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EFFECT OF PLYOMETRICS ON STRENGTH OF ANKLE MUSCULATURE AND AGILITY IN FEMALE KHO-KHO PLAYERS

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Abstract: Asian kho-kho federation was established in the year 1987 during third South Asia federation games held at Kolkata, India. This game demands a high level of physical fitness, stamina, strength, speed, technique and self-control. Kho-kho players have to change their direction rapidly & accurately for enhancing the performance. The kho-kho player should be able to pick up speed as quickly as possible & perform the movement rapidly. Plyometrics are training techniques used by players in all type of sports to increase the strength and explosiveness. **OBJECTIVES:** To evaluate pre and post values of strength of ankle dorsi flexor and plantar flexor muscles (peak torque) by using isokinetic analyser. To evaluate pre & post values of agility of the players by using illinois T test. **METHODOLOGY:** The study design is an quasi experimental study in which 30 female kho-kho players were randomly selected (n=30).Players age group was between 18 to 25years.All players received warm up and cool down exercises. Plyometric training for three days in a week for six weeks duration and one session per day. **OUTCOME MEASURES:** Strength of ankle joint musculature and agility. **RESULTS:** After the analysis, the results revealed significant improvement of strength of ankle musculature and agility p(<0.00). **CONCLUSION:** The study showed significant improvement in ankle musculature of strength and agility in kho-kho players.

Keywords: Kho-kho players, plyometric training, agility, strength

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INTRODUCTION

Asian kho- kho federation was established in the year 1987 during third South Asian federation games held at kolkata, India. Kho- kho is a tag sport played by team of 12 players, of which nine enter the field, who being to be touched by members of the opposite team. The game is very interesting and exciting in nature and demands a high level of physical fitness, stamina, strength, speed technique and self control[1]. The physical variables namely speed, endurance, agility, flexibility, dynamic balance, power & reaction time are very important for kho-kho players because the nature of the game requires fast running for escaping from the opponents as well as changing the opponents during running & chasing. Kho-kho players have to change their direction rapidly & accurately for enhancing the performance. The kho-kho player should be able to pick up speed as quickly as possible & perform the movement rapidly[2].Ankle injuries are common in khokho players .ankle sprains which are not treated on time or properly can lead to ankle instability resulting in recurrent ankle sprain.[3] Incidence of injuries in kho-kho players was seen strain (49%), cramps (37%), and contusion (37%)(14%) contusions.

In khokho most injuries occurred in the calf(31%),hamstrings(23%) & quadriceps(18%).These injuries can takes place due to inadequate strength and warm up/cool down ,most commonly affect the ankle musculature [4.]

According to Michael Voight, Plyometrics is defined as quick, powerful movements involving prestretching the muscle and activating the stretch shortening cycle (SSC) to produce a subsequently stronger concentric contraction[5]. Plyometrics are training techniques used by athletes in all type of sports to increase the strength and explosiveness. It consists of rapid stretching of a muscle immediately followed by a concentric or shortening action of the same muscle and connective tissue. The stored elastic energy within the muscle is used to produce more force than can be provided by the concentric action alone. It is used with a strength training program can contribute to improvements in vertical performance ,acceleration ,leg strength, muscle power, increased joint awareness and over all proprioception[6]

Agility is the physical ability which enables an individual to rapidly change body position and direction in precise manner. Agility is reinforcement of motor programe through the neuromuscular conditioning and neural adaptation of muscle spindle, golgi tendon organ and joint proprioceptors by enhancing balance and control of body position during movement, agility should improve.

The isokinetic dynamometry is concerned with the provision of this resistance and measurement .Muscle strength which is the principle factor in the general muscle performance domain has been assessed by using the manual muscle testing. The human capacity to accurately judge the amount of resistance in both absolute and relative terms are poor. Hence

isokinetic analyser is used in this study. Multi joint systems (MJS) provided the feedback necessary and safely load the muscle. Number of clinicians initially emphasized isolated testing and rehabilitation. In recent years an integrated approach to rehabilitation has become the method of choice. Isokinetic device used both isokinetic and isotonic exercise and subjects can perform exercise both concentrically and eccentrically in rehabilitation programme.[5]

This study is done to find the effect of plyometrics on strength of ankle musculature and agility in female kho-kho players.

NEED OF THE STUDY :The game needs skill full execution such as sitting & getting up , giving kho, fast running ,sudden stopping ,pole turning ,dividing ,intermittent sudden burst of speed. These repetitive movements, zigzag running, foot work, dodge, sudden start & stopping, sitting &getting up demands lot of strength of the ankle joint musculature. The players may land up in injuries due to lack of strength. Hence, the main purpose of the study is to evaluate the effect of plyometrics on strength of ankle musculature and agility in female kho-kho players.

AIM OF THE STUDY: To determine the effect of plyometrics on strength of ankle musculature and agility in female kho-kho players**.**

MATERIALS AND METHODOLOGY

MATERIALS: Isokinetic analysers, cones, stop watch, inch tape, whistle and weighing machine.

METHODOLOGY: The data is collected in Sri Padmavathi Degree College and department of Physiotherapy, SVIMS, Tirupati. The study design in quasi experimental study. Simple random sampling is used and the sample size is 30 players. The study duration is 6 weeks, 3days/week – one session/day (duration: 50 min).

INCLUSIVE CRITERIA: Age group 18-25 years, female professional kho-kho players.

EXCLUSIVE CRITERIA: Male Kho-kho players, age less than 18 yrs-greater than 25 years, previous injuries in lower limb, acute sprains in lower limb, fractures in lower limb.

OUTCOME MEASURES: Peak torques of ankle dorsiflexors and plantar flexors and agility.

PROCEDURE: 30 players who met the inclusive criteria were taken up for the study and participated in plyometric training .The procedure has been explained to all the players who are willing to participate in the study and informed consent is taken from all the players. Pre values were taken for strength and agility. Isokinetic analyser is used to analyze the peak torque of ankle dorsiflexors and plantar flexors and agility is measured by using illinois T test.

INTERVENTION

The plyometric training group participated in a six weeks training programme performing a variety of plyometric exercises designed for lower extremity. All 30 subjects participated in experimental group .pre values were taken for strength and agility, strength is measured by using isokinetic analyser for peak torque of ankle dors iflexors and plantar flexors and agility is measured by using illinons T test respectively.

After begin protocol six weeks plyometric training with varied exercises for every 2 weeks during 1st and 2nd week low form of exercises , .3rd and 4th week moderate form of exercise and 5th and 6th complex of exercise.

TRAINING WEEK	PLYOMETRIC EXERCISE	SETS X REPETITIONS	TRAINING INTENSITY
WEEK 1 & 2	Squat jump		Low
	Jump to box	2 x15	Low
	Lateral jump to box		Low
	Double leg hop		Low
WEEK 3 & 4	Split squat jump		Moderate
	Tuck jump	2x15	Moderate
	Lateral box push offs		Moderate
	Bounding		Moderate
	Bounding with rings		Moderate
	Box drill with rings		Moderate
	Lateral hurdle jumps		Moderate
WEEK 5 & 6	Zigzag hops		Complex
	Single leg tuck jump	2x 15	Complex
	Single leg lateral hops		Complex
	Depth jump		Complex

	Lateral jump single jump	Complex
	Double hops	Complex

These six weeks plyometric training programme was developed by using before the protocol 10 min warm up exercises stretching's, jogging, running, free exercise .plyometric exercise has 15 repetitions of each exercise two sets between the sets has 1min rest interval .each exercise has consist of 20sec rest 35 minutes exercises for 3 days one session per week during the training programme, all subject under direct supervision and instruct to perform each exercise. After completed the protocol 5 minutes cool down.

STATISTICAL ANALYSIS

Statistical analysis has been carried out to analyze the significant impact of the protocol used to the players by using IBM SPSS Inc.20.0 version. All 30 athletes completed the entire study protocol as defined by 6 weeks in the training sessions. Statistical tools such as independent sample t-test and paired t-test has been applied to the outcome measures peak torque for ankle dorsiflexors and plantar flexors at 60°/s. Descriptive measures like mean, standard deviation have been reported along with P value .

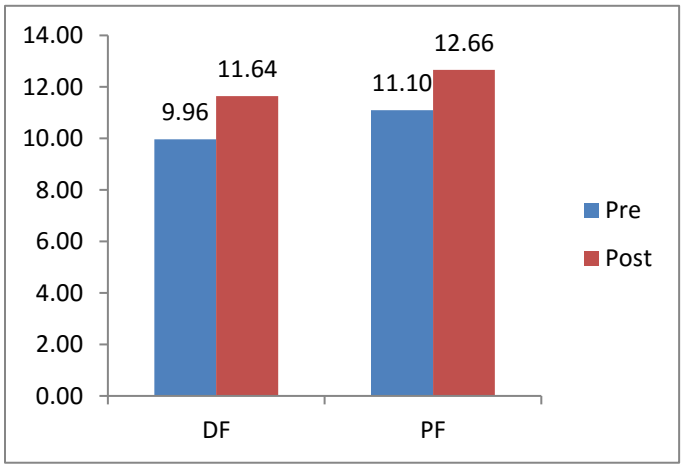
RESULT

Analysis of pre and post mean values of strength of ankle dorsiflexors and plantar flexors at 60°/s for right side

Strength-Right side	N	Mean	SD	t-value	p-value
DF-Pre	30	9.96	1.142	13.016	0.000
DF-Post	30	11.64	1.343		
PF-Pre	30	11.10	1.239	11.398	0.000
PF-Post	30	12.66	0.995		

RESULT:-pre and post mean and standard deviation values of dorsiflexors at 60°/s 9.96±1.142 and at 11.64±1.343 and pre and post mean of plantar flexors 11.10±1.239 and 12.66±o.9995 which shows significant increases in post intervention.

Graphical representation of the mean values of pre and post mean peak torque values of ankle dorsiflexors and plantar flexors for right side.



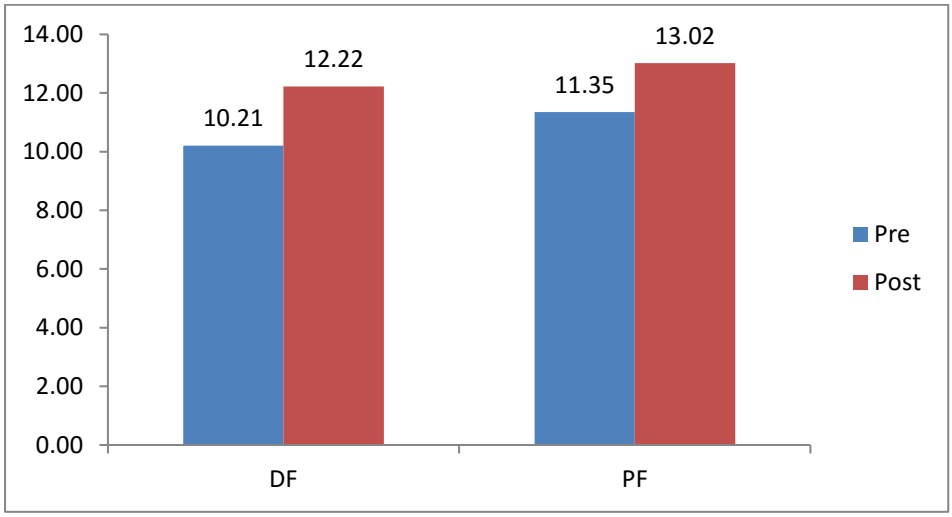
Comparsion of pre and post values of parameters peak torque of the ankle dorsiflexors and plantar flexors on right side. T-test for paired sample observation has been utilized .it is observed that the post intervention values have shown significant impact on the subject $p<0.05$ concluded that difference was statistical significant of 5% level significance.

Analysis of pre and post mean values of strength of ankle dorsiflexors and plantar flexors at 60°/s for left side

Strength-Left	N	Mean	SD	t-value	p-value
DF-Pre	30	10.21	1.153	14.569	0.000
DF-Post	30	12.22	1.120		
PF-Pre	30	11.35	1.176	11.312	0.000
PF-Post	30	13.02	0.955		

RESULT:-pre and post mean and standard deviation values of dorsiflexors at 60°/s 10.21±1.153 and at 12.22±1.120 and pre and post mean of plantar flexors 11.35±1.176 and 13.02±o.955 which shows significant increases in post intervention.

Graphical representation of the mean values of pre and post peak torque values of ankle dorsi flexors and plantar flexors for left side.

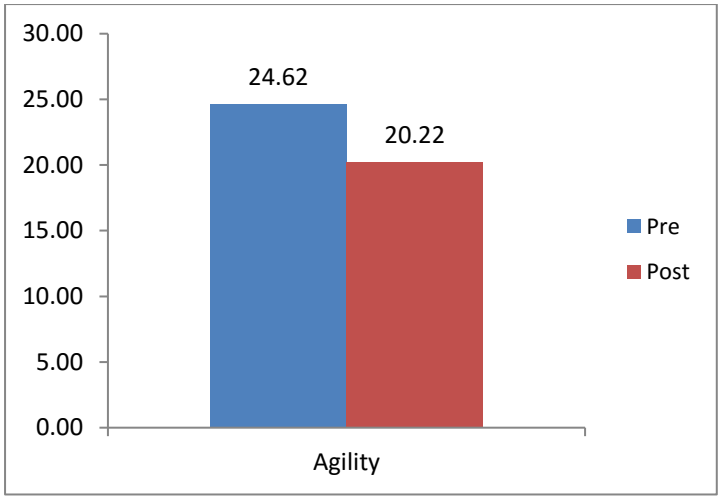


ANALYSIS OF PRE AND POST VALUES OF AGILITY

Agility	N	Mean	SD	t-value	p-value
Pre	30	24.62	2.306	14.037	0.000
Post	30	20.22	1.253		

RESULT:-Pre and post mean and standard deviation values of agility 24.62±2.306 and 20.22±1.253.

Graphical representation of pre and post mean values of agility



Comparison of pre and post values of agility T-test for paired sample observation has been utilized .It is observed that the post intervention values have shown significant impact on the subject $p<0.05$ concluded that difference was statistical significant of 5% level significance.

DISCUSSION

In the present study 30 players were selected for the plyometric training and have completed the protocol for a period of 6 weeks. The player's age group was 18-25 years.

According to the data analysis, a significant difference was found between pre and post values of strength of ankle musculature and agility in experimental group ($p<0.05$).

Plyometric training is to decrease the amount of time required between the eccentric muscle contraction and initiation of overcoming concentric contraction. It begins form a static starting position by an eccentric pre stretch that loads the muscle and prepares it for the ensuring concentric contraction. The coupling of eccentric to contraction muscle contraction is known as stretch shortening cycle (SSC) proprioception reflexes and elastic properties of muscle fiber. Muscle represented three component model, a contractile component (CC) and series elastic component (SEC) and parallel elastic component (PEC) all interact to produce a force output. Muscle contracts in a concentric fashion most of the force that is produced comes from the muscle fiber filaments sliding part on another. When eccentric contraction occurs muscle lengthens like a spring .The ability to use this stored elastic energy is affected by three variables time, magnitude of stretch and velocity of stretch. The type of muscle fiber involved in the contraction can also effect storage of elastic energy .It is slow twitch versus fast twitch muscle fibers responds to high speed small amplitude prestretch. When along slow stretch is applied muscle ,slow and fast twitch muscle fiber exhibit a similar as amount of elastic energy to greater extent with the slow twitch fibers elastic energy more efficiently in ballistic movement characterized by long and slow prestretching in the stretch shortening cycle (SSC). Mechanoreceptors that primarily responsible for stretch reflex are the golgi tendon organ and spindles. Sensory information the length of muscle spindle and rate of applied stretch transmitted to the central nervous system (CNS).

The more rapidly the load is applied of the muscle greater the firing frequency of the spindle and restretch reflexive muscle concentration. Polymetric training can increase the force or power output involves the inhibitory effect of Golgi tendon serve as a tension –limiting reflex restricting the amount of force can be produced. Plyometric training improves muscular performance centers around neuromuscular coordination[5]. When combined with a vigorous muscle contraction, plyometric actions should greatly increase the force that overloads the principles, there by facilitating increase in strength and power[7].

The results on the statistical analysis these result of the study showed that there is significant improvement in the post values of peak torque of ankle dorsi flexors and pantar flexors and agility (Table -1 and 2)

A similar study are done by D.Mantubaro (2012) concluded that the training might affect positively on neuromuscular coordination and musculoskeletal system might get hypertrophy. Agility is the outcome of speed and strength ,the significiant improvement of agility was occurred along with the improvement of explosive strength and speed[8].

Michael Lehnert et 'al (2013). The results of the study of elite basketball players did not positively support the assumption that plyometric exercises can be an effective tool for the improvement of explosive strength and agility. However, in some players the improvements corresponded to average improvements after training programmes presented in literature[9].

Khadijeh Iranoutst et'al(2014)concluded that plyometric training strength and combined groups showed significant improvement in selected physical fitness performance[10].

Table 3 shows the significant improvement of agility Aasadi (2012) concluded that high intensity plyometric training with in improved power, agility, sprint and dynamic balance especially in basket ball players[11.]

Dr.Gajendra et al (2012) concluded that improve the physical fitness skills for kho-kho players is plyometric training is important[12].

CONCLUSION: The present study concluded that there is significant improvement of strength of ankle musculature and agility in female kho-kho players.

STUDY LIMITATION: Sample size is small, only females are included in this study, Only lower body (ankle)muscle strength was measured, Short duration is less, No long term effects of this study was monitored .

RECOMMENDATIONS: The future study is recommended with large sample size, the future study is recommended for more than 10 weeks duration, and the future study is recommended for 5 days /week 2 sessions /day plyometrics exercise for better result, comparison of kho-kho and kabaddi players.

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