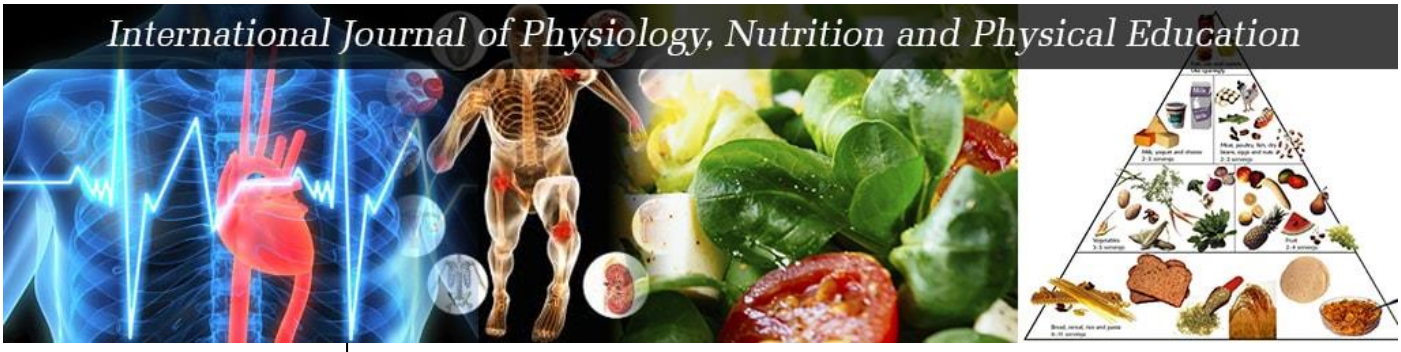

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Effect of eight weeks proprioceptive training program on dynamic postural stability of male kho-kho players using star excursion balance test (SEBT)

Ashutosh Pandey and Dr. Reeta Venugopal

Abstract
Objective: The purpose of the present study was to find out the effect of 8 weeks Proprioceptive training program on dynamic postural stability of male Kho-Kho players using Star excursion balance test (SEBT).
Methodology: Fifty (50) male national level Kho-Kho players from Bhilai (C.G) India, were selected purposively as subjects for the present study. These subjects were categorized into experimental group (N=25) & Control group (N=25). Age of the subjects ranged from 14-18 years. Star excursion balance test (SEBT) performance on Non-dominant leg (Right leg stance) was used as a tool to assess dynamic postural stability among experimental & control groups before, during & after 8-weeks Proprioceptive training program.
Statistical technique used: Descriptive statistics was used to characterize dynamic postural stability among experimental & control group. Analysis of covariance (ANCOVA) was used to find out the effect of 8-weeks Proprioceptive training program on dynamic postural stability through the mean of SEBT performance. Trend analysis was used to assess the trend of improvement in experimental group during Proprioceptive training program. The level of significance was set at 0.05.
Results & Conclusion: The result of the present study showed significant difference ($p< 0.05$) in SEBT (Normalized excursion distance) performance on non-dominant leg (Right leg stance) that leads to improvement in dynamic postural stability. Proprioceptive training program showed 44 % improvement in SEBT performance & a positive trend of improvement in SEBT performance after 8-weeks Proprioceptive training program.

Keywords: Proprioceptive training program, Star excursion balance test, dynamic postural stability, Kho-Kho etc.

Introduction
Proprioception" is a sensitivity mechanism present in mammals which has direct connection with central nervous system through Mechanoreceptors present in the joint, muscles, & tendons as a result it signals the body how to react & with what amount of tension against a particular message. Proprioception is unconscious initially, but it can be enhanced via training. Proprioception is defined as the awareness of posture, movements & changes in equilibrium as well as the knowledge of position, weight & resistance to objects in relation to the body.
Proprioceptors are special sense organs which helps in execution of smooth & coordinated movements in effective patterns. Proprioceptors are also significant as they maintain normal body posture and muscle tonus. They provide information to the antigravity muscle to counterbalance the effect of gravity, so that the movement occurs effectively while maintaining the stability of the body**.** (Edward l. fox, 1989, Pg-143) [20].
Correct execution & learning of skill is a complex phenomenon which cannot be completed without the assistance of proprioceptors. Skill learning is originated and operated in cerebral cortex & cerebellum, when a movement is originated in the motor cortex; it is transmitted to the muscles which send the information through proprioceptors back to cerebellum. As a result a corrected signal regarding the skill, generated in the cerebellum is received by the muscles to execute skill (Edward l. fox, 1989, Pg-155) [20].
Postural control may be defined as ability to maintain a posture for a given time without taking the assistance of base of support.

It is often described on the basis of body position into two categories, Static postural control (attaining a particular position of body without undergoing movement or with minimal movement) and dynamic postural control (maintaining a constant body position while undergoing a functional task.

Dynamic postural stability fulfills the demands of Proprioception i.e. more is the dynamic postural stability more is Proprioception. It is well acquainted by the population, the concept of proprioception that proprioception helps to maintain normal body posture and muscle tonus. The antigravity muscles are well informed by proprioceptors so as to counterbalance the effect of gravity, in order to make the movement effective and efficient in relation to space while maintaining the stability of the body**.** (Edward l. fox, 1989, Pg-143) [20]. Proprioceptive deficits lead to imbalance in dynamic postural stability as they are proportional to each other.

Star excursion balance test (SEBT) is one of the tests for assessing the dynamic postural stability of healthy population, which was for the first time notified by Gray in 1995.Kinzey and Armstrong (1998) [14] & Hertal *et al.* (2000) [4] (0.81-0.96) provides strong intra-reliability (0.67-0.87, 0.81-0.96) respectively of SEBT measurements.

Star excursion balance test (SEBT) is a series of single leg stance using non-stance limb for excursion in the eight directions maintaining base of support with the stance limb (Gribble & Hertal, 2013; Gribble, P.A. 2003; Gribble *et al*, 2004) [4, 5, 7].

Kho-kho is an indigenous game generally played in the rural areas of India, which require physical fitness at its optimum; quickness, agility, speed, reaction time, dynamic & static stability, peripheral vision etc. are the necessity of the game. It is a game which is played between two teams in a limited interval of time, each team comprised of 12 players with nine (9) playing members. The nature of the game enforces the players to assemble themselves with speed, agility, explosive strength, reaction time etc. since the skills in chasing and running requires it equally. Kho-Kho is a popular traditional game played mostly in South-Asian, now it is not only popular in South-Asian countries but it is also played in South Africa. The origin of this game was difficult to trace but historians believed its origin in Maharashtra, who believed the game as a game of running and chasing. Federation controlling the game was formed in 1987 during 3rd south-asian games held in Kolkata named as 'The Asian Kho-Kho Federation' (Retrieved on 02/09/2017 https: //en.wikipedia. org/ wiki/ Kho-kho).

To our knowledge studies have been done to prove the usefulness of SEBT as a tool to improve the dynamic postural stability in athletes with lower extremities impairment, the scholar attempted to study effect of proprioceptor training on SEBT performance (which is directly proportional to dynamic postural stability) of healthy Kho-Kho players.. It is hypothesized that the dynamic postural stability of subjects in experimental group participating in the intervention program would be better than the subjects in control group. Present study will assist the researcher to implement the proprioceptive training for improving the dynamic postural stability of female Kho-Kho players. The study will help coaches to develop broad idea in relation to proprioceptrive training & implement training programs for other games & sports.

Methodology of the study

Selection of Subjects

For the purpose of present study fifty (50) national level male Kho-Kho players from Bhilai, Chhattisgarh, India, aged 14 to 18 years were selected as subjects. These subjects were divided in experimental group (N=25) and Control group (N=25) respectively. The experimental group underwent eight weeks proprioceptive training program while control group followed their normal daily routine.

Selection of Variable

Eight weeks Proprioceptive training acts as an independent variable and SEBT performance (Excursion distance) with non-dominant leg (Right leg stance) acts as dependent variable for the present study.

Experimental design

Repeated measure group design was used for the present study, since the data were collected at different intervals. The test was conducted before the Proprioceptive training program i.e. at baseline level, then after 4 weeks & finally after 8 weeks of Proprioceptive training program.

Dimension of the testing area

The dimension area of the test includes two pairs of perpendicular lines bisecting each other at 45^0 angles. The first pair of lines are drawn in horizontal & vertical axis, whereas another pair is drawn at 45^0 angle bisecting the horizontal and vertical line at the centre. A box is drawn at the centre i.e. at the point of intersection of the lines, for the subject to stand in (Gribble and Hertel (2003).

Administration of test

The SEBT protocol described by Gribble and Hertel (2003), requires the subjects to stand in right leg stance at the centre of the grid formed by eight lines extending out at 45^0 angle from each other. All the subjects were asked to begin the test with their right leg stance without compromising base of support & Non-dominant leg as excursion leg, subjects were then asked to reach as far as possible along each of the eight lines and touch the line with their distal part of leg, then return back to double leg stance without breaking their balance. Subjects were asked to perform three trials in each of the eight directions, beginning with anterior direction and progressing in clockwise manner around the grid, without compromising the base of support. The test was conducted at three intervals, before the commencement of eight weeks Proprioceptive training programi.e at baseline level, then after 4 weeks of training and finally after 8 weeks of training.

Fig 1: Dynamic postural stability assessment (Star Excursion Balance Test)

Data analyses

The excursion distance scores for each direction from SEBT test were averaged for 3 trials and normalized to leg length to get the percentage of leg length (Percentage of leg length = Excursion distance/ leg length × 100). The normalized excursion distance in each of the direction was then summed for Non-dominant limb (Right leg stance).

Proprioceptive Training (www.sportsinjurybulletin.com)

The Proprioceptive training program of 8 weeks, five days/week, once/day was developed for the present study. The total duration of each session was 45 minutes. Repetition exercise starts with 10 repetitions/day which was increased to 2-5 repetitions/day & for timed exercise start from 30 seconds hold which was increased by 10 seconds/day, until 30 repetitions and 60 seconds hold for each exercise were obtained till the last day of week. 10-15 minutes of warming up session was prepared before the commencement of training program, so that the body gets prepared for the training. The progression of training load (exercise) was according to the principles of training i.e. it was increased gradually in relation to the principle of load adaptation.

Statistical analysis

Statistical techniques used were descriptive statistics and ANCOVA. One standard condition trend analysis was used to observe the trend (linear and Quadratic Trend) of improvement on SEBT performance with Non-dominant leg (Right leg stance) before, during & after 8 weeks of Proprioceptive training program. The level of significance was set at 0.05 & the data was analyzed using Statistical package for Social science (SPSS).

Finding & Results

Table 1: Descriptive Statistics of Star Excursion Balance Test Performance (Excursion distance) on Dominant leg (Left leg stance) among Experimental and Control Groups in Pre-test & Post-test observations of Male Kho-Kho players.

Measures	Experimental group		Control Group	
	PRE-TEST	POST-TEST	PRE-TEST	POST-TEST
Mean	715.71	796.14	781.28	780.85
Standard Error	8.30	6.83	11.05	11.29
Standard Deviation	41.52	34.13	55.23	56.44
Kurtosis	1723.75	1164.52	-0.41	-0.70
Skewness	-0.50	-0.21	0.09	0.02
Minimum	618.36	715.87	681.11	680.33
Maximum	778.37	856.33	894.20	889.89

Table 1 shows Mean, SE and SD of pre and posttests of Star excursion balance test performance in experimental and control group.

Table 2: Analysis of variance: Comparison of mean scores of Star Excursion Balance Test (SEBT) Performance on Non-dominant leg (Right leg stance) among Experimental and Control Groups of Male Kho-Kho players.

Observations	Source of variance	Value of sum of Squares	Value of degree of freedom	Mean Square Value	'F' Value	Significance value
Pre-test	Between Groups	53731.665	1	53731.665	22.509	.000
	Within Groups	114580.019	48	2387.084		
Post-test	Between Groups	2921.384	1	2921.384	1.343	.252
	Within Groups	104403.711	48	2175.077		

*Significant at 0.05 level

F' Value required to be significant at 1, 48 *df* = 4.04

Table 2 shows comparison of SEBT mean scores before training between experimental & control groups, and it is evident that the 'F' Value of 22.509 was significant at 0.05 level, since the obtained value was higher than the tabulated value (4.04) at 1, 48 df, which indicates statically significant difference in the mean scores of experimental & control groups in Pre-test observation.

In contrast insignificant difference was noted between the post-test means of experimental & control groups since the 'F' value of 1.343 was lower than the tabulated value (4.04) at 1, 48 df.

Table 3: Scores of Adjusted Post Test means of Star Excursion Balance Test (SEBT) Performance on Non-dominant leg (Right leg stance) among Experimental and Control Groups in Male Kho-Kho players.

Groups	Score of adjusted Mean	Score of Standard Error	95% Confidence Interval	
			Lower Bound value	Upper Bound value
Experimental group	820.08	6.744	806.511	833.647
Control group	756.91	6.744	743.343	770.479

Table 3 shows the scores of adjusted post-test mean and standard error of star excursion balance test performance on non-dominant leg (Right leg stance) among experimental and control groups during post-testing. The observed adjusted mean score and standard error for experimental and control groups are 820.079 & 6.74 and 756.911 & 6.74 respectively. It is also evident from the table that the effect of covariate was eliminated, since the differences in the initial scores of mean were compensated during post testing.

Table 4: Analysis of Covariance: Comparison of Adjusted Post Test mean scores of Star Excursion Balance Test (SEBT) Performance on Non-dominant leg (Right leg stance) among Experimental and Control Groups of male Kho-Kho players

Source of variations	Value of Sum of Squares	Value of Degree of freedom	Mean Square value	'F' Value	Significance value	Value of Partial Eta Squared
Contrast	33954.590	1	33954.590	36.860	.000	.440
Error	43294.932	47	921.169			

*Significant at 0.05 level

F value required to be significant at 1, 47 df = 7.21.2017

Table 4, shows comparison between adjusted post mean SEBT scores that the obtained 'f' value of 36.860 was significant at 0.05 level, since the obtained value was higher than the tabulated value (7.21) at 1, 47 df, which indicates significance difference between the adjusted post-test means of experimental & control groups. Value of partial eta squared showed 44 % improvement in Star excursion balance test performance on Non-dominant leg (Right leg stance) after Proprioceptors training program.

Table 5: Result of trend analysis showing the effect of Proprioceptors Training on Star Excursion Balance Test (SEBT) Performance on Non-dominant leg (Right leg stance) of male Kho-Kho Players

Source of variation	Value of type III Sum of Squares	Value of degree of freedom	Value of mean square	Value of 'F'	Significance value
Intercept	88318777.551	1	88318777.551	13859.012	.000
Error	312260.367	49	6372.661		

Table 5 clearly shows significant improvement in the trend of performance on Star excursion balance test with non-dominant leg (Right leg stance), since the F-Value of 13859.012 was significant at 0.05 level of significance. The trend of improvement was observed during Proprioceptors training on Star excursion balance test performance with No dominant leg (Right leg stance).

Table 6: Result of Linear and Quadratic trend showing the effect of Proprioceptors Training on Star Excursion Balance Test (SEBT) Performance on Non-dominant leg (Right leg stance) of male Kho-Kho Players

Source of variation	Experimental group	Value of type III Sum of Squares	Value of degree of freedom	Value of Mean Square	Value of 'F'	Significance value
factor1	Linear	39998.000	1	39998.000	29.397	.000
	Quadratic	409.104	1	409.104	1.917	.172
Error (factor1)	Linear	66670.161	49	1360.616		
	Quadratic	10455.681	49	213.381		

It is evident from the table 6 that in case of linear trend the F-Value was found to be 29.397, which was significant at 0.05 level The table also revealed insignificant difference in the performance in case of quadratic trend.

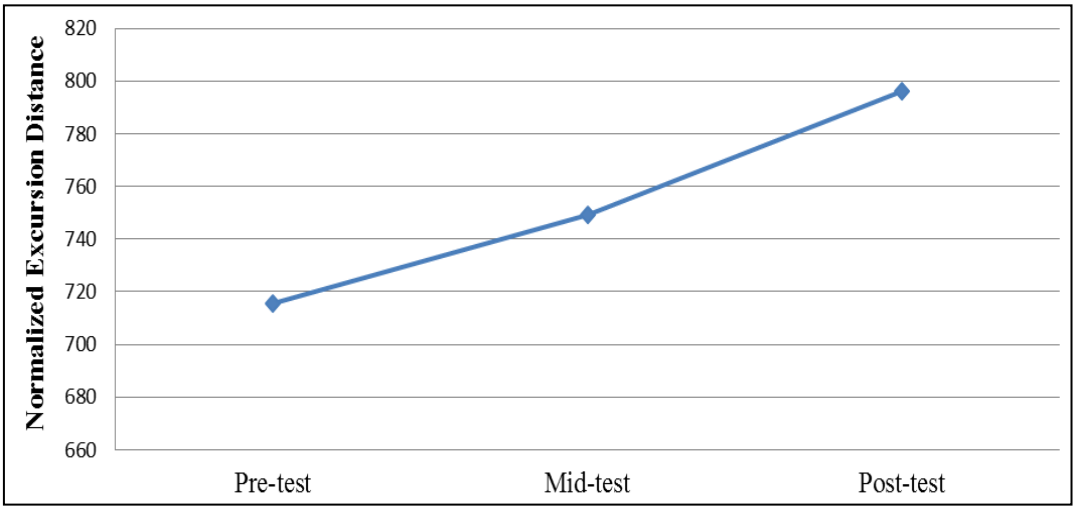

Fig 2: Trend (Linear & Quadratic) of Normalized excursion distance (Non-dominant leg, Right leg stance) in experimental group

Figure 2 reported the graphical representation of SEBT performance on non-dominant leg (Right leg stance) between three observations (Pre-test, Mid-test & Post-test). In between Pre-test & Mid-test observations, the improvement in the performance on SEBT with non-dominant leg (Right leg stance) occurs gradually which continues up-to Post-test observation.

Discussion

Researcher hypothesized that dynamic postural stability of experimental group would be better than control group by assessing performance (normalized excursion distance) on star excursion balance test. The Pre-test (715.71) & Post-test (796.14) mean scores of experimental group showed significant difference in SEBT performance (Normalized

excursion distance) on Non-dominant leg (Right leg stance) when compared with the mean difference of control group which proved the effectiveness of Proprioceptive training, which lead to improved dynamic postural stability of experimental group. The result of the present study also reported positive improvement in the trend of performance on SEBT after Proprioceptive training program.

As we know dynamic postural stability is the ability to maintain a constant posture without undergoing functional task which depends on the functioning of lower extremities (knee & hip joint). Joint & muscle proprioceptors receives stimulus and sends the information to central nervous system for further proceedings, which finally helps in maintaining the posture of body during functional task, thus improving dynamic postural stability. Strengthening these proprioceptors through training improves dynamic postural stability.

Fitzgerald, D., Trakarnratanakul, N., Smyth, B & Caulfield, B (2010) [3] reported from their study the effectiveness of wobbleboard based therapeutic exergaming system on dynamic postural stability. Their study suggested improvement in composite score of SEBT performance that improves dynamic postural stability. Betkar *et al* (2006) also examined the same result in relation to dynamic postural stability using therapeutic exergaming system.

Wortmann, M. A & Docherty, C (2013) [9] demonstrated a bunch of 4 relevant studies exploring the effectiveness of balance training on subjects with chronic ankle instability (CAI). They included two randomized controlled trials & two cohort studies. Finding of all the relevant studies suggested 4-6 weeks balance training leads to improvement in dynamic postural stability in subjects with chronic ankle instability.

Filipa, A., Byrnes, R., Paterno, M. V., Myer, G. D., & Hewett, T. E. (2010) [2] conducted a study on 20 uninjured female soccer players. They proved the fruitfulness of SEBT as a tool for assessing dynamic postural stability which was improved due to 8-weeks neuromuscular training program.

The result of the above studies justifies the objective of present study that Proprioceptive training program improves dynamic postural stability using SEBT as a measuring tool.

Conclusion

The present study concluded a positive effect of Proprioceptive training on SEBT performance (Normalized Excursion Distance) on Non-dominant leg (Right leg stance) since the Pre & Post, mean scores of experimental & control group shows significant difference. 44% improvement in Star Excursion Balance Test (SEBT) performance in Kho-Kho players was observed due to the intervention of Proprioceptive training. It is recommended that sports personnel should use Proprioceptive training program for other sports discipline, which may increase the performance.

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There was no funding from any organization or authorship for the present study.

Researchers found vast area of investigation in relation to Proprioceptive training and its effectiveness on different discipline. Proprioceptors training help in controlling dynamic postural stability. (Sekir & Gur. 2005 [11]; Paterno, Myer, Ford & Hewett, 2004 [10]; Fitzgerald, Trakarnratanakul, Smyth, & Caulfield, 2010 [3]; Hazine *et al*, 2010). Postural control may be defined as the ability to maintain a base of support with least movement as well as the ability to perform a task while maintaining a stable position, Postural control is bifurcated as Static or dynamic categories. There are various instrumented and non-instrumented techniques for assessing static and dynamic balance. The reported sensory information obtained from somatosensory, vestibular & visual systems and motor responses that affect joint range of motion (ROM), coordination & strength are the factors influencing balance. (Grigg, 1994 [8]; Neshner, Black & Wall, 1982) [12].

Gribble, Hertel, Denegar & Buckle (2004) [7] Researchers found vast area of investigation in relation to Proprioceptive training and its effectiveness on different discipline. Proprioceptors training help in controlling dynamic postural stability. (Sekir & Gur. 2005 [11]; Paterno, Myer, Ford & Hewett, 2004 [10]; Fitzgerald, Trakarnratanakul, Smyth, & Caulfield, 2010 [3]; Hazine *et al*, 2010). Postural control may be defined as the ability to maintain a base of support with least movement as well as the ability to perform a task while maintaining a stable position, Postural control is bifurcated as Static or dynamic categories. There are various instrumented and non-instrumented techniques for assessing static and dynamic balance. The reported sensory information obtained from somatosensory, vestibular & visual systems and motor responses that affect joint range of motion (ROM), coordination & strength are the factors influencing balance. (Grigg, 1994 [8]; Neshner, Black & Wall, 1982) [12].

Gribble, Hertel, Denegar & Buckle (2004) [7] reported the effect of fatigue & chronic ankle instability on dynamic postural control using Star excursion balance test. The excursion distance for anterior, medial & posterior was assessed on SEBT before and after fatiguing situations on both the legs. They noticed a positive influence of chronic ankle instability and fatigue on dynamic postural control. reported the effect of fatigue & chronic ankle instability on dynamic postural control using Star excursion balance test. The excursion distance for anterior, medial & posterior was assessed on SEBT before and after fatiguing situations on both the legs. They noticed a positive influence of chronic ankle instability and fatigue on dynamic postural control.

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Reference

1. Betkar AL, Szturm T, Moussavi ZK, Nett C. Vedio game- based exercises for balance rehabilitation: a single-subject design, Arch Phys. Med Rehabilitation. 2006; 87:1141-1149.
2. Filipa A, Byrnes R, Paterno MV, Myer GD, Hewett TE. Neuromuscular traibning improves performance on the star excursion balance test in young female athletes. Journal of orthopaedic& Sports physical therapy. 2010; 40(9):551-558.
3. Fitzgerald D, Trakarnratanakul N, Smyth B, Caulfield B. Effects of a wobble board-Based therapeutic Exergaming System for balance training on dynamic postural stability and intrinsic motivation levels, Journal of Orthopaedic & Sports physical therapy. 2010; 40(1):11-19.
4. Gribble PA, Hertal J. Considerations for normalizing measures of the star excursion balance test. Measurement in physical education and exercise science. 2013;

7(2):89-100.
5. Gribble PA. The Star Excursion Balance Test as a measurement tool, Athletic Therapy Today. 2003; 8(2):46-47.
6. Hertel J, Miller S, Denegar C. Intratester and intertester reliability during the star excursion balance test. Journal of Sport Rehabilitation. 2000; 9(2):104-116.
7. Gribble PA, Hertel J, Denegar CR, Buckley WE. The effect of Fatigue and Chronic Ankle Instability on Dynamic Postural Control. Journal of Athletic training. 2004; 39(4):321-329.
8. Grigg P. Peripheral neural mechanisms in proprioception. Journal of sports rehabilitation. 1994; 3:2-17.
9. Wortmann MA, Docherty C. Effect of Balance Training on Postural stability in subjects with chronic ankle instability. Journal of Sports rehabilitation. 2013; 22:143-149.
10. Paterno MV, Myer GD, Ford KR, Hewett TE. Neuromuscular training improves single limb stability in young female athletes. Journal of Orthopaedic & Sports Physical Therapy. 2004; 34(6):305-316.
11. Sekir U, Gur H. A multistation proprioceptive exercise program in patients with bilateral knee osteoarthrosis : Functional capacity, pain & Sensoriomotor function. A Randomized controled trail. Journal of sports science & medicine. 2005; 4:590-603.
12. Neshner LM, Black FO, Wall C 3rd. Adaptation to altered support and visual conditions during stance: patients with vestibular deficits. Journal of Neuroscience. 1982; 2:536-554.
13. Donahoe B, Turner D. Worrell T. The use of functional reach as a measurement of balance in boys and girls without disabilities ages 5 to 15 years. Pediatric Physical Therapy. 1994; 6:189-193.
14. Kinzey S, Armstrong C. The reliability of the star excursion balance test in assessing dynamic balance. Journal of Orthopedic and sport physical therapy. 1998; 27:356-360.
15. Chan YH. Biostatistics 101: Data presentation. Singapore medicine journal. 2003; 44(6):280-285.
16. Clark HH, Clark DH. Research process in physical education. Englewood cliffs, New Jersey: Prentice Hall, Inc., 1975
17. Verma JP. A text book on Sports Statistics. Gwalior: Venus Publications, 2000.
18. Verma V. Sports and spirituality. New Delhi: Sports Publication, 2007.
19. Gray GW. Lower Extremity Functional Profile. Adrian, MI: Wynn Marketing, Inc., 1995.
20. Edward L. fox. The physiological basis of physical education and athletics. Dubuque (IOWA): Wm. C. Brown publishers, 1989, 143-155.
21. Retrieved on 02/09/2017 from https://en.wikipedia.org/wiki/Kho_kho.