Relationship between Dynamic Balance and Agility in Trained Soccer Players – A Correlational Study

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Abstract- Background: Performance in athletic activities demands stability as well as accuracy in functional movements. Agility involves moving laterally and changing directions rapidly, which is most apparent in sports like soccer. Although studies have examined balance and agility performances of soccer players, research that evaluates the relationship between these components in university players is rather limited. Hence, the purpose of this study was to determine if dynamic balance in soccer players was related to the agility skill.

Methods: A total of 44 university male football players (age 24.64 ± 1.38 years) were recruited in this cross sectional study using convenience sampling. The Y Balance Test- Lower Quarter (YBT-LQ) was used to assess dynamic balance in the anterior, posterolateral and posteromedial directions. Agility was evaluated using the modified agility T-test. Karl Pearson correlation coefficient was used to estimate the relationship between the variables.

Results: The modified agility T-test scores had a strong negative correlation with YBT-LQ composite scores, and reach distance in each direction viz., anterior, posterolateral and posteromedial (r = -.925, -.720, -.754 and -.853 respectively) which was statistically significant ($p<0.05$).

Conclusion: The balance measures were significantly related to agility performance. These results suggest the use of appropriate testing and training procedures so as to improve balance and agility performance.

Index Terms- agility prediction, balance performance, SEBT, T-test

Abbreviations: SEBT: Star Excursion Balance Test; YBT-LQ: Y Balance Test-Lower Quarter;

I. Introduction

Agility is perceived as the capacity to change directions easily, and to quickly start and stop.[1] Some authors described agility as the ability to maintain and regulate correct positions of the body while rapidly changing direction through a series of movements.[2] This skill is a determinant of sport success in field and court competition, demonstrated by analysis of time-motion, evaluation of testing batteries for elite and non-elite athletes, and coaching analyses for different team sports.[3]

Soccer involves multiple sprints consisting of various explosive motions such as forward and backward shuffles, to be executed at varying intensities during a match.[4] Whether attacking or defending, agility skill requires the ability to perceive and respond rapidly and accurately to relevant information about opponent's movements. Owing to its various embodiments (forward-backward, rotational, lateral, etc.), agility is challenging to generally develop through strength and conditioning training.[5] Dynamic balance refers to maintaining equilibrium during motion or re-establishing equilibrium by rapidly and successively shifting positions.[6] Soccer requires a unipedal balance to execute various technical motions such as dribbling, shooting and passing.[7] Players must learn compulsory motor skills and monitor their posture during the match, while using visual inputs about the opposing team members.[8] Authors claim that apart from speed and explosive strength, balance training should be considered as one of the main features of improving agility.[9]

Miller et al. reported that the improvement in balance and control of body positions during complex movements could enhance agility.[10] This theory seems plausible because agility performances have a pattern of stop and-go movement pattern, where equilibrium is likely to have a major impact on the efficacy of the directional change. In other words, body segments appear to retain the direction of movement due to inertia, while balance capacity ensures positioning stability and a subsequent change of direction.[11] Studies testing dynamic balance and agility in team handball and in male basketball players showed a substantial increase in agility performance.[12,13]

Existing literature based on enhancing athletic performance indicates connections between balance and agility. However, no study has explored the correlation among these measures in male university soccer players. Therefore, the purpose of this study was to estimate the relationship between agility and dynamic balance in university soccer players. Such awareness can help coaches and trainers identify suitable testing and training methods with the aim of enhancing performance.

II. METHODS

In this descriptive cross-sectional study, a total of 80 male soccer players between ages 20 to 30 years were screened for the eligibility criteria. Zonal and University healthy soccer players, with 3 or more years of competitive experience, practicing regularly for minimum 2 hours/day for at least 3 days/week and not involved in any balance training program apart from their typical sports training were included in the study. Recreational soccer players, and those who reported vestibular problems, low back pain or lower limb injuries that required treatment or that may have impeded performance in the past year, those who had undergone lumbar spine or any lower extremity surgery in the past 6 months were excluded from the study. The study was undertaken between March 2018 to March 2019. A written informed consent was obtained from each participant. The study was approved by the ethics committee of A J Institute of Medical Sciences, Mangalore.

Procedure:

An initial examination including demographic data and anthropometric variables such as BMI, limb length and leg dominance was carried out prior to the study. They participated in assessment of dynamic balance using the Y Balance Test – Lower Quarter (YBT-LQ) and agility using modified agility T-test. The subjects performed the tests wearing their choice of shoes (excluding the balance testing, which was completed barefoot). The first day of testing consisted of anthropometrics and the balance measurements. The second day was used for the modified agility T-test. To account for diurnal variation in fitness abilities, all the tests were performed at the same time (4-6 PM) and same day.

Outcome Measures:

The Y Balance Test – Lower Quarter:

The participants performed the YBT-LQ in the anterior, posterolateral and posteromedial directions.[14-16] Verbal instructions and visual demonstration of the test were given by the therapist before performing the test. During the test, both hands were held at the iliac crest. The leg used for kicking the ball during game was used as the stance limb, with the distal most part of the great toe set at the intersection of the three measuring tapes taped to on the floor (Figure 1). While they maintained the single-leg stance, they were to use the opposite leg to reach on the line along the respective directions, touch the ground at the farthest point possible with the distal most part of the great toe and return to the starting position. In order to rule out the influence of shoes, the test was performed barefoot. After three practice trials, the subjects were asked to rest for two minutes and thereafter perform three test trials in each direction. At each test trial, the order of the reaching directions was randomized. If a subject failed to maintain the stance leg or in returning the reaching foot to the starting position, the test was discarded and repeated over again. In each direction, the longest reach distance was used for further analysis. To exclude the influence of limb length, it was normalized with the reach distances of the subject.[17,18] The limb length was measured from the anterior superior iliac spine to the center of the ipsilateral medial malleolus.[18] The composite score was calculated using the formula: {sum of three directions/(limb length*3)*100}.[14]

Modified agility T-test:

Agility was assessed using the modified agility T-test protocol outlined by Sassi et al.[19] A stopwatch was used to record the time taken to complete the test. The players carried out the test using the same instructions as the standard T-test, except they did not have to move laterally or face forwards (Figure 2). Instead of its base, the players had to hit the top of the cones. A-B displacement (5-m): each subject sprinted to cone B at his own discretion, and touched the top of the cone with his right hand. B-C displacement (2.5-m): the player shuffled left to cone C facing forward and reached the top of the cone with his left hand. C-D displacement (5-m): the subject then shuffled to cone D to the right and touched the top. D-B displacement (2.5-m): the participant shuffled the cone B back to the left and reached the centre. B-A displacement (5-m): the player ran as fast as possible and returned line A. Two maximum tests were performed, and the best time was further subjected to statistical analysis.

Sample size and Sampling

A sample size was estimated with 95% confidence level and 80% test power based on the parameters of Sharma et al. where the Karl Pearson correlation coefficient (r value) was 0.547.[21] This showed that the ideal sample size for the study would be 44. The study subjects were recruited using convenience sampling on the basis of the inclusion and exclusion criteria.

Data Analysis

Statistical package SPSS (IBM SPSS Statistics for Windows, ver. 21.0. Armonk, NY: IBM Corp.) was used to analyze the data. Demographic data and descriptive characteristics of the outcome measures were presented as Mean and Standard Deviation (SD). Correlation between T-test and YBT-LQ composite scores and reach distance in each direction viz. anterior, posterolateral and posteromedial was analysed using the Karl Pearson correlation coefficient (r value). Statistical significance was inferred at $p < 0.05$.

III. RESULTS

Out of 80 subjects that were initially screened for the study, 31 subjects did not meet the inclusion criteria (22 players had less than 3 years of experience; 9 players had a history of recent lower limb injury). Then, 49 subjects were recruited in the study, out of which 4 dropped out due to personal reasons. Finally, data collected from 45 players was subjected to statistical analysis.
Then mean age and BMI of the participants was 24.64 ± 1.38 years and 23.93 ± 1.08 kg/m^2 respectively. The descriptive statistics of the primary outcome measures are described in Table 1.

The Karl Pearson correlation co-efficient showed a strong negative relationship between the modified agility T-test and YBT-LQ composite scores and the reach distance scores in the anterior, posterolateral and posteromedial directions ($p<0.05$) (Table 2). Figure 3 displays the scatter plot diagrams that illustrate a strong negative relationship between the modified agility T-test and YBT-LQ scores.

IV. DISCUSSION

The findings of this study revealed that the YBT-LQ composite scores and maximum reach in each direction highly correlated with the scores of the modified agility T-test. Similar to these results, Sekulic et al. also found in their analysis that agility had the most pronounced effect of balance on agility in men.[11] They indicated that the subjects exhibited lateral movements during the T-test. In such motions, the feet rotate, and because of the limited ankle and knee lateral flexibility, stability is compromised. Therefore, during such performance, the influence of the balance is much more conspicuous.

The ability to accelerate and decelerate rapidly while moving forward and quick changes in movement from side to side is critical to succeed in the agility test. Since these movements cause regular COG disruptions that requiring efficient neuromuscular control adaptations, one's ability to maintain dynamic balance efficiently can positively affect agility performance. These claims have also been proven by Davlin and Hrysomallis in their studies.[6,22] In this study, the correlation between agility and balance is higher than those previously identified by Sekulic and Bayraktar, where they reported low (0.37) to moderate (0.58, 0.41) correlations.[11,13] These discrepancies in the obtained results can be due to the variations in subjects included and the testing procedures.

We also noted that the YBT-LQ composite scores and maximum reach distance scores were high in our study. Literature states that sports requiring agility skills have demonstrate superior unipedal static and dynamic balance compared to the non-athletic counterparts.[23] Our results generally support previous findings where lateral movements showed the highest correlations with balance.[11] Posteromedial and especially posterolateral reaching distances showed higher correlations with the agility test than the anterior direction, probably due to the lower balance disruptions during this position.

Soccer players, independent of playing position, perform high-intensity work such as agility for short periods and have longer periods of low intensity movements and rest. Hamza et al. assessed the static and dynamic balance performance of soccer players based on their positions and concluded that dynamic balance is more crucial among the midfielders.[24] Midfielders are the link between the defenders and forwards. They have a couple of different roles, both in the defending part and in the team's offense. Also, midfielders are the ones who generally cover most distance during a soccer game. However, our study did not address this argument.

Several limitations of this study should be considered. First, the sample size was small and the participants were all male university soccer players. Thus, further confirmation of these results must be done in more diverse populations, including female athletes and larger samples. Second, this study did not include the other qualities that could be judged as important in agility tasks, for example flexibility and cognitive variables. Third, the use of photoelectric cells and the YBT-LQ grid could have provided greater accuracy in our results and may be a limitation. However, the use of a manual stopwatch and floor adhered measuring tapes are much cheaper and feasible in this kind of setting.

V. CONCLUSION

A statistically significant relationship exists between balance ability and agility skill among soccer players. It is evident that balance can be an important component of fitness for male players at university. Therefore, physical therapists, coaches and trainers should recommend using balance training exercises to enhance players' dynamic balance, aiming to develop agility skills and overall performance.

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Figure 1: Directions of the Y Balance Test – Lower Quarter. A: Anterior; B: Posterolateral; C: Posteromedial

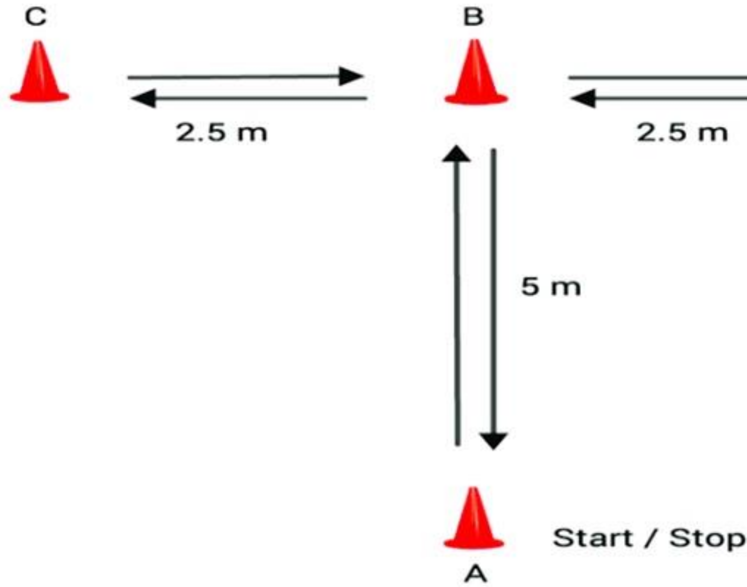

Figure 2: Outline for modified agility T-test
Note: Reprinted from Ramirez-Campillo R et al.[20]

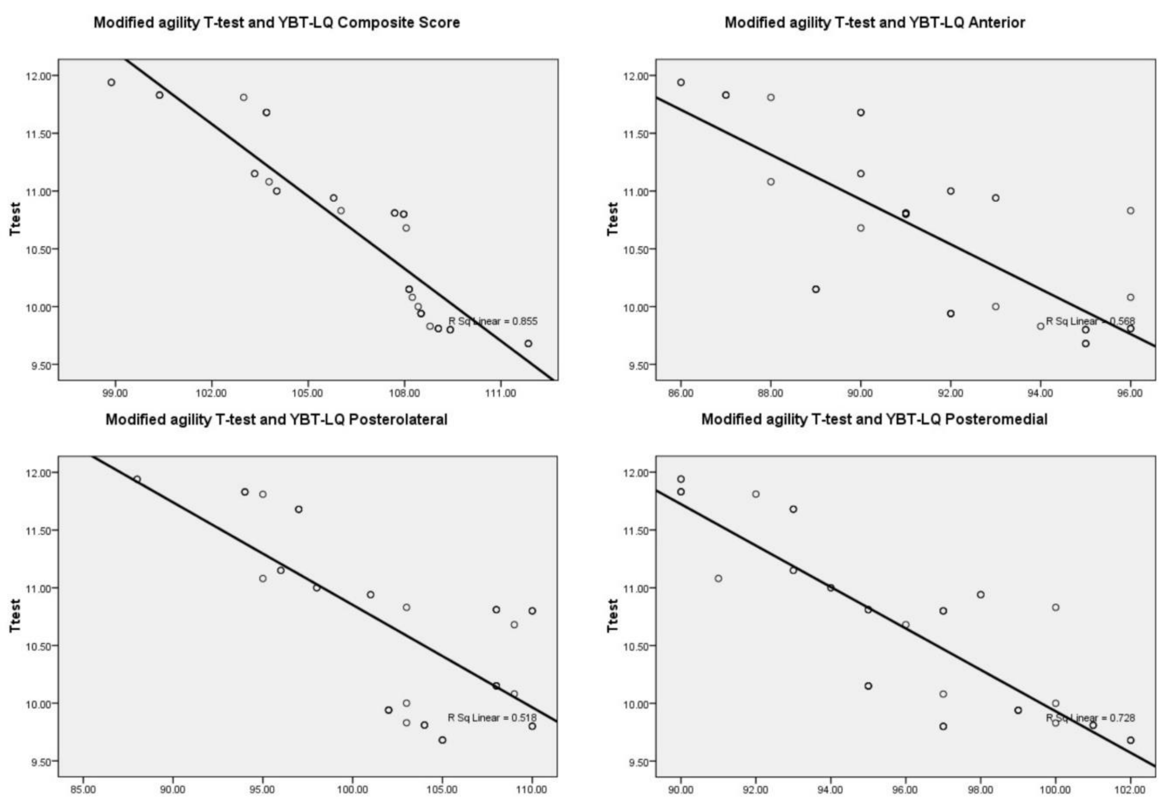

Figure 3. Scatter plot diagrams showing strong negative correlations between modified agility T-test and the YBT-LQ composite scores and the reach distance scores in the anterior, posterolateral and posteromedial directions

Table 1: Descriptive characteristics of outcome measures				
Outcome Measure	**N**	**Minimum**	**Maximum**	**Mean ± SD**
Modified agility T-test (in seconds)	45	9.68	11.94	10.63 ± 0.76
YBT-LQ Composite Score (in cms)	45	98.87	111.85	106.52 ± 3.37
YBT-LQ Anterior (in cms)	45	86	96	91.50 ± 2.95
YBT-LQ Posterolateral (in cms)	45	86	110	102.43 ± 6.15
YBT-LQ Posteromedial (in cms)	45	90	102	96.06 ± 3.61
N= Number of participants; SD= Standard Deviation; YBT-LQ= Y Balance Test- Lower Quarter				

Table 2. Karl Pearson Correlation between outcome measures		
	YBT-LQ	r value *
Modified agility T-test	Composite score	-.925
	Anterior	-.720
	Posterolateral	-.853
	Posteromedial	-.754
*Correlation significant at the 0.01 level (2 tailed) r value= Karl Pearson correlation coefficient; YBT-LQ= Y Balance Test- Lower Quarter		