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Comparison of Multidirectional Plyometric Training and Eccentric Muscle Training on Vertical Jump Performance in Young Soccer Players Using My Jump App

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ABSTRACT

AIM &OBJECTIVE: To Compare the effects of Multidirectional Plyometric Training and Eccentric Muscle Training on Vertical Jump Performance in Young Soccer Players using My Jump App.
METHODOLOGY: An experimental study was conducted on 40 young soccer players in age group of 18-25 years according to inclusion and exclusion criteria divided into two groups randomly doing Multidirectional Plyometric Training and Eccentric Muscle Training respectively. Both groups received training for 8 weeks and the effect of the said protocols on vertical jump height was analysed using my jump app.
RESULT: Significant difference was found in pre and post intervention values for Vertical Jump Height in both groups ($p<0.0001$) by using Paired T test. Also, Significant difference was observed in between groups ($p=0.02$) by using unpaired T test. Significant changes were observed in Multidirectional Plyometric Group as compared to Eccentric training group. Therefore, it can be stated that Multidirectional Plyometric Training helps to improve Vertical Jump Performance better than Eccentric Muscle Training protocol in young Soccer Players.
CONCLUSION: Multidirectional Plyometric Training Program is more effective protocol than eccentric training protocol to improve vertical jump height in young soccer players and should be incorporated in their training sessions.

Keywords: Multidirectional Plyometric, Eccentric Muscle Training, My Jump App.

INTRODUCTION

Soccer is a sport characterized by intermittent periods of activity, where a player's ability to execute actions such as sprinting, jumping, kicking, and changing direction significantly impacts their performance during a match. [(1)] The literature concludes that the total distance covered during a soccer match was 6311 ± 948 m, with 12% of this distance being attributed to high-intensity activities. [(2)] The players spent 9% of the total time played (3789 ± 109 s) engaging in high-intensity activity, which was comparable to the duration spent standing still (11%). [(3)]

Soccer involves many movements that require high-velocity concentric and eccentric muscular contractions, including those that involve the muscular stretch-shortening cycle (SSC). As such, plyometric

training (PT) is recognized as an effective way to help soccer players meet the demands of the game. PT has been shown to enhance neuromuscular control in soccer players by promoting anticipatory postural adjustments. [4] During PT, balance and stability challenges can create proactive and/or feed-forward adjustments in soccer players, which enables them to make appropriate muscle contractions prior to contact with the pitch or landing. This results in improved neuromuscular control and better ability to meet the demands of the game. [5,6]

PT can be performed using vertical or horizontal exercises, or a combination of both. However, it is worth noting that the stretch-shortening cycle (SSC) plays a lesser role in horizontal jumping performance compared to vertical jumping performance. This is because a vertical loading of the musculo-tendinous unit accumulates more elastic energy during the eccentric phase of the movement, which enhances the SSC and ultimately results in greater performance. [7]

It is reasonable to expect that MPT may result in favorable adaptations since improvements in lower-extremity muscle power have been associated with improvements in postural performance. This is because there is a relationship between the rapid torque produced by the leg extensor muscles and postural performance in young individuals. [8]

Soccer is a multidirectional sport, meaning that physical preparation for soccer must account for the various directional movements that are required during a match. It is essential for soccer players to undergo comprehensive physical training that addresses the multidirectional nature of the sport. [9] Research in badminton has demonstrated that resistance and multidirectional PT can improve the specific physical qualities required in this multidirectional sport. Similarly, since soccer is also a multidirectional sport, it is reasonable to hypothesize that optimal physical preparation for soccer players should also incorporate multidirectional exercises. [10] Athletic Training also involves strength and conditioning, In a meta-analysis that compared the efficacy of various exercise modalities in inducing muscular adaptations, it was found that high-intensity eccentric training resulted in greater muscular adaptations compared to concentric training. [11] The peak force generated during eccentric muscle actions is significantly higher compared to that produced during concentric muscle contractions. [12,13] The higher forces generated during eccentric contractions are attributed to specific activation strategies employed by the nervous system. [14] Several longitudinal studies have provided evidence that eccentric cycling can effectively enhance lower-body strength [15,16] and expression of power. [17,18]

This study incorporates Eccentric Training for Hamstring and Gastrosoleus to study their effectiveness on vertical jump height. The Nordic hamstring exercise is a method of hamstring training that is known to effectively increase eccentric strength. Research has shown that this exercise can increase eccentric hamstring strength more effectively than traditional hamstring curls. However, the impact of this training method on hamstring position of peak torque and dynamic performance is currently unknown. [19] Gastrosoleus Training on stairs proved as an effective measure to improve Eccentric strength was incorporated to athletes. [20]

My Jump app has been published on Apple and android play store which helps in calculation of vertical jump height. This app helps in practical and affordable easy calculation of vertical jump height. [21,22] The validity of the above said act has been demonstrated in young creation athletes. [22,23] Analysis for valiant reliability of my jump app found r=0.980 which is significant. [24] This study uses the same app to calculate vertical jump height, post above exercise protocols.

MATERIALS & METHODS

All the subjects signed a consent form before beginning the assessment.

STUDY DESIGN - Experimental Study

STUDY SETTING - IAMR

SAMPLE SIZE - 40
SAMPLING METHOD - Simple Random Sampling
TARGET POPULATION - Young Elite Athletes.

INCLUSION CRITERIA -

1. Both Males and Female athletes with the age group of 18 to 25 years.
2. Athletes who have completed at least 1 full year of competitive athletics.
3. Subjects with good flexibility and strength of lower limbs.
4. Subjects who have been involved in any professional active outdoor sporting activities involving running, jumping and speed movements.

EXCLUSION CRITERIA -

1. Lower limb and Spine fractures and deformities.
2. Tightness and contractures of muscles and tendons of lower limbs.
3. Any intrinsic complains by the athlete that limits the athletic performance.

PHONE APPLICATION USED -
My Jump App
The subjects were randomly allotted to two groups namely Multidirectional Plyometric Training and Eccentric Training. Participants were not paid for the study. Institutional Ethical clearance was obtained for the same.

PROCEDURE FOR WARM UP [25]

Serial No.	Warm Up Exercise	Duration	Sessions
1	Standing Hip Rotations	45 Seconds 4 times I week	32 sessions
2	Standing Hip Flexion Extension	45 Seconds 4 times I week	32 sessions
3	Standing Hip Abduction Adduction	45 Seconds 4 times I week	32 sessions
4	Standing Trunk Rotations	45 Seconds 4 times I week	32 sessions
5	Standing Knee Rotations	45 Seconds 4 times I week	32 sessions
6	Standing Ankle Rotations	45 Seconds 4 times I week	32 sessions
Total		5.5 Minutes	32 sessions
Rest Period 30 Seconds)			

PROCEDURE FOR MULTIDIMENSIONAL PLYOMETRIC GROUP (7 Days / Week X 8 Weeks) [26]

Week	Exercises	Directions	Sets x repetitions per-session	Foot contacts per-session
1	Alternating jumps (right-left leg) forward throughout Hoops	V-A	3 x 6	54
	Alternating jumps lateral (right-leftleg) throughout Hoops	V-L	3 x 6	
	Jumps with feet together and then separated throughout Hoops	V-A-L	3 x 6	

2	Alternating jumps (right-left leg) forward throughout Hoops	V-A	4 x 6	72
	Alternating jumps lateral (right-leftleg) throughout Hoops	V-L	4 x 6	
	Jumps with feet together and then separated throughout Hoops	V-A-L	4 x 6	
3	Jumping, feet together throughout Hoops	V-A	4 x 8	96
	Alternating jumps lateral (right-left leg) throughout Hoops	V-L	4 x 8	
	Jumps with feet together and then separated throughout Hoops	V-A-L	4 x 8	
4	Jumping, feet together throughout Hoops	V-A	4 x 8	104
5	Alternating jumps lateral (right-left leg) throughout Hoops	V-L	4 x 9	112
	Jumps with feet together and then separated in Hoops	V-A-L	4 x 9	
	Jumps forward between barriers (30 cm)	V-A	4 x 10	
	Lateral Jumps over a bench (20 cm)	V-L	4 x 9	
6	Jumps with feet together and then separated throughout Hoops	V-A-L	4 x 9	116
	Jumps forward between barriers (30 cm)	V-H	4 x 10	
	Lateral Jumps over a bench (20 cm)	V-L	4 x 10	
7	Jumps with feet together and then separated throughout Hoops	V-A-L	4 x 9	120
	Jumps forward between barriers (30 cm)	V-H	4 x 12	
	Lateral Jumps over a bench (20 cm)	V-L	4 x 9	
	Jumps with feet together and then separated throughout Hoops	V-A-L	4 x 9	
8	Jumps forward between barriers (30 cm)	V-A	4 x 12	124
	Lateral Jumps over a bench (20 cm)	V-L	4 x 10	
	Jumps with feet together and then separated throughout Hoops	V-A-L	4 x 9	

- Eccentric Training for calf will be performed as per the given protocol. For the progression of weight, the athlete was instructed to to use a rucksack with 5 kg of books.

ECCENTRIC TRAINING PROTOCOL FOR CALF (7 DAYS / WEEK X 8 WEEKS) [27]

Week	Exercise	Reps	Sets	Frequency
1	Single Heel drops (Slow Pace)	15	3	7 Days/Week
2	Single Heel drops (Fast Pace)	15	3	7 Days/Week
3	Single Heel drops (Fast Pace)	15	3	7 Days/Week
4	Single Heel drops with weight (Slow Pace)	15	3	7 Days/Week
5	Single Heel drops with weight (Slow Pace)	15	3	7 Days/Week
6	Single Heel drops with weight (Slow Pace)	15	3	7 Days/Week
7	Single Heel drops with weight (Fast Pace)	15	3	7 Days/Week
8	Single Heel drops with weight (Fast Pace)	15	3	7 Days/Week

ECCENTRIC TRAINING PROTOCOL FOR HAMSTRING (7 DAYS / WEEK X 8 WEEKS) [28]

Week	Session Per Week	Reps	Sets	Technical Notes
1	1	5	2	The subject is encouraged to resist falling as long as possible
2	1	5	2	The subject is encouraged to resist falling as long as possible
3	2	6	2	Subject Tries to reduce lowering Speed
4	2	6	2	Subject Tries to reduce lowering Speed

5	3	6	3	Subjects can resist falling even longer, and for an increased number of repetitions
6	3	6	3	Subjects can resist falling even longer, and for an increased number of repetitions
7	3	8	3	Load on the subject increases by allowing more speed in the start phase, as well as another gradual increase in repetitions
8	3	8	3	Load on the subject increases by allowing more speed in the start phase, as well as another gradual increase in repetitions

RESEARXH PROCEDURE [25,26,27,28]

After a successful participant selection process and complete randomisation of samples, subjects were allotted to Plyometric and Eccentric Training group. Jump height assessment was done using My Jump app.

After a warmup protocol, Group specific exercise protocol was performed for 8 weeks. Post exercise measurement of Jump height was done after which Statistical analysis of the data was done.

STATISTICAL ANALYSIS & RESULTS

The entire data of the study was entered in MS Excel 2007 before it was statistically analyzed in "GraphPad Instat version 3.05" which revealed the p-value for Inter-group pre and post Vertical Jump Test using My Jump App was found to be 0.02, significant using the Unpaired T test. Normality was assessed using the one-sample Kolmogorov-Smirnov test.

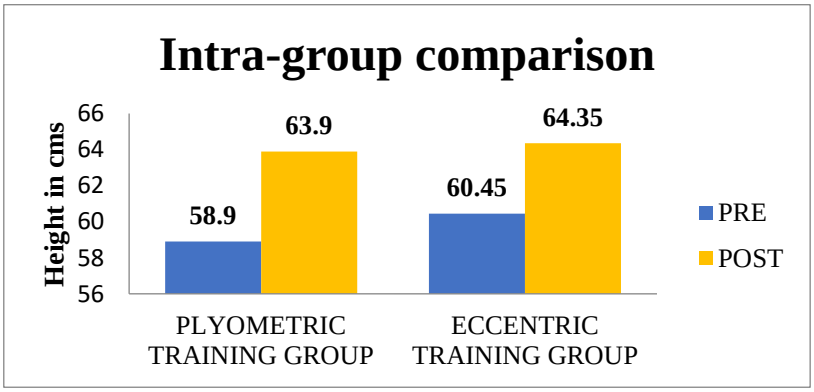
The gender wise distribution of the subjects showed 10 Females (50%), 10 Males (50%) in Plyometric Group, 12 Females (60%) 8 Males (40%) from total 40 subjects.

Table 1: Multidirectional Plyometric Exercise Program (Intra-Group Comparison)

	MEAN	SD	TEST USED	P-VALUE	SIGNIFICANCE
PRE	58.9	6.6	PAIRED T TEST	<0.0001	SIGNIFICANT
POST	63.9	6.9			

Table 2: Eccentric Training Exercise Program (Intra-Group Comparison)

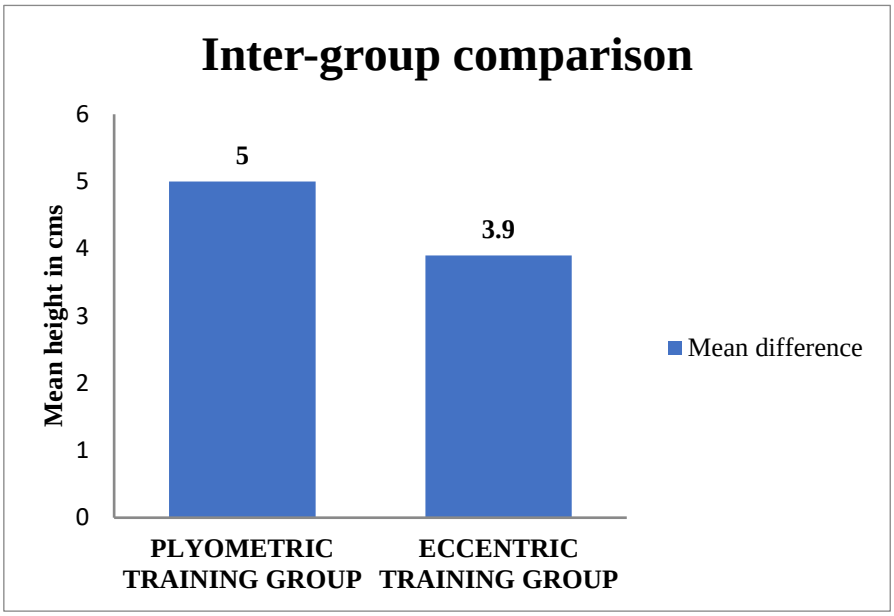
	MEAN	SD	TEST USED	P-VALUE	SIGNIFICANCE
PRE	60.4	5.8	PAIRED T TEST	<0.0001	SIGNIFICANT
POST	64.3	5.7			



Graph 1: Plyometric Training & Eccentric Training Exercise Program Vertical Jump Test using My Jump App (Intra-Group Comparison)

Table 3: Plyometric Training & Eccentric Training Exercise Program Vertical Jump Test using My Jump App (Inter-Group Comparison)

	Plyometric Training Group	Eccentric Training Group	Test Used	P-Value	Significance
	Mean ± SD	Mean ± SD	UNPAIRED T TEST	=0.02	Significant
NPRS	5±1.414	3.9±1.518			



Graph 2: Plyometric Training & Eccentric Training Exercise Program Vertical Jump Test using My Jump App (Inter-Group Comparison)

DISCUSSION

Current study compared the effects of Multidimensional Plyometric training with eccentric muscle training of hamstring and calf to analyse their effects on Vertical Jump Height. After a successful analysis of vertical jump height by using my jump app, multidimensional plyometric training showed better result as compared to its counterpart.

To start with, the Eccentric Muscle Training has been found to improve the muscle strength better than the concentric exercises (11,12,13) Exercises we used in the current study were targeted towards hamstring and calf muscles specifically. Athletes developed better strengths in these muscle groups. Eccentric working of these flexor muscle groups mainly helps in offloading of joints, whereas the plyometric training helps in training extensors mainly involved in pushing phase of the jump as explained below.

Plyometric Training found to improve the stretch-shortening cycle of musculotendinous units. This is attributed to muscle-tendon behaviour of the agonists, increment in muscle tendon stiffness. It was also found that PT helps in decreasing the antagonistic neuro-muscular activity mainly in the breaking phase of the plyometric cycle. (29,30) MTP has been found to increase strength and power of the lower extremity extensor group of muscles. (31) Also, a significantly better activation of motor unit with a better coordination of the antagonist and agonist muscles. (32) Vertical Jump height is already correlated with a significant increase in the overall lower limb strength and/or power in young soccer players. (33)

These mechanisms are found to increase the vertical jump height better than the eccentric muscle training protocol which just increased the strength not working much at the musculotendinous junction level.

CLINICAL & FUTURE IMPLICATIONS

The findings of the current study have an array of applications in the current sports and clinical scenario. This gives a pathway to train athletes which require improvements in vertical jump height that improves the athletic performance in sports demanding them to jump to play shots. Rather than making a complex plan comprising of different strengthening protocols, MTP is a

better option for training specifically for improvements in jump height.

CONCLUSION

Multidirectional Plyometric Training Program is a better protocol than eccentric training protocol to improve vertical jump height in young soccer players and should be incorporated in their training sessions.

Declaration by Authors

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Conflict of Interest: The authors declare no conflict of interest.

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