. *Phys Ther* 2001; 81: 1455-62.
45. Pauole K, Madole K, Lacourse M. Reliability and validity of the T-test as a measure of agility, leg power and leg speed in college aged men and women. J*ournal of Strength and Conditioning Research* 2000; 14: 443-450.
46. Jackson PL, Doyon J, Richards CL et al. The Efficacy of Combined Physical and Mental Practice in the Learning of a Foot-Sequence Task after a stroke: a case report. *Neurorehabilitation and Neural Repair* 2004; 18(2); 1114-1123.
47. Potteiger JA, Lockwood RH, Haub MD et al. Muscle power and fiber characteristic following 8 weeks of plyometric training. *Journal of Strength and Conditioning Research* 1999; 13: 275-279.
48. Ramsey R, Cumming J, Edwards MG. Exploring a Modified Conceptualization of Imagery Direction and Golf Putting Performance. *IJSEP* 2008; 6: 207-223.
49. Richardson A. Mental Practice: A Review and Discussion (Part II). *RES Q* 1967; 38(2): 263-73.
50. Roland PE, Larsen B, Lassen et al. Supplementary Motor area and other cortical areas in organization of voluntary movements in man. *J Neurophysiol* 1980; 43(1): 118- 136.
51. Tamir R, Dickstein R, Huberman M. Integration of Motor Imagery and Physical Practice in Group Treatment Applied to Subjects With parkinsons disease. *Neurorehabil Neural Repair* 2007; 21(1); 68-75.
52. Salmon J, Hall C, Haslam I. The use of imagery by soccer players. *Journal of Applied Sport Psychology* 1994; 6(1): 116-133.
53. Braun SM, Beurskens AJ, Borm PJ et al. The Effects of Mental Practice in Stroke Rehabilitation: A Systematic Review. *Arch Phys Med Rehabil* 2006; 87(6): 842-52.
54. Toumi H, Thiery C, Maitre S et al. Training Effects of Amortization Phase With Eccentric/Concentric Variations in the Vertical Jump. *Int J Sports Med* 2001; 22(8): 605-610.
55. Vaeley RS. Current status and prominent issues in sport psychology interventions. *Medicine and science in sports and exercise* 1994; 26: 495-502.
56. Vandell RA, Davis RA, Herbert A et al. The function of mental practice in acquisition of motor skills. *Journal of General Psychology* 2012; 29: 243-250.
57. Vealey RS, Greenleaf CA. Seeing is believing: understanding and using imagery in sport. in j.m. williams (ed) Applied Sport Psychology: personal growth to peak performance. 5th edition. boston: mcgraw hill. 2006; 306-348.
58. Voigt M, Simonsen EB, Dyhre-Poulsen P et al. Mechanical and muscular factors influencing the performance in maximal vertical jumping after different prestretch loads. *Journal of Biomechanics* 1995; 28(3): 293-307.
59. Wagner D, Kocak M. A multivariate approach to assessing anaerobic power following a plyometric training program. *The Journal of Strength and Conditioning Research* 1997; 11(4): 251-255.
60. Warner L, McNeill ME. Mental imagery and its potential for physical therapy. *Phys Ther* 1988; 68(4): 516-521.
61. Yaguez L, Nagel D, Hoffman H et al. A mental route to motor learning: improving trajectoral kinematics through imagery training. *Behav Brain Res* 1998; 90(1): 95-106.
62. Yue G, Cole KJ. Strength Increases From the Motor Program: Comparison of Training With Maximal Voluntary and Imagined Muscle Contractions. *Journal of Neurophysiology* 1992; 67(5): 1114-23.
63. Ramsay R, Cumming J, Edwards MG. Mental imagery inflates performance expectations but not actual performance on novel task. *Imagination Cognition*

**ISSN: 2581-5822**
**DOI: https://doi.org/10.24321/2581.5822.201902**

*and Personality* 2008; 28(4): 331.

64. Hewett TE, Stroupe AL, Nance TA et al. Plyometric training in female athletes. Decreased impact forces and increased hamstring torques. *Am J Sports Med* 1996; 24(6):765-73.
65. Herrero JA, Izquierdo M, Maffiuletti NA et al. Electromyostimulation and plyometric training effects on jumping and sprint time. *Int J Sports Med* 2006; 27(7): 533-539
66. Ehrsson HH, Geyer S, Naito E. Imagery of voluntary movements of fingers, toes and tongue activates corresponding body part specific motor representations. *J Neurophysiol* 2003; 90(5): 3304-3316.
67. Weinberg RS. The Relationship between mental preparation strategies and motor performance: A review and critique. *Quest* 1982; 33(2): 195-213.

**ISSN: 2581-5822**
**DOI: https://doi.org/10.24321/2581.5822.201902**