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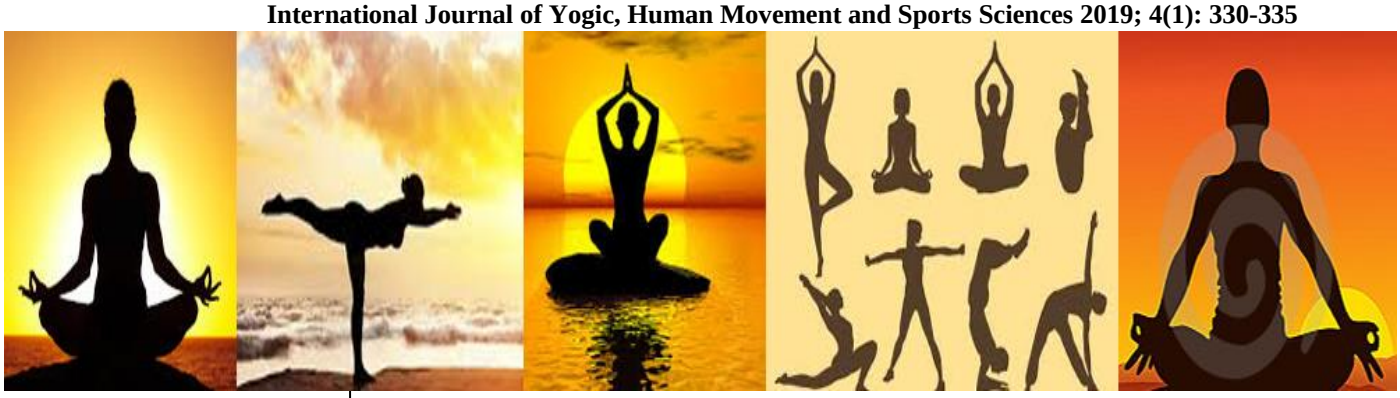

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Impact of an exercise training protocol on selected agility speed and injury prevalence among basketball and handball players

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Abstract
Purpose: The purpose of the study was to determine the impact of an exercise training protocol on agility, speed and injury prevalence among college level men basketball and handball players.
Method: Forty (N = 40; 20 Basketball + 20 Handball) players were selected and divided into two groups: Experimental group (N =20; 10 Basketball + 10 Handball) and Control Group (N = 20; 10 Basketball + 10 Handball). Both the experimental and control group endured a common fitness training for 20 min per season 3 to 5 seasons in a week for 8 weeks with a gradual increase in number of seasons/week as the training progresses. The experimental group underwent a special deigned exercise training protocol in addition to the fitness training and control group did not undergo the training protocol. The factors namely agility, speed and injury prevalence were measured by semo agility test, 50-meter dash and injury ratio questionnaire assessment respectively. The data were collected and tested from each subject before and after the training period and statistically analyzed by using analysis of covariance (ANCOVA).
Results: The result of the study showed that eight weeks of exercise training protocol significantly improved agility (F = 239.70), speed (F=7.70) and reduced injury prevalence (F=5.53) of basketball and handball players. After training intervention, the results showed 8.53% improvement in agility, 5.61% improvement in speed and 60% reduction in injury prevalence in experimental groups after eight weeks of exercise training protocol.
Conclusion: This study shows that there was a significant improvement in the experimental groups on selected factors namely agility, speed and a significant reduction in injury prevalence due to the 8-weeks of exercise training protocol and has made a factual attempt to reduce the injuries of college level men basketball and handball players.

Keywords: Exercise training protocol, agility, speed, injury prevalence, injury prevention, basketball, handball

Introduction
Basketball and handball are among the most popular team sports in the world and their performance is highly dependent upon a combination of technical, physical and tactical skills of players among which physical fitness plays a vital role during a match (Borowski *et al*., 2008; Maffulli *et al*., 2010) [5, 24]. In basketball and handball, abrupt and intense change of direction, regular commencement and preventing, and contact among players mostly depend on dynamic balance. It is obvious that basketball and handball playing ability is possibly related to balance maintenance while moving, passing, shooting, dribbling etc. After commencement of basketball and handball in Olympics, it steadily improved the players' physical fitness, physique, physiological and psychological physiognomies. The intensity of the games has been enhanced because of new training approaches. Injuries can counter the helpful impacts of sports participation if an athlete who is unable to continue to participate because of residual effects of injury (Longo *et al*., 2010; Longo *et al*., 2011; Longo *et al*., 2008; Maffulli *et al*., 2010; Maffulli *et al*., 2011; Maffulli *et al*., 2010) [21-26]. During a basketball and handball match players perform irregular activities at high intensity that require a blend of aerobic and anaerobic fitness (Buchheit *et al*., 2009; Buchheit *et al*., 2009; Delamarche *et al*., 1987; Rannou *et al*., 2001; Souhail *et al*., 2010) [6, 7, 11, 31, 37]. In spite of the various medical advantages,

participation in a physically demanding game such as basketball and handball can result in increased risk of injury (Borowski *et al*., 2008 and Maffulli *et al*., 2010) [5, 25].
Multidirectional speed, which comprehends linear and change-of-direction speed (i.e., planned agility), is a vibrant physical quality for many athletes (Lockie *et al*., 2013) [20]. Agility training is thought to be a re-inforcement of motor programing through neuromuscular conditioning and neural variation of muscle spindle, Golgi-tendon organs, and joint proprioceptors (Singh *et al*., 2015) [35]. Agility is a fundamental factor in most field requiring high-speed action (acceleration, maximal speed) and especially team sports competition. Furthermore, agility is a recipe of speed and coordination (Homoud, 2015) [16]. The responsive nature of movement patterns requires the capacity to reach high maximal running speeds and to rapidly change direction (Sheppard *et al*., 2006) [34]. Achieving maximum speed prior or possessing greater acceleration has obvious advantages in many sports (Cronin and Hansen 2005) [10]. Enhanced acceleration and speed are accomplished by increasing the physical, metabolic, and neurological mechanisms associated with sprinting (Facciono 1993) [14]. The game basketball and handball involves frequent, whole-body maximal ballistic actions in addition to rapid lateral movement in reaction to external stimuli. As such, there is always a possibility of injury risk that must be recognized. Very few studies have been conducted to address these factors especially on Indian basketball and handball players. This study attempts to find the effect of an exercise training protocol on agility, speed and injury prevalence among college level men basketball and handball players.

Material & methods

Subjects

Forty (N = 40; 20 Basketball + 20 Handball) college level basketball and handball players were selected from the Department of Physical Education, Annamalai University, Tamil Nadu, India. These players have minimum of 3 years of playing experience and gave willingness to take part in the study. The general characteristics of the participants in experiment group and control group as shown in Table 1. A written explanation of the experimental procedure and potential risk factors were given to each player and their informed consent was obtained.

Table 1: General characteristics (mean ± SD) of experimental group and control group.

		EXP Group (n=20)	CON Group (n=20)	Total (n=40)
Mean (±) SD	Age (years)	21.28 ± 2.13	21.34 ± 2.55	21.31 ± 2.34
	Height(cm)	175.22 ± 5.34	174.08 ± 4.24	174.65 ± 4.79
	Weight(kg)	64.99 ± 3.64	65.25 ± 6.03	65.12 ± 4.84

Group Design

The subjects were randomly assigned to two groups; Group 1 (EXP = 20; 10 Basketball + 10 Handball) and Group 2 (CON = 20; 10 Basketball + 10 Handball). Testing of each group was performed on two occasions first before administration of training as pre-test and after eight weeks of training as post-test.

Exercise Training Protocol

Both the experimental and control group endured a common fitness training for 20 min per season 3 to 5 seasons in a week for 8 weeks with a gradual increase in number of seasons as the training progressed. The experimental group underwent a special deigned exercise training protocol in addition to the fitness training, which include components of reaction time, flexibility, mobility, balance, explosive strength and Vo_2 max. The training includes agility drills, balancing exercises, static and ballistic stretching, multidirectional movement drills and quickness training.

Methods of Assessment

Table 2: Methods of Assessment.

S. No.	Variables	Method of Assessment
1	Agility	Semo agility test
2	Speed	50 meters' yard dash test
3	Injury prevalence	Questionnaire

Agility

Semo agility test was used to evaluate the subjects' agility as showed in table II. The test was administered for two trails with rest in between. The time taken to complete the course was recorded to the nearest seconds. The best of two trails was the final score.

Speed

The speed of subjects was measured by 50 meters' yard dash test as showed in table II. The tester instructs and used the command ready and clap, the subject would run across the finish line, drawn at 50 meters from the starting line, as fast as possible. The score was the elapsed time to the nearest tenth second between the starting signal and the subject crossing the finishing line.

Injury prevalence

Injury prevalence was assessed by a questionnaire as showed in table II which aimed at gathering information on the type, number of occurrence, circumstances of occurrences (match/training) before and after the training durations for both the groups.

Statistical Analyses

The data were collected from each subject before and after the training period and Analysis of Covariance (ANCOVA) was used to find out the significant difference between the experimental and control groups on each variables separately. All the statistical tests were calculated using the statistical package for the social science (SPSS) for MacBook Air (Version 23). The level of statistical significance was set at $p< 0.05$ as the number of subjects was limited and also as the selected variables might fluctuate due to various extraneous factors.

Results and Discussion

The effects of independent selected factors were determined through the collected data by using appropriate statistical techniques and the results are presented below. The analysis of co-variance (ANCOVA) test on the data obtained for agility, speed and injury prevalence of the pre-test, post-test and adjusted post-test means of experimental group and control groups have been analysed and presented in table III. The percentage of gain in agility, speed and injury prevalence before training and after eight weeks of training among EXP group and CON group is presented in table III.

Table 3: Analysis of covariance (ANCOVA) on agility, speed and injury prevalence of experimental groups and control group

Variable	Test	CON	EXP	F-Ratio
Agility	Pre Test Mean (±) SD	12.49 ± 0.32	12.66±0.33	2.83
	Post Test Mean (±) SD	12.45 ± 0.24	11.58 ± 0.25	127.54*
	Adjusted Post-test Mean	12.49	11.53	239.70*
	Gain	0.04 ↓	1.08 ↓	
	%Gain	0.32% ↓	8.53% ↓	
Speed	Pre Test Mean (±) SD	7.68 ± 0.15	7.66 ± 0.13	0.23
	Post Test Mean (±) SD	7.32 ± 0.13	7.23 ± 0.16	3.44
	Adjusted Post-test Mean	7.32	7.25	7.70*
	Gain	0.36 ↓	0.43 ↓	
	%Gain	4.69% ↓	5.61% ↓	
Injury Prevalence	Pre Test Mean (±) SD	0.65 ± 0.59	0.75 ± 0.55	0.31
	Post Test Mean (±) SD	0.70 ± 0.57	0.30 ± 0.47	5.85*
	Adjusted Post-test Mean	0.70	0.30	5.53*
	Gain	0.05 ↑	0.45 ↓	
	%Gain	7.69% ↑	60% ↓	

*Significant at .05 level of confidence.

Agility

The pre-test means (F = 2.83) of experimental and control group doesn't shows a significant difference (*P*< 0.05), whereas the post-test and adjusted post-test means (F = 127.54 and 239.70) shows a significant difference (P > 0.05), as showed in table-III. This indicates that there is a significant change in agility among experimental group (Figure I). This suggested that, eight weeks of exercise training protocol resulted improvement in agility.

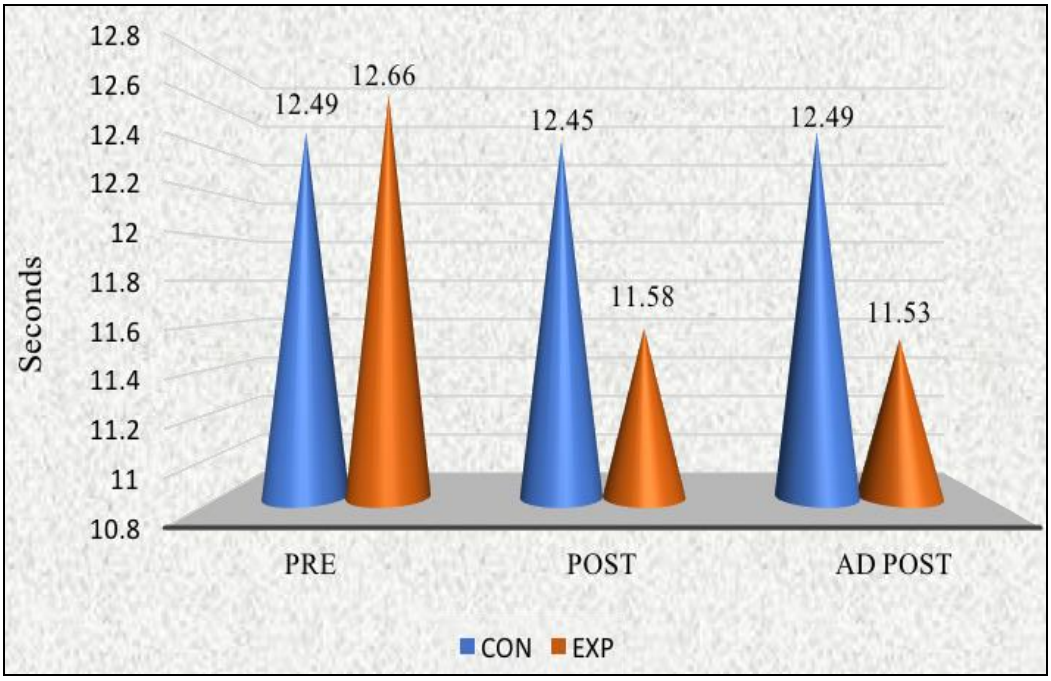

Fig 1: Bar Diagram showing the pre, post and adjusted post-test mean values of experimental groups and control group on agility.

The finding of this study showed that there was a significant difference in agility due to the eight weeks of exercise training protocol. This training protocol resulted in an improvement in agility by 8.53% (12.66 ± 0.33 vs 11.58 ± 0.25) in the experimental group as showed in table-III. This finding is in agreement with the studies of Young *et al*., (2002) [40] for agility performance of handball players. Castello and Kreis (1993) [9]; who observed a direct connection between increased agility, rhythm and movement. Similar resulted in neuromuscular adjustment, improved athleticism, injury prevention and decreased rehabilitation time (Young *et al*., 2002) [40]. This finding is also in accordance with the findings of Miller *et al*., (2006) [29]; Robinson & Owens, (2004) [32]; Young *et al*., (2001) [41]; Alricsson *et al*., (2001) [1]; Ebben, (2002) [13]; Bal *et al*., (2011) [4]; Asadi & Arazi, (2012) [3]; Shallaby, (2010) [33]; Lim, *et al*. (2012) [19].

Speed

The pre-test and post-test means (F = 0.23 and 3.44) of experimental and control group doesn't shows a significant difference (*P*< 0.05), whereas the adjusted post-test means (F = 7.70) shows a significant difference (P > 0.05), as showed in table-III. This indicates that there is a significant change in speed among experimental group when compared with the control group (Figure II). This suggested that, eight weeks of exercise training protocol showed improvement in speed.

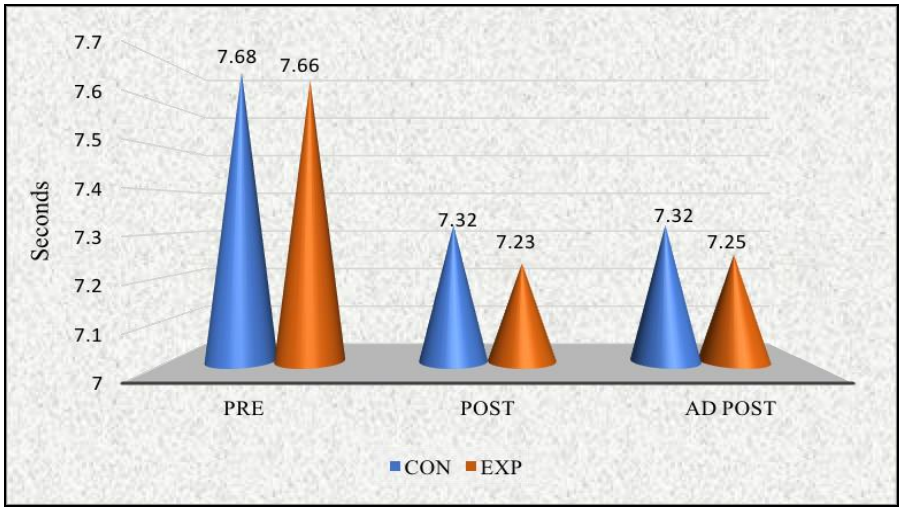

Fig 2: Bar Diagram showing the pre, post and adjusted post test mean values of experimental groups and control group on speed.

The finding of this study showed that there was a significant difference in speed due to the eight weeks of exercise training protocol. This training protocol resulted in an improvement in speed by 5.61% (7.66 ± 0.13 vs 7.23 ± 0.16) in the experimental group as showed in table-III. This finding is in agreement with the studies of Young *et al*., (1995) [42] and Delecluse, (1997) [12] for speed performance of handball players. similar results in speed performance can be improved by effective training programmes that develop both neural and muscular physiognomies (Delecluse, 1997) [12]. Also this judgment is in accordance with the findings of Spinks *et al*. (2007) [38] have reported that an 8-week resistance sprint training program significantly improved acceleration and Kotzamanidis *et al*. (2005) [18] who found significant improvements in 30-m sprint performance in non elite soccer players.

Injury Prevalence

The pre-test means (F = 0.31) of experimental and control group doesn't shows a significant difference ($P< 0.05$), whereas the post-test and adjusted post-test means (F = 5.83 and 5.53) shows a significant difference (P > 0.05), as showed in table-III. This indicates that there is a significant change in injury prevalence among experimental group when compared with the control group (Figure III). This suggested that, eight weeks of exercise training protocol showed less injury prevalence rate in experiment group then control group.

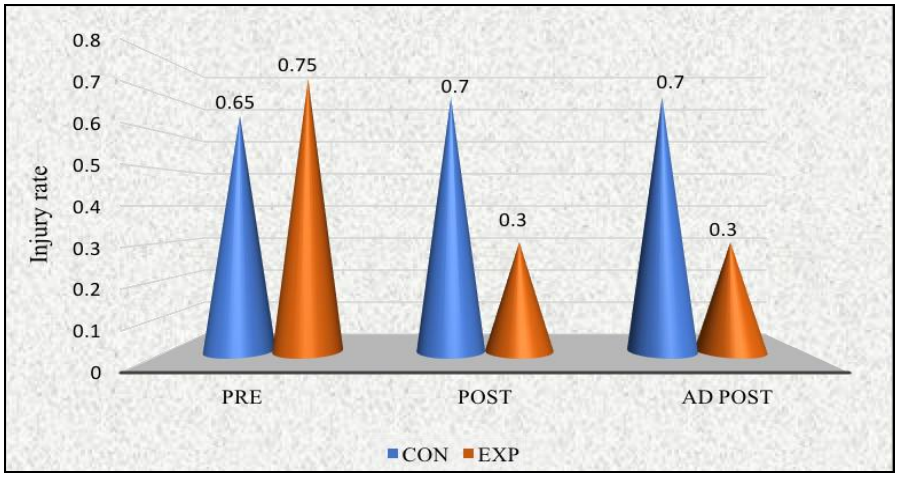

Fig 3: Bar Diagram showing the pre, post and adjusted post test mean values of experimental groups and control group on injury prevalence.

The finding of this study showed that there was a significant difference in injury prevalence due to the eight weeks of exercise training protocol. This training protocol resulted in the reduction of injury prevalence by 60% (0.75 ± 0.55 vs 0.30 ± 0.47) in the experimental group, as showed in table-III. Our finding is in agreement with the studies on preventive programs, however, were effective in youth team handball players (Olsen *et al*., 2005) [30], young female soccer players (Soligard *et al*., 2008) [36], young male soccer players (Junge *et al*., 2002) [17] and senior elite soccer players (Arnason *et al*., 2008; Caraffa *et al*., 1996) [2, 8]. Other findings are in accordance with the effect of various intervention programmes considered to reduce the risk of injury to the lower extremities in young female footballers has been studied earlier (Heidt *et al*., 2000, Mandelbaum *et al*., 2005 and Steffen *et al*., 2008) [15, 28, 39].

Conclusion

The result of the study revealed that the training group has shown significant improvement in agility, speed and injury prevalence. The present study has made a factual attempt to reduce the injuries due to the exercise training protocol and which in turn will improve the performance of college level men basketball and handball players. It is recommended that a modified exercise training protocol for basketball and handball players at all skill levels and age be implemented to prevent injury.

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