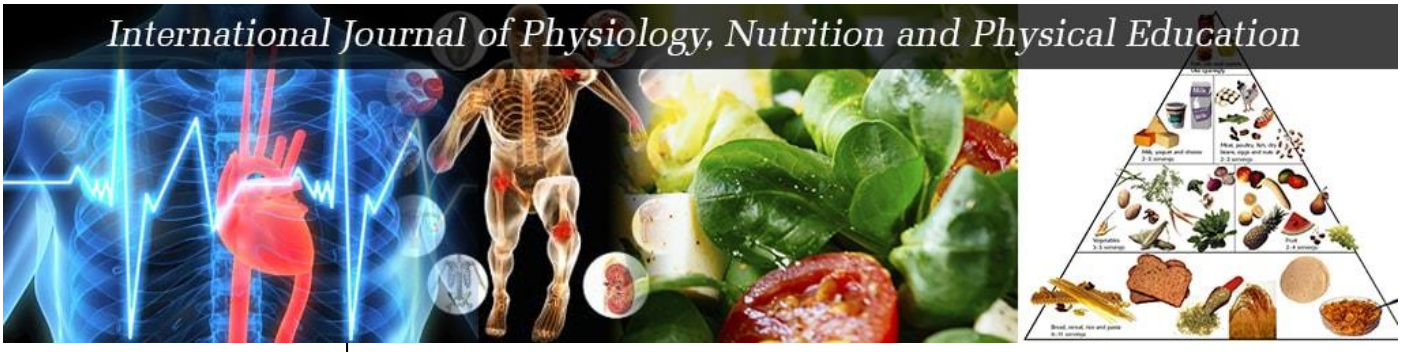

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Impact of an exercise training protocol on selected balance flexibility and injury prevalence among basketball and handball players

Naseer Ahmad Bhat and Dr. K Sreedhar

Abstract
Purpose: The purpose of the study was to determine the impact of an exercise training protocol on balance, flexibility 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 balance, flexibility and injury prevalence were measured by star excursion balance test, sit and reach test 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 balance (F = 1247.07), flexibility (F=119.01) and reduced injury prevalence (F=5.53) of basketball and handball players. After training intervention, the results showed 8.03% improvement in balance, 12.98% improvement in flexibility 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 balance, flexibility and 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, balance, flexibility, injury prevalence, injury prevention, basketball, handball

Introduction
Basketball and handball were among the world's most prevalent physical activities, complex and highly challenging intermittent sport, concerning multiple high-intensity runs (Hermassi *et al*., 2016; Schwesig *et al*., 2016) [11, 20], repeated body contacts and other high-intensity strength and power actions. Innovativeness in blend with speed-jumping, turning, evolving pace, ball throwing, and lateral movements makes these sport very attractive but intense to play. Although both the sports were entirely not considered as contact sport, the lower limb joints are continually exposed to physical stress from the technical movements and exceptional physical interactions during play (Cumps *et al*., 2007) [4]. However, the regular participation among young players, further to the specific risks of these sport can rise the chances of suffering an injury (Borowski *et al*., 2008; Deitch *et al*., 2006) [2, 5] predominantly due to the immaturity of the musculoskeletal system during the era of structural and motor development (Gaca, 2009; Taylor and Attia, 2000) [9, 22]. From a sports medicine perception, the prevention of sports injuries is imperative, as an injury occurring at a young age can have short and long-term effects on both physical and mental health. A precondition for the development of prevention strategies is adequate comprehension of the extent (i.e. incidence) and risk factors of sports injuries (Emery, 2003) [7]. Writers of imminent investigations have revealed that previous injury (Starkey, 2000) [21], anatomical factors (Hewett *et al*., 2005) [12], biomechanical

alignment (Drakos *et al*., 2010) [6], diminished muscle flexibility (Witprouw *et al*., 2000) [25], and poor balance (McGuine *et al*., 2000) [16] are usual risk factors for lower appendage injuries in basketball and handball players.

Moreover, in basketball and handball, good balance enables players to control their bodies, to reduce errors, to protect themselves against falling when they change direction and to move fast within the pitch in order to implement technical skills efficiently (Mahmoud, 2011) [15]. Flexibility training is a fundamental factor in achieving high performance in basketball and handball (Hayes, 2004) [10]. Thus balance and flexibility exercises appear to help this activation occur faster and more effectually (Sammarco, 1995) [19]. In other words, the target of balance and flexibility exercises probably reduces the time between neural stimuli and muscular response preventing imminent injuries (Zachazewski *et al*., 1996) [26]. 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 balance, flexibility 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 are 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

Study 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 progresses. 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	Balance	Star excursion balance test (SEBT)
2	Flexibility	Sit and reach test
3	Injury prevalence	Questionnaire

Balance

Star excursion balance test (SEBT) was used to evaluate the subjects' balance (table 2). The subjects were asked to stand on one foot in the center of the star with their hands on their hips. The subjects then reach with one foot as far as possible in one direction and lightly touch the line before returning back to the starting position. Support foot must stay flat on the ground. This is repeated for a full circuit, touching the line in every reach direction. The assessor was mark the spot on the line where the subject was able to reach. The test repeated three times for each foot. The trial was invalid if the subject cannot return to the starting position, the foot makes too heavy of a touch, or if the subject loses balance.

Flexibility

The flexibility of subjects was measured by sit and reach test (table 2). The subjects were seated on the mat with both legs extended forward, the measuring scale was placed on the floor in-between both legs. The zero end of the measuring scale was placed as proximal end. The subject bent forward and extended both arms forward- the zero point of the measuring scale was placed to the tip of the middle finger. The subjects slowly stretched forward the hip, back and the arm forward to the maximum extent. The maximum distance reached was recorded adequate rest in between.

Injury prevalence

Injury prevalence was assessed by a questionnaire (table 2) 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 balance, flexibility 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 3. The percentage of gain in balance, flexibility and injury prevalence before training and after eight weeks of training among EXP group and CON group is presented in table 3.

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

Variable	Test	CON	EXP	F-Ratio
Balance	Pre Test Mean (±) SD	(74.96 ± 4.70)	75.84 ± 5.16	0.32
	Post Test Mean (±) SD	74.96 ± 4.67	81.93 ± 5.08	20.41*
	Adjusted Post-test Mean	75.39	81.49	1247.07*
	Gain	0	6.09 ↑	
	%Gain	0%	8.03% ↑	
Flexibility	Pre Test Mean (±) SD	24.63 ± 0.56	24.88 ± 0.72	1.46
	Post Test Mean (±) SD	24.71 ± 0.64	28.11 ± 1.25	117.71*
	Adjusted Post-test Mean	24.78	28.03	119.01*
	Gain	0.08 ↑	3.23 ↑	
	%Gain	0.32% ↑	12.98% ↑	
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.

Balance

The pre-test means (F = 0.32) of experimental and control group doesn't shows a significant difference (P<0.05), whereas the post-test and adjusted post-test means (F = 20.41 and 1247.07) shows a significant difference (P>0.05), as showed in table-3. This indicates that there is a significant change in balance among experimental group when compared with the control group (Figure 1). This suggested that, eight weeks of exercise training protocol showed improvement in balance.

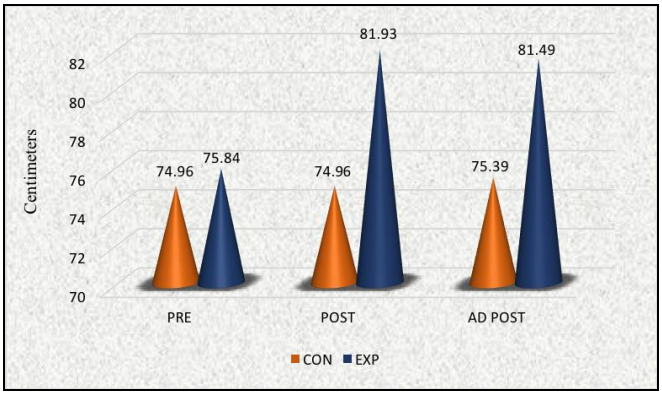

Fig 1: Bar Diagram showing the pre, post and adjusted post test mean values of experimental groups and control group on balance.

The finding of this study showed that there was a significant difference in balance due to the eight weeks of exercise training protocol. This training design resulted in an improvement in balance by 8.03% (75.84 ± 5.16 vs 81.93 ± 5.08) in the experimental group after showed in table-3. This finding is in agreement with the studies of Holm *et al*., (2004) [13]; Paterno *et al*., (2004) [17] was demonstrated that balance might be improved after 6 to 7 weeks of training. Another study of core-stability training, testified that maximal reach distances on the SEBT improved in vigorous participants after a 6-week core-stability–training program. The balance test findings are comprised with previous studies, which investigated the effects of core training on dynamic balance for athletes (Kahle and Gribble, 2009) [14]. Filipa *et al*., (2010) [8] was found that 8 weeks' core stability training happened increase of 103% in dynamic balance (SEBT) test results. Other related finding to our study suggested that 8 weeks' core stability training comprises static and dynamic exercises like current study improved core endurance test times when compared to the control group of elite junior players (Bassett and Leach, 2011) [1].

Flexibility

The pre-test means (F = 1.46) of experimental and control group doesn't shows a significant difference (P<0.05), whereas the post-test and adjusted post-test means (F = 117.71 and 119.01) shows a significant difference (P>0.05) as showed in table-3. This indicates that there is a significant change in flexibility among experimental group when compared with the control group (Figure 2). This suggests that, eight weeks of exercise training protocol resulted improvement in flexibility.

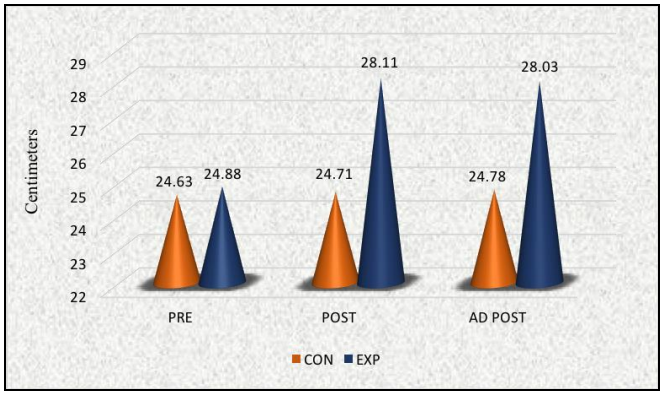

Fig 2: Bar Diagram showing the pre, post and adjusted post test mean values of experimental groups and control group on flexibility.

The finding of this study showed that there was a significant difference in flexibility due to the eight weeks of exercise training protocol. This training protocol resulted in an improvement in flexibility by 12.98% (24.88 ± 0.72 vs 28.11 ± 1.25) in the experimental as group showed in table-3. This finding is in agreement with the studies of Polman, *et al*., (2004) [18] shown the excellence of the warm-up and cooling down sessions, combined with the improved fitness, valour has enhanced the players' flexibility. Similar result shown the improvement of flexibility is seen in Polman, *et al*., (2004) [18] study and it is an essential fact to increase sports performance.

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-3. This indicates that there is a significant change in

injury prevalence among experimental group when compared with the control group (Figure 3). This suggested that, eight weeks of exercise training protocol showed less injury prevalence rate in experimental group then control group.

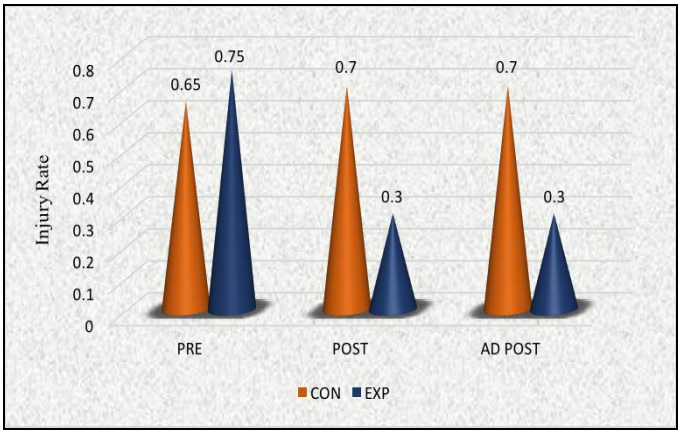

Fig 3: Bar Diagram showing the pre, post and adjusted post test mean values of experimental groups and control group on injury prevalence.

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-3. Other findings are in accordance with the more specific, injury rates reductions on professional athletes after the application of balance exercise program have been recorded by many authors. Tropp *et al*. (1985) [23] first showed the preventive effect of balance-board training on the prevalence of ankle sprains. Caraffa *et al*. (1996) [3] proved in a prospective controlled study that the rate of ACL ruptures was extremely reduced after presenting proprioceptive training on balance-boards to semi- professional male soccer teams. Similarly, Wedderkopp *et al*., (1999) [24] revealed that the application of a balance training program on balance boards by fit female handball players, for 10 months resulted in reduction of incidence of lower limb injuries.

Conclusion

The result from the study revealed that the training group has shown significant improvement in balance, flexibility and injury prevalence. The present study has made a factual attempt to reduce the injuries due to the 8-weeks of 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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