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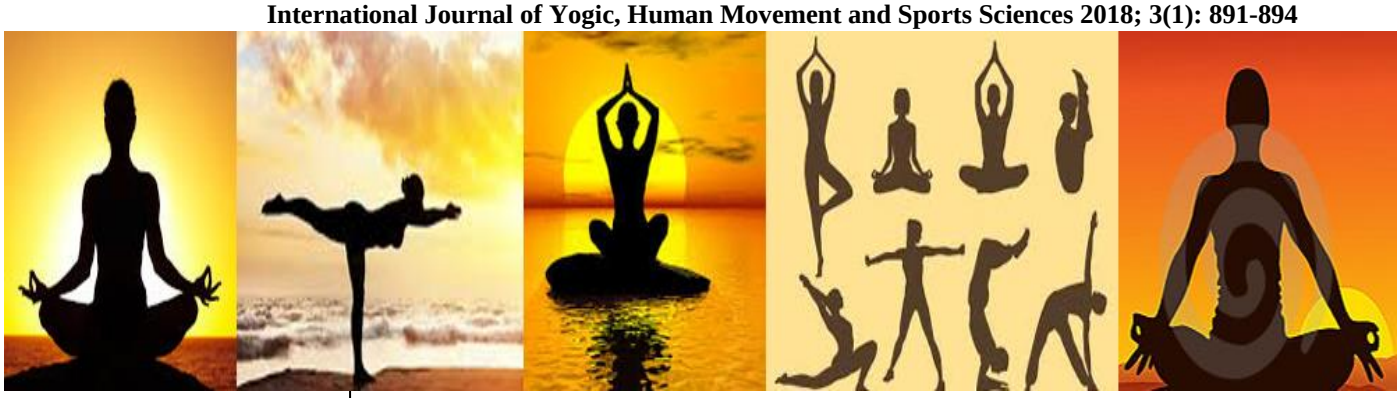

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Joint Re-Position sense in sportspersons participating in different sports

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Abstract
Precise and coordinated body movement is critical for success in competitive sports. Successful interaction with the surrounding environment is accomplished by senses. The kinesthetic sense is based on proprioception, which is awareness of the position of joints. kinaesthesia is not an isolated sense or ability, rather an integral part of the movement controlling system. proprioception is often discussed in the context of joint stability. Kinesthesia has been often interchangeably used with proprioception. In sports, the understanding of kinesthesia has been facilitated by motor control research. The development of the kinesthetic sense itself is almost never the primary focus of training interventions in sports. The subjects for the study were inter-University level sportspersons participating in Indigenous (N=119) and Non-Indigenous sports (N=199). The subjects in the indigenous sports were from Kabaddi and Kho Kho; whereas in non-indigenous sports were from Handball, Football and Volleyball. Sportspersons representing Bangalore, Mangalore, Mysore, Karnatak University and Kuvempu University were selected through purposive random sampling technique. Test selected for the study was the modified form of Weight-Bearing and non-weight bearing knee joint reposition sense tests by Drouin, *et. al*. (2003). The necessary data was collected by the investigator with the help of a trained helper during coaching camps for inter University level competitions. Apart from descriptive statistics, independent sample 't' test was employed to examine the differences in balance ability. There exists significant difference in Weight bearing joint reposition sense between sportspersons in indigenous and non-indigenous sports. Further, there were no significant differences found in non-weight bearing joint reposition sense between two groups. Results are discussed in detail and conclusions drawn.

Keywords: proprioception, kinesthetic sense, joint re-position sense, sportspersons

Introduction
Precise and coordinated body movement is critical for success in competitive sports. Successful interaction with the surrounding environment is accomplished by senses. During movement, specialized senses enable perception of self or extrinsically induced movement of our bodies. Three different but basic senses have been recognized, to be of importance for regulation of human movement. These are vision, vestibular and kinesthesia or proprioception (Guerraz & Bronstein, 2008) [7].

The kinesthetic sense is sometimes called "muscle memory," and is the awareness of own movement, for example when we walk, eat, write, or brush our teeth. The kinesthetic sense is based on proprioception, which is awareness of the position of joints. Kinaesthesia is not an isolated sense or ability, rather an integral part of the movement controlling system. As its sub-modality, kinaesthesia is responsible for perceiving specific characteristics of our own movement, and for being able to correct it accordingly to the goals or demands of the movement and the task performed (Proske, 2006) [14].

What is Kinesthesia?
The fundamental anatomical basis for the connection between the brain and limbs was first identified in 1826 by a Scottish physiologist, Charles Bell. Sixty years later, the English anatomist and pathologist Henry Bastian introduced the term "kinesthesia", derived from two Greek words "kinein" (move) and "aisthesis" (sensation). Subsequently, in 1906, the English neurophysiologist Sir Charles Sherrington coined "proprioception", from a combination of the Latin "proprius" (one's own) and "perception", to give a term for the sensory information

derived from (neural) receptors embedded in joints, muscles and tendons that enable a person to know where parts of the body are located at any time. He referred to proprioception as "the perception of joint and body movement as well as position of the body, or body segments, in space" (Sherrington, 1906) [19].

In research, as well as in sports and rehabilitation literature, different terms such as proprioception, sensory-motor function, balance and kinesthesia are often interchangeably used. Usually the same subject of interest is discussed but from various perspectives. Today proprioception is often discussed in the context of joint stability. Kinesthesia has been often interchangeably used with proprioception. Lephart *et. al*. (2000) [11] described kinesthesia as a sub-modality of proprioception, which is associated with the sensation of joint movement that can be either active or passive. Schmidt and Wrisberg (2008) [18] in their textbook Motor Learning and Performance, distinguish between kinesthesia as the sensation of gross body orientation and proprioception as the sense of limb positions. All definitions agree in the point that kinesthesia is a sense of body and limb movement that can be consciously perceived.

Kinesthetic sense in sports settings

A fundamental shift in the research field of human movement control has occurred in recent decades, largely due to a growing understanding of the role that sensory information plays in neuroplasticity through use dependent mechanisms (Goble, 2010) [6]. In sports, the understanding of kinesthesia has been facilitated by motor control research. The development of the kinesthetic sense itself is almost never the primary focus of training interventions in sports. Its improvement usually happens in parallel to other functional and structural changes which are the primary aim of a certain type of training. Kinesthesia has been correlated to sports injury prevention and rehabilitation, and is proposed to be an important factor in re-establishing proper motor control after injury (Riemann & Lephart, 2002) [16]. The essence of kinesthesia is the corporal self-awareness and is of most importance in sports performance, injury prevention and rehabilitation.

Novice athletes rely on their kinesthetic sense for the correct execution of the new movement they are learning. Experienced athletes rely on their kinesthetic sense to influence otherwise automatic movement, and to correct it accordingly to the environmental and internal task demands to achieve superior skill. Kinesthesia is an important tool used by the motor control system, enabling improvements in movement skills and building correct movement patterns that are the resulting outcomes carried out almost automatically. Affected kinesthesia has been shown to be an important sports injury predisposing factor. Further, measures of kinesthesia in functional movements enable us to understand the effects of practice and other intrinsic factors, such as fatigue (Rosker and Sarabon, 2010) [17].

The purpose of the present study was to assess the weight bearing and non-weight bearing joint re-position sense of inter University level sportspersons participating in indigenous and non-indigenous sports.

Methodology

The subjects for the study were inter-University level sportspersons participating in Indigenous (N=119) and Non-Indigenous sports (N=199). The subjects in the indigenous sports were from Kabaddi and Kho Kho; whereas in non-indigenous sports were from Handball, Football and Volleyball. Sportspersons representing Bangalore, Mangalore, Mysore, Karnatak University and Kuvempu University were selected through purposive random sampling technique.

Joint re-position sense measurements: Measures of position sense have been most frequently used as a kinesthetic sense assessment tool. They have been proven useful in studying effects of fatigue (Carpenter, Blasier, & Pellizzon, 1998) [3], aging (Ribeiro *et. al*., 2007) [15], limb dominance (Sigmundsson *et. al*., 2000) [20], training effects (Hupperets, Verhagen, & van Mechelen, 2009) [9], pathology (Chung *et. al*., 2006; and de Noronha *et. al*., 2006) [4, 5], and other factors/conditions which modulate kinesthetic sensation. Most common protocol used in active joint repositioning methods includes repositioning of a limb into a reference position (Niessen *et. al*., 2009) [12]. Measurements usually start with positioning the measured limb in a specific position. The subject is asked to try to remember the position of the limb/joint. Then the limb is passively returned into the starting position. After familiarizing the subject with the reference position, he is asked to move the limb into the most appropriate place to match the reference position. The difference between the two represents the measure of active joint position sense.

Test selected for the study was the modified form of Weight-Bearing and non-weight bearing knee joint reposition sense tests by Drouin, et. al. (2003). In original test, knee joint reposition sense was tested under two conditions: weight-bearing and non-weight-bearing. The order of test condition was assigned for each subject in a counterbalanced fashion. Each subject was measured for the amount of anterior tibial displacement in the knee by a goniometer.

Modified weight bearing joint reposition sense test

A calibrated goniometer was attached to each subject's knee on an imaginary line connecting the greater trochanter and the lateral malleolus with double- sided tape and non-adhesive elastic wrap. While the subject was standing in a comfortable stance with feet shoulder-width apart and looking straight ahead, the goniometer was zeroed. This point represented anatomical zero for measurement of all knee-joint angles during all joint reposition sense testing.

The weight-bearing condition measured participants' ability to actively reproduce a target angle of 60°. While in single-leg stance on a 6-in-high box, each subject was instructed to slowly squat. The researcher instructed the subject to stop and pause for 15 seconds when the knee-joint angle measured 60°. Next, the subject returned to a standing position and waited for 15 seconds. The subject was then instructed to reproduce the target angle for that trial as accurately as possible. Each subject maintained balance by leaning backward against the wall. The non-testing leg remained fully extended and non-weight-bearing off the edge of the box during the entire test. Between trials, each subject walked 20 ft to eliminate any proprioceptive memory of the test.

Modified non-weight bearing joint reposition sense test

To assess joint reposition sense in the non-weight-bearing condition, each subject was seated on a chair reclined to 55°. The joint line of the dominant leg was aligned 10 cm from the edge of the seat. While seated with the test leg fully extended, the subject was instructed to slowly flex the knee. The

researcher instructed the participant to stop when the knee-joint angle measured 60° and to hold the position for 15 seconds. The subject then returned the test leg to the fully extended position and paused for 15 seconds. Next, the subject was instructed to reproduce the target angle of that trial as accurately as possible. Between trials the subject performed 5 repetitions of knee flexion and extension to eliminate any proprioceptive memory.

The necessary data was collected by the investigator with the help of a trained helper during coaching camps for inter University level competitions. Apart from descriptive statistics, independent sample 't' test was employed to examine the differences in balance ability.

Findings

Descriptive analysis of raw data on Weight bearing and Non-weight bearing joint reposition sense measured through difference between target and achieved knee joint angles was carried out. The results are provided in table 1.

Table 1

	Groups	N	Mean	Std. Deviation
Weight bearing joint reposition sense	Indigenous sports	119	62.82	5.67
	Non indigenous sports	199	60.81	5.90
Non-weight bearing joint reposition sense	Indigenous sports	119	63.39	5.20
	Non indigenous sports	199	62.40	4.99

The results in table 1 makes it clear that the scores on joint re-position sense are normally distributed and homogeneity is acceptable. The results on 't' test for independent variables was employed and the results are provided in table 2.

Table 2

m	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Weight bearing joint reposition sense	2.974	316	.003	2.00526	.67420
Non-weight bearing joint reposition sense	1.684	316	.093	.98957	.58754

From table 2 it is evident that there exists significant difference in Weight bearing joint reposition sense between sportspersons in indigenous and non-indigenous sports. Further, there were no significant differences found in non-weight bearing joint reposition sense between two groups. It can be inferred that the sportspersons from non-indigenous sports have high Weight bearing joint reposition sense as compared to their counterparts in indigenous sports.

Discussion

The sportspersons participating in non-indigenous sports have better Weight bearing joint reposition sense due to the nature of game they are involved. Contrary to present findings Bisht, Singh and Mardikar (2017) [2] did not find any significant difference in Balance Ability among the sportspersons of Contact, Semi-contact and Non-Contact Sports. The peculiarities of the game induces this type of ability in sports persons. The socio-economic status of sportspersons involved in indigenous sports have to be taken into consideration in this context. Mostly, sportspersons in games like Kabaddi and Kho-Kho come from a rural and poor background. In a similar study by Khan, Pooja and Prabhu (2018) [10] Inter University level sportspersons participating in indigenous sports had higher balance ability than those participating in non-indigenous sports.

According to Hrysomallis (2011) [8] balance training may lead to task-specific neural adaptations at the spinal and supraspinal levels. It may suppress spinal reflex excitability, such as the muscle stretch reflex during postural tasks, which leads to less destabilizing movements and improved balance ability.

Conclusion

Inter University level sportspersons participating in non-indigenous sports have higher Weight bearing joint reposition sense than those participating in indigenous sports.

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