
ORIGINAL RESEARCH

COMPARISON OF DYNAMIC BALANCE IN ADOLESCENT MALE SOCCER PLAYERS FROM RWANDA AND THE UNITED STATES

Robert J. Butler, DPT, PhD^{1,2,3}

Robin M. Queen, PhD³

Brian Beckman, BS⁴

Kyle B. Kiesel, PhD, PT, ATC^{5,6}

Phillip J. Plisky, DSc, PT, ATC^{5,6}

ABSTRACT

Purpose/Background: Dynamic balance is an important component of motor skill development. Poor dynamic balance has previously been associated with sport related injury. However, the vast majority of dynamic balance studies as they relate to sport injury have occurred in developed North American or European countries. Thus, the purpose of this study was to compare dynamic balance in adolescent male soccer players from Rwanda to a matched group from the United States.

Methods: Twenty-six adolescent male soccer players from Rwanda and 26 age- and gender-matched control subjects from the United States were screened using the Lower Quarter Y Balance Test during their pre-participation physical. Reach asymmetry (cm) between limbs was examined for all reach directions. In addition, reach distance in each direction (normalized to limb length, %LL) and the composite reach score (also normalized to %LL) were examined. Dependent samples t-tests were performed with significant differences identified at $p < 0.05$.

Results: Twenty-six male soccer players from Rwanda (R) were matched to twenty-six male soccer players from the United States (US). The Rwandan soccer players performed better in the anterior (R: 83.9 ± 3.2 %LL; US: 76.5 ± 6.6 %LL, $p < 0.01$), posterolateral (R: 114.4 ± 8.3 %LL ; US: 106.5 ± 8.2 %LL, $p < 0.01$) and composite (R: 105.6 ± 1.3 %LL; US: 97.8 ± 6.2 %LL, $p < 0.01$) reach scores. No significant differences between groups were observed for reach asymmetry.

Conclusions: Adolescent soccer players from Rwanda exhibit superior performance on a standardized dynamic balance test as comparison to similar athletes from the United States. The examination of movement abilities of athletes from countries of various origins may allow for a greater understanding of the range of true normative values for dynamic balance.

Levels of Evidence: 3b

Keywords: Global, Injury risk factor, Star Excursion Balance Test

¹ Duke University, Durham, NC, USA

² Duke Health Systems Physical Therapy Sports Medicine Division, Durham, NC, USA

³ Michael W. Krzyzewski Human Performance Research Laboratory, Duke University, Durham, NC, USA

⁴ Play for Hope, Kigali, Rwanda

⁵ University of Evansville, Evansville, IN, USA

⁶ ProRehab PC, Evansville, IN, USA

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CORRESPONDING AUTHOR

Robert J. Butler

Duke University

DUMC 104002

Durham, NC 27705

Phone: 919.681.7225

Email: robert.butler@duke.edu

INTRODUCTION

Musculoskeletal injuries are one of the most common medical reports associated with participation in soccer.¹⁻³ To curb these trends, a number of studies have researched screening protocols designed to identify athletes at the greatest risk for injury and develop corrective strategies.⁴ While this is an important concept, it should be noted that the single strongest predictor of injury in soccer is prior injury.⁵⁻⁷ Although previous injury itself is non-modifiable, it may be of value to consider the modifiable motor control risk factors that tend to be unresolved following injury. One of the factors that have been reported to be altered following an injury is dynamic balance.⁸⁻¹⁰ Standardized criteria to measure and assess balance may be helpful in ensuring athletes readiness to return to play, however before this can be determined factors that affect the interpretation of any standardized measure should be examined.¹¹⁻¹³

The Star Excursion Balance Test (SEBT) has shown promise as a return to sport test due to its ability to identify motor control deficits that remain following injury in people with chronic ankle instability and anterior cruciate ligament (ACL) deficiency.¹⁴ In addition, the SEBT was found to be predictive of injury risk in high school basketball players, college football players, and active college students.¹¹ Asymmetry in the anterior reach direction as well as a poor composite reach score when compared to the risk cut point for the same age, gender, and sport group indicates that some athletes have an elevated risk of musculoskeletal injury.¹¹ Additional research has suggested that limited posterolateral reach ability is associated with an elevated risk of ankle injuries in active adults.¹⁵ The ability of this test to predict injury risk supports the inclusion of such a test in pre-participation assessments. In addition, an assessment of dynamic balance is relevant for return to play standards given that this movement based construct has previously been associated with lower extremity injury and is likely important to normalize prior to returning athletes to the field following injury.¹⁶ Currently, dynamic balance performance has been shown to be affected by age, gender, and sport played, however, one area that has not yet been examined are potential performance differences that are due to differences in country of origin.^{11,12,17}

Assessments across countries of origin are often completed to examine differences in various factors such as health or education. These comparisons are desirable in order to look beyond the local environment to establish how a given society compares to its peers from different cultures.^{18,19} This type of comparison across countries of origin has yet to be completed in the area of dynamic balance. Comparing dynamic balance across different countries of origin may lend insight to clinicians with regards to values that are possible, and potentially optimal, as opposed to that which are common. These comparisons may be particularly helpful in understanding the potential range of values for dynamic balance.

In order to examine if differences exist in athletes' dynamic balance from different countries of origin, data from a group of adolescent male soccer players from the United States was compared to data from a similar aged cohort of soccer players from Rwanda. An improved understanding of cross cultural abilities in dynamic balance could help to further define objective return to sport values for dynamic balance. Such objective values could ultimately help assess the effect of previous injury on subsequent injury risk. Based on a lack of previously published data in this area, the null hypothesis was assumed for all between-group measures for dynamic balance.

METHODS

In order to examine the differences in dynamic balance across athletes from different countries, an a-priori sample size estimate was performed using data on adolescent male soccer players from the United States. In addition to this information, an $\alpha = 0.05$ and a $\beta = 0.20$ was utilized along with an expected clinically relevant difference of 10% for the sample size calculation. The combination of these factors provided an estimate that 21-25 subjects would be required to observe a statistically significant difference. All subjects (both in the United States and Rwanda) completed a pre-participation physical during which they completed a dynamic balance assessment. After the completion of all pre-participation physicals, the data from both groups were de-identified by the testers and were sent to the research team for analysis. The Rwandan cohort contained 26 adolescent (between the ages of 14-18) male soc-

cer players. They were matched by age and gender to control subjects from a de-identified database of high school soccer players from the United States. This protocol utilized a retrospective assessment of previously collected, de-identified data and received Ethics approval from the Institutional Review Board at the site of the primary author.

Dynamic balance data were assessed using the Lower Quarter Y Balance Test (YBT-LQ) protocol, a validated derivative of the SEBT, which included use of the Y Balance Test Kit.^{14,20} All testers completed the free online training (move2perform.com, Evansville, IN) for the YBT-LQ protocol and were certified to collect YBT-LQ data. The onsite testers in Rwanda were trained in the United States by one of the authors of the original protocol and were determined to be capable of collecting reliable and reproducible YBT-LQ data using the standardized methods before completing onsite testing in Rwanda. All YBT-LQ collection occurred as part of the standard medical physical for sport participation in both cohorts. Any athlete who was painful at the time of testing or ineligible for athletic competition did not complete the YBT-LQ testing and his data was not included in the analysis.

The YBT-LQ examines an individuals' dynamic unilateral balance and consists of reaching in three independent directions (anterior, posteromedial, and posterolateral) while standing on the opposite leg²¹ (Figure 1). All testing began with 6 practice repeti-

tions in each reach direction and on each foot in order to lessen the learning effect of the testing protocol. Performance trials were conducted beginning with a set of 3 repetitions for the right leg followed by 3 repetitions for the left leg for the anterior reach followed by 3 repetitions of posteromedial and posterolateral reaches. The trials were named for the stance leg utilized during each reach. The previously described protocol was completed according to the standardized procedure established by Plisky and colleagues.²¹ In addition, each subject's lower extremity limb length was measured in supine with a cloth tape measure from the inferior aspect of the anterior superior iliac spine to the inferior aspect of the medial malleolus only on the right leg. The limb length measurement allowed for the normalization of the reach distance to control for inherent anthropometric differences between groups. The maximum reach values for each limb in each reach direction were utilized to assess dynamic balance. From these data, the composite reach distance was calculated by summing the maximum reach distance for the three reach directions on a given limb and dividing by three times the limb length prior to multiplying by 100 in order to reference the composite reach as a percentage of leg length (% LL). Composite reach distance was calculated using the following equation:

$$\left(\frac{\text{Maximum Anterior} + \text{Maximum Posteromedial} + \text{Maximum Posterolateral}}{3 * \text{limb length}} \right) * 100$$



Figure 1. Examples of the Lower Quarter Y Balance testing in Rwanda (a) anterior; b) posteromedial; c) posterolateral.

The variables of interest were extracted from the calculated data following the YBT-LQ assessment. The first set of variables consisted of the composite reach scores and normalized reach distance (cm/LL = % LL) for each independent reach direction. Since previous research has suggested that no bilateral differences exist, left and right sides were averaged for each subject to provide the discrete variable to represent the athletes' performance for each direction as well as for the composite reach.¹² The second set of analyses assessed reach asymmetry for each reach direction. In order to examine this variable, the absolute value of the bilateral difference in the non-normalized reach scores for each direction was calculated (cm). It should be noted that reach asymmetry for the composite score was calculated using the absolute difference in %LL.

Statistical analysis was carried out using independent samples t-tests. An $\alpha = 0.05$ was used to identify statistical significance. In addition, an effect size index (ESI) was calculated for each variable in order to increase the understanding of the potential clinical relevance of the difference between groups. ESI was calculated as the absolute value of the mean difference between groups divided by a pooled standard deviation.

RESULTS

Twenty-six adolescent male soccer players from Rwanda were matched by age and gender with twenty-six adolescent male soccer players from the United States. The results of the matching process yielded groups without statistically different ages ($p = 0.20$; R: 16.5 ± 1.2 years, US: 16.1 ± 0.9 years) and leg lengths ($p = 0.68$; R: 92.0 ± 4.1 cm, US: 91.5 ± 4.8 cm).

Differences in dynamic balance across the groups existed for all reach directions, however, the anterior and posterolateral directions and the composite score revealed statistically significant differences (Figure 2). For all reach directions the Rwandan athletes exhibited greater reach scores than the American athletes. In the anterior reach direction the Rwandan athletes exhibited a normalized reach of 83.9 ± 6.2 %LL while the United States' athletes exhibited a normalized reach of 76.5 ± 6.6 %LL ($p < 0.01$, ESI = 1.15). The posterolateral reach direction was also higher in the Rwandan athletes (114.4

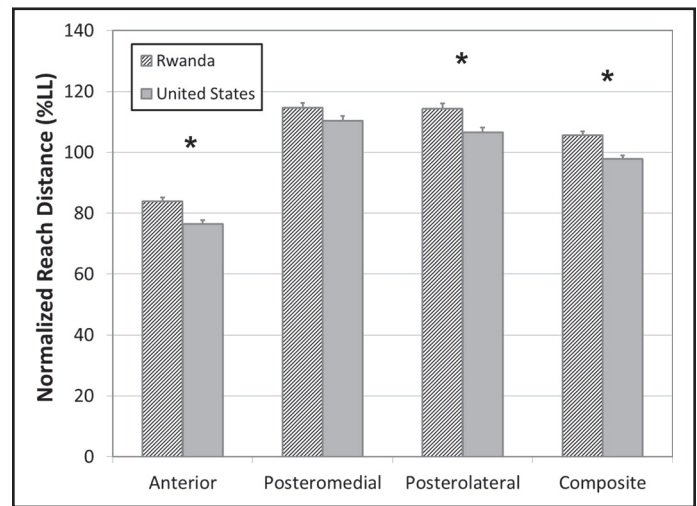


Figure 2. Lower Quarter Y Balance Test scores for all reach directions and the composite score [mean \pm sem] cm, * = $p < 0.05$.

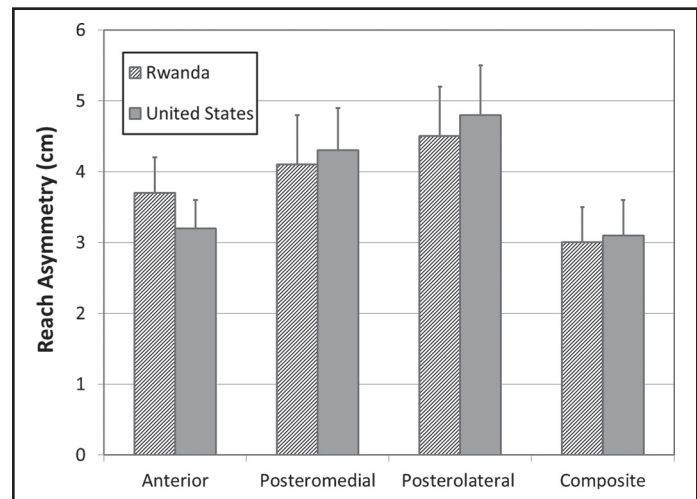


Figure 3. YBT-LQ asymmetry scores for all reach directions and the composite score [mean \pm sem] cm with the exception of composite reach which is reported as %LL.

± 8.3 %LL) compared to the United States' athletes (106.5 ± 8.2 %LL, $p < 0.01$, ESI = 0.96). These reach direction findings contributed to a higher composite reach score in the Rwandan athletes (105.6 ± 6.8 %LL) compared to the United States' athletes (97.8 ± 6.2 %LL, $p < 0.01$, ESI = 1.22).

Bilateral asymmetry in dynamic balance was not observed to a statistically significant level for any of the reach directions (Figure 3). The range of differences between groups was 0.1-0.5 cm which is associated with an effect size index from 0.03-0.25.

These differences were neither statistically significant nor considered clinically relevant.

DISCUSSION

Dynamic balance is an important factor associated with injury and performance in athletes.¹⁶ Performance on dynamic balance has previously been determined to depend on an individual's age, competition level, gender, and sport.^{11,13,17} The results of this study suggest that dynamic balance may also differ based upon an individual's country of origin. In the current study, the adolescent male soccer players from Rwanda exhibited better dynamic balance, as measured by the SEBT, when compared to their counterparts from the United States. These results may suggest a reconsideration of the traditional United States definition of normal unilateral lower extremity function.

The results of the current study suggest that across all dynamic balance measures of maximum reach, the Rwandan male adolescent soccer players exhibited superior performance over their counterparts from the United States. Interestingly, no differences were observed for reach asymmetry for any of the independent reach directions. The finding for maximum normalized reach is contrary to the initial null hypothesis, while the finding for reach asymmetry is congruent with our initial hypothesis. Since, to the authors' knowledge, this is the first study that assessed dynamic balance between athletes from different countries, a new level of understanding is now available to those who assess dynamic balance. A literature review by Hrysomallis²² recently suggested that dynamic balance is different between sports and dynamic balance also tends to improve across level of competition. Similar findings were observed in a recent study examining dynamic balance ability across competition levels in male soccer players using the YBT-LQ protocol.²³ Across competition levels there was an increase in dynamic balance performance (Professional, College > High School). Interestingly, this trend did not exist for the isolated anterior reach direction on which the high school athletes outperformed the college and professional soccer players. The Rwandan adolescent soccer players in the current study exhibited greater anterior reach scores than all of subject groups in the

aforementioned study, while they exhibited similar posteromedial and posterolateral reach scores as the college and professional athletes.²³ This combination of factors results in the Rwandan soccer players exhibiting a greater composite reach (105.6 ± 1.3 sem %LL) than the college (100.9 ± 0.8 sem %LL) and professional (101.8 ± 1.2 sem %LL) soccer players from the prior study.²³ While the differences are apparent, the interpretation of what the differences mean is not as clear. All that can currently be stated is that adolescent male soccer players from the United States have decreased dynamic balance when compared to adolescent male soccer players from Rwanda. It could be extrapolated, that due to the differences in available technology for the athletes recreational activities it is likely that the athletes from Rwanda had less of a sedentary lifestyle outside of their athletic participation and as a result exhibit an increased in dynamic balance. Previous research by Duncan and colleagues²⁴ has positively correlated activity with functional movement pattern competency in a pre-adolescent population. Decreased activity levels may have led to the differences in dynamic balance observed in the current study. Other differences in footwear, general levels of dynamic balance in society and training strategies may have led to these differences as well. Further research is warranted in this area to identify what specifically led to the improved dynamic balance scores in the Rwandan athletes.

A few limitations of this study should be noted. The first limitation is the lack of data collection on height and weight variables. This was attributed to the conditions during data collection in Rwanda and the transport of such measurement systems. Previous research has correlated limb length to height, which may provide an ancillary measure from which the authors can suggest that the heights were similar. However, this relationship may be different depending on an individuals' phenotype. This information would have assisted the research team in identifying whether the changes in dynamic balance were associated with any specific anthropometric differences. In addition, the study would have benefitted from an examination of each athlete's previous injury history. However, due to the retrospective nature of this study, the previous injury history was not available.

It is possible that changing the exclusion criteria so that individuals with an ankle sprain in the past year were excluded could have influenced the study findings, due to the potential impact of previous ankle sprains on YBT-LQ performance.⁹ Finally, no information on training sessions, training curriculum, or the inclusion of neuromuscular training programs during these sessions could be obtained for comparison which may have affected the dynamic balance performances of these two groups.

CONCLUSION

The results of this study suggest that normative values for dynamic balance may be influenced by country of origin in addition to the previously established covariates of gender, sport, and competition level. Additional research needs to be conducted in order to identify if dynamic balance has a similar association with non-contact injuries in other cultures/countries as have been observed in the United States. However, it may be appropriate to reconsider what the traditional United States definition of normal performance on the YBT-LQ is and how this could influence what are considered to be dynamic balance standards.

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