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Intervention of Plyometric Training in Varied Motor Fitness

Chandrachooda M.[1*], Subraya Prabhu S.[1] and K. Sekarbabu[2]
[1]Assistant Professor, Department of Physical Education,
Veterinary College, KVAFSU, Hebbal, Bengaluru (Karnataka), India.
[2]Associate Professor, Department of Physical Education,
Annamalai University, Annanagar, Chennai (Tamil Nadu), India.

(Corresponding author: Chandrachooda M.)*
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ABSTRACT: The present study was conducted to explore the effect of plyometric training on motor fitness. The male students categorized as novice and trained players (n=25 in each group of age 18-25 years) studying in various colleges of Bengaluru, Karnataka, India during the academic year 2018-2019 were subjected to plyometric training of various types in three alternative sessions per week of one hour per day for 12 weeks at the sports ground of Veterinary College, KVAFSU, Hebbal, Bengaluru-24 from July starting to September end of 2018 and the motor fitness components like speed, explosive power, muscular strength, flexibility, balance, coordination and reaction time were assessed as per standard field tests before and after the training. Novice players showed increase in speed, explosive power, muscle strength, flexibility, balance, coordination and reaction time by 6, 17, 11, 46, 9, 20 and 12 per cent, respectively. While in case of trained players 5, 12, 7, 25, 8, 14 and 8 percent raise were noticed in motor fitness with respect to speed, explosive power, muscle strength, flexibility, balance, coordination and reaction time, respectively. On an average, novice players exhibited 17 per cent improvement in their performance whereas 11 per cent was exhibited by trained players as previously also they had received continuous training for one hour per day. The present study stated that plyometric training is needed for athletes or group sports persons but challenge lies in the type of training for the given sports activity, period of training and measurement of motor fitness. On the whole, the plyometric training provided for both the groups' novice and trained players significantly contributed to enhancement of motor fitness, thus improving their sports activities.

Keywords: Plyometric, Novice, Explosive power, Flexibility, Performance.

INTRODUCTION

Sport is a physical activity to express the physical fitness and mental wellbeing, forming social relationships and also to participate in competition. It is dependent on numerous motor skills, like power, speed and agility that affects the performance and involves a stretch-shortening cycle (Clark *et al.,* 2016; Garcia-Gil *et al.,* 2018). A type of exercise training with speed and force of different movements to build muscle power is termed as plyometrics. Plyometric training thus helps in improving physical performance and ability to do different activities. The exercises such as sit ups, double leg lowering and push-ups performed on a plyometric training increase the level of muscular activity of the abdominals and obliques more than curl-ups, double leg lowering and push-up performed on a stable surface (Barbado *et al.,* 2015; Roy and Debnath 2023).

A vertical jump, sprint performance and agility tests are commonly used in research to investigate the effects of plyometric training on physical fitness of team sports (Chaouachi *et al*., 2009; Ramirez-Campillo *et al.,* 2014, 2015). However, effective contextual improvement with plyometric training requires knowledge about the intervention. Plyometric training can be recommended as an effective form of physical conditioning for augmenting vertical jump performance; yet, the effects of plyometric training could vary because of a large number of variables, such as training program design, target group (gender, age), training level, type of sports, duration and training intensity (Markovic, 2007; de Villarreal, 2009; Chelly *et al*., 2014). Numerous studies on plyometric training have demonstrated improvements in vertical jump height ranging from 4.7 to 15% that could be attributed to the enhanced coordination and muscle power after training (Gehri *et al*., 1998; Kotzamanidis, 2006). Diallo *et al.* (2001) found that 10 prepubescent soccer players of 12-13 age when given various plyometric exercises like jumping, hurdling and skipping for 3 days/week during 10 weeks increased the athletic performances. Godara (2016) provided plyometric training programme for a period of six weeks with explosive strength, muscular endurance, speed for 25 national level handball players of 14 to 15 years belonging to Kendriya Vidyalaya, Sri Ganganagar, Rajasthan that increased the explosive strength 15.44%, muscular endurance 12.46%, speed 11.13%, agility 1.27% and flexibility 2.15% at the end of the treatment. Ozmen and Aydogmus (2017) showed that a six week plyometric training improved agility and vertical jump in 10 adolescent badminton players (12 years). Polymetric training are useful for improving

performance in different strength and power tests in eleven young female handball players of 17 years (Falch *et al*., 2018). Rangaraj and Rajkumar (2021) gave plyometric training consisting of 45-60 min/day, 3 days in a week till twelve weeks to 15 hockey players of age 18 years of SRMIST, Kattankulathur, Tamilnadu that significantly increased their speed (10.22), muscular endurance (11.17) and flexibility (18.71) exhibiting their better performance.

Anitha *et al.* (2018) found that the plyometric training extended to 24 male volleyball players from various engineering college in Chennai, Tamilnadu for 6 weeks significantly improved the speed, muscular endurance, flexibility, agility, explosive strength, vital capacity and anaerobic capacity. While Shumye and Ephrem (2022) also observed statistically significant differences in power, agility, muscular endurance and balance of female volleyball trainees after 12 weeks of interventions of plyometric training two days a week for forty minutes. Upper and lower limb plyometric training induced distinct neuro-muscular adaptations in the upper and lower body musculature and was considered as an efficient method for enhancing athletes' physical fitness when 523 participants aged 12 to 22 years were included in the analyses by Deng *et al*. (2023) and was in agreement with Kumaravelu and Govindsamy (2018). During the regular basketball training, an additional 7-week plyometric training improved lower extremity strength, balance, agility and jump performance in adolescent female basketball players (17 years old) as per Mezler and Vaczi (2019); Bouteraa *et al*. (2020). Application of plyometric exercises in aqua, grass and parquet surfaces positively improved the vertical jump strength, agility, balance skills, long jump, and anaerobic power performance of 12-15 age-group of 24 male basketball players (Gencer and Buga 2022). Turgut *et al.* (2017) revealed that 12-week plyometric training for 14 female volleyball players resulted in improvements in star excursion balance test scores for legs. Similar trend was noticed by Kristicevic *et al.* (2016); Thakur *et al*. (2016); Mine *et al.* (2020) among volleyball players who received plyometric training.

In the present study, an attempt has been made to explore the intervention of plyometric training in chosen motor fitness of boys involved in group games

MATERIAL AND METHODS

In the present study the participants and their details along with their plyometric training test performance and statistical analysis are mentioned in this section.

About the subjects. The subjects or participants (novice & trained players) of the present study were confined to fifty male students (18-25 age group) studying in various colleges involved in any type of group games in Bangalore, Karnataka, India during the academic year 2018-2019. Of which 25 each from novice (inexperienced or untrained persons) and already trained (received 1 hour training per day continuously) categories were considered. The duration of the study was from July to September for 3 months during the year 2018 and the plyometric training was offered to the subjects at the sports ground of Veterinary College, KVAFSU, Hebbal, Bengaluru with prior permission from the Dean of the college.

About plyometric training. Both novice and trained players performed plyometric training of three alternative sessions of exercises like weight lifting, endurance of 1 hour per day per week for 12 weeks. The motor fitness components chosen as follows: speed, explosive power, muscular strength, flexibility, balance, coordination and reaction time were assessed as per standard field tests (Heyward and Gibson, 2014) prior to and immediately after the training period.

Motor fitness components and tests carried out with unit of measurement

Variables	Test Items	Unit of Measurement
Speed	50 mts dash	Seconds
Explosive Power	Vertical Jump	Centimeters
Muscular Strength	Bent knee sit ups	Numbers
Flexibility	Sit and Reach test	Centimeters
Balance	Stork Stand test	Seconds
Co-ordination	Alternate Hand Wall Toss Test	Number
Reaction Time	Reaction Time Ruler Test	Seconds

Statistical Analysis. All the values obtained in the result of the present study were average of three trials. The data was analysed using R software (R-4.3.1 for Windows) for statistical computing. ANOVA tables were prepared to analyse the data and the critical difference was calculated (P=.05) and used to identify the significant differences that are indicated in the result tables through superscripts. The formula for the critical difference (CD) was

$CD = \sqrt{2} \times MSS\ (E) \times t\alpha$ @ 0.05 level of significance

Where, MSS (E) = Mean Sum of squares of the error; r = number of replications; $t\alpha$ = table t from value at α level of significance.

RESULTS AND DISCUSSION

The participants divided as novice & trained players of 25 male students each in the age group between 18 and 25 years studying in various colleges in Bangalore, Karnataka, India during the academic year 2018-2019 were subjected to plyometric training at Sports ground of Veterinary College, KVAFSU, Hebbal, Bengaluru-24 for three alternative sessions per week for a duration of 12 weeks from July 2018 - September 2018 and the motor fitness components like speed, explosive power, muscular strength, flexibility, balance, coordination and reaction time were assessed as per standard field tests before and after the training. Table 1 presents the data on speed, explosive power, muscle strength and flexibility obtained for novice and trained players and their analysis

Speed Performance. The speed performance before performing plyometric training (pre) was 7.21, 7.82 and; after training (post) was 7.87 and 8.28, for novice and trained players, respectively. The running speed improved in both groups by 6 and 5 percent after training and trained group performed better than novice

group with respect to data values as the continuous trained would have helped them.

Explosive Power. The explosive power performance of novice and trained players before performing plyometric training (pre) was 24.36 and 34.92; after training (post) was 29.36 and 39.92, respectively. Explosive power in novice and trained players increased after the training by 17 and 12 per cent, respectively. The trend remained the same in power performance as observed in speed.

Muscular Strength. The muscular strength performance before performing plyometric training (pre) was 49.64 in novice group and 64.52 in trained group while after training (post) was 55.60 and 69.52, among novice and trained groups, respectively. Muscle strength improved in trained group after training compared to novice group but they also showed better muscle strength by 11 per cent.

Flexibility Performance. The novice and trained players flexibility performance before performing plyometric training (pre) was 4.64 and 7.52 and after training (post) showed improvement of 8.68 and 10.52, respectively. The trained players exhibited more flexibility when compared to novice who also were better after the training by improving the performance to 46 per cent.

Table 2 indicates the mean values obtained for novice and trained players with respect to motor skills such as balance, co-ordination and reaction time and their analysis.

Balance Performance. The novice and trained players balance performance before plyometric training (pre) was 32.68 and 36.88 and after training (post) was 35.68 and 40.12, respectively. Trained players balanced better than the novice group who showed improvement by 9 per cent.

Co-ordination. The novice and trained players co-ordination performance before performing plyometric training (pre) was 19.24 and 23.52; after training (post) was 24.24 and 27.52, respectively. The performance by novice players was 20 percent and trained players accounted for 14 percent, indicating the significance of continuous training for the second group of players.

Reaction Time. The novice and trained players reaction time performance before performing plyometric training (pre) was 0.40 and 0.35; after training (post) was 0.36 and 0.33, respectively. This indicated faster reaction in trained group while novice group was also better by 12 per cent after plyometric training

All the selected motor fitness tests of both the groups' novice and trained players revealed significant increase among groups with respect to the parameters. Novice players showed increase in speed, explosive power, muscle strength, flexibility, balance, coordination and reaction time by 6, 17, 11, 46, 9, 20 and 12 per cent, respectively. On an average novice players exhibited 17 per cent improvement in their performance where as 11 per cent was observed in trained players which may be attributed to the continuous training provided for them. On par with the present study, Kotzamanidis (2006) demonstrated improvements in vertical jump height (ranging from 4.7 to 15% that could be attributed to the enhanced coordination and muscle power after training. Diallo *et al.* (2001) also could bale to find that short-term plyometric training programmes increase athletic performances in prepubescent soccer players. Godara (2016) provided plyometric training programme for a period of six weeks with explosive strength, muscular endurance, speed and agility for 50 national level handball players aged 14 to 15 years old divided as experimental group (n=25) and control group (n=25), belonging to Kendriya Vidyalaya STPS Suratgarh, Sri Ganganagar, Rajasthan that revealed increased the explosive strength of 15.44%, muscular endurance of 12.46%, speed of 11.13% agility of 1.27% and flexibility of 2.15% in experimental group at the end of the treatment. Rangaraj and Rajkumar (2021) also found significant increase in speed (10.22), muscular endurance (11.17) and flexibility (18.71) exhibiting better performance due to plyometric training consisting of 45-60 min/day, 3 days in a week till twelve weeks to hockey players (n=30; age 18 years of SRMIST, Kattankulathur, Tamilnadu, India. Upper and lower limb plyometric training induced distinct neuro-muscular adaptations in the upper and lower body musculature and was considered as an efficient method for enhancing athletes' physical fitness when 523 participants aged 12 to 22 years were included in the analyses by Deng *et al*. (2023) and was in agreement with Kumaravelu and Govindsamy (2018). During the regular basketball training, an additional 7-week plyometric training improved lower extremity strength, balance, agility and jump performance in adolescent female basketball players (17 years old) as per Mezler and Vaczi (2019); Bouteraa *et al*. (2020).

Table 1: Effect of plyometric training on Novice and Trained Groups on Speed, Explosive power, Muscle Strength and Flexibility.

Training period	Type of Group							
	Novice				Trained			
	Variables							
	Speed (sec.)	Explosive Power (cm)	Muscle Strength (no.)	Flexibility (cm)	Speed (sec.)	Explosive Power (cm)	Muscle Strength (no.)	Flexibility (cm)
Pre	7.21[a]	24.36[a]	49.64[a]	4.64[a]	7.87[a]	34.92[a]	64.52[a]	7.52[a]
Post	7.67[b]	29.36[b]	55.60[b]	8.68[b]	8.28[b]	39.92[b]	69.52[b]	10.52[b]
CD (*P*=.05)	**0.35**	**0.93**	**1.11**	**0.61**	**0.40**	**0.87**	**1.03**	**0.49**

Note: All the values are average of 3 trials with n=25 for novice and n=25 for trained Group; CD – Critical difference; Different superscripts in the column indicate significant difference at *P*=.05 level

Table 2: Effect of plyometric training on Novice and Trained Groups on Balance, Coordination and Reaction time.

Training period	Type of Group					
	Novice			Trained		
	Variables					
	Balance (sec.)	Co-ordination (no.)	Reaction time (sec.)	Balance (sec.)	Co-ordination (no.)	Reaction time (sec.)
Pre	32.68[a]	19.24[a]	0.40[a]	36.88[a]	23.52[a]	0.36[a]
Post	35.68[b]	24.24[b]	0.35[b]	40.12[b]	27.52[b]	0.33[b]
CD (*P*=.05)	**0.88**	**0.91**	**0.04**	**0.68**	**0.78**	**0.02**

Note: All the values are average of 3 trials with n=25 for novice and n=25 for trained group; CD – Critical difference; Different superscripts in the column indicate significant difference at *P*=.05 level.

CONCLUSIONS

Motor fitness components like speed, agility, balance, coordination, power, reaction time, are the key to all the type of sports activities especially in the competitive modern world. Motor fitness is referred to as skill-related fitness. The present study indicated the use of plyometric training to improve motor skills that surely enhanced the power of novice and trained players in their sports activities.

FUTURE SCOPE

More motor skills with modern testing methods may be adopted for larger group of players of various sports to improvise the statistical data in plyometric training. Apart from this training periods and age groups may be varied in the study to obtain better result of plyometric training

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Conflict of Interest. None.

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