

Differences in Soccer Players' Dynamic Balance Across Levels of Competition

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Context: Balance ability has been associated with performance and injury prevention in athletes. Few published reports have investigated the differences in dynamic balance abilities among male high school, collegiate, and professional soccer players.

Objective: To examine the differences on the Lower Quarter Y-Balance Test in male high school, collegiate, and professional soccer players.

Design: Descriptive laboratory study.

Setting: Field testing.

Patients or Other Participants: Dynamic balance data were collected for male high school (HS; $n = 38$), collegiate ($n = 37$), and professional ($n = 44$) soccer players during preparticipation physical examinations using the Lower Quarter Y Balance Test standardized protocol.

Main Outcome Measure(s): For the Lower Quarter Y Balance Test, the participant reaches with 1 foot in the anterior, posteromedial, and posterolateral directions while standing on a centralized stance platform with the other foot. The test is

performed for both left and right limbs. Differences in reach distances between competition levels were analyzed using a 1-way analysis of variance with significance set at $P < .05$. The HS group had a greater anterior reach distance than the other 2 groups. In contrast, the HS group had less reach distance in the posteromedial and posterolateral directions than the other groups. Also, HS players tended to exhibit a lower composite reach score than the other groups, but this difference was not significant ($P = .08$). No differences were observed among groups for bilateral symmetry in any of the reach directions.

Conclusions: Dynamic balance performance varied with competition level. This may indicate that athletes' movement strategies may be different depending on the competition level and that normative values may need to be established for each competition level.

Key Words: injury prevention, single-leg balance, athletes, Lower Quarter Y Balance Test

Key Points

- Among male soccer players, anterior reach was greater on the Lower Quarter Y-Balance Test in high school athletes than in collegiate or professional athletes.
- In the posteromedial and posterolateral reach directions, the high school players performed worse than did the collegiate and professional players.
- Determining normative values for different competition levels may be helpful in identifying injury-risk thresholds and return-to-activity criteria after lower extremity injury.

Injury incidence in soccer players has been reported to be as high as 18.75 injuries per 1000 athlete-exposures in games and practices.^{1,2} The most common injuries involve the lower extremities, with ankle sprains and internal knee derangements at the top of the list, and result from contact or noncontact mechanisms of injury.^{1–7} The average comprehensive cost per injury in soccer has been reported to be as high as \$10432.⁵ Because of the high injury rates associated with the sport, researchers have focused on field-ready screening tools, and injury-prevention programs have been instituted across different levels of competition to decrease the incidence of injury and associated costs.^{4,7}

Previous investigators^{1–4,6–12} have suggested that the use of an injury-screening tool associated with dynamic balance

may be successful in identifying athletes at risk for injury. *Dynamic balance* is the ability of an individual to maintain stability of the center of mass during movement; as an inherent component of many sporting activities, this is an important construct to examine in relation to injury risk. Specifically, soccer players have inferior balance when compared with gymnasts and dancers but superior balance when compared with basketball players and control participants.^{13–16} Within soccer players and across different levels of competition (eg, national team versus regional team), a higher level of competition was associated with greater dynamic balance.^{17,18} One of the difficulties in establishing a gold standard for dynamic balance is the number of ways in which the construct can be measured.

One tool that assesses dynamic postural control is the Lower Quarter Y Balance Test (YBT-LQ). This test is a variation of the Star Excursion Balance Test, which has been shown to be both valid and reliable as well as being predictive of lower extremity injury in basketball players.^{12,19} An anterior reach difference of 4 cm or more or a composite score less than or equal to 94% of leg length for women on the YBT-LQ during a preparticipation athletic screening is a predictor of lower extremity injury.¹⁹ Because the YBT-LQ is a clinically efficient, field-ready test, understanding how the test can facilitate injury prediction and performance discrimination is beneficial.

Currently, the effect of competition level (ie, high school [HS], collegiate [COL], and professional [PRO]) on YBT-LQ scores in soccer players is unknown. As a result of this gap in the literature, our goal was to determine if differences in average YBT-LQ scores exist across these levels of competition; such information may be beneficial in developing return-to-play criteria for soccer players after injury.^{20,21} Based on previous research,^{17,18} we expected that higher-level soccer players (COL and PRO) would exhibit greater dynamic balance than those at the lower level (HS).

METHODS

The data for this study were collected at multiple sites using a standardized protocol¹⁹ as part of a preseason screening for musculoskeletal function in male soccer players. Participants were currently active in HS (varsity level, $n = 38$), COL (National Collegiate Athletic Association Division I, $n = 37$), or PRO (top PRO leagues in the United States and Germany, $n = 44$) soccer leagues. Descriptive statistics for the group are presented in Table 1. To be included, all participants had to be free of pain at the time of the study and cleared for involvement in soccer-related activities. Participants were excluded if they were currently receiving medical care or had pain during the balance test but not if they had previous experience with the YBT-LQ during rehabilitation or strength and conditioning programs. All data were deidentified and sent to the research team for analysis. This research protocol was approved by the Human Subjects Institutional Review Board at the University of Evansville.

The YBT-LQ is a measure of dynamic balance in unilateral stance that has been deemed to be reliable and valid.¹⁹ The participant reaches with 1 foot in the anterior, posteromedial, and posterolateral directions while standing on the other foot on a centralized stance platform. The test is performed barefoot with both left and right limbs. Following the protocol, each participant was required to perform 6 practice trials before the 3 data-collection trials. With the stance-foot toes immediately behind the start line, the participant was instructed to reach as far as he could while maintaining his balance. Each was instructed that any of the following activities would constitute a failed attempt, after which an additional trial would be performed: (1) touching the reach foot down before returning to the stance platform under control, (2) using momentum (ie, kicking) to move the reach indicator, (3) stepping on top of the reach indicator for support, or (4) losing balance before returning under control to bilateral stance. The amount of rest time between trials was long enough for the rater to record the

Table 1. Descriptive Statistics for Anthropometric Data of Male Soccer Players

Variable	Competition Level (Mean \pm SD)			P Value
	High School (n = 38)	College (n = 37)	Professional (n = 44)	
Age, y	15.6 \pm 1.0	18.8 \pm 1.2	26.2 \pm 4.0	<.01
Weight, kg	75.6 \pm 7.8	76.9 \pm 7.4	78.2 \pm 6.7	.26
Height, m	1.74 \pm 0.10	1.80 \pm 0.07	1.82 \pm 0.06	<.01

reach distance and return the indicator to its starting position. All raters were trained in performing the YBT-LQ protocol. The reach distance in each direction was normalized to the limb length (ie, inferior anterosuperior iliac spine to inferior medial malleolus). The sum of 3 normalized reach distances was then averaged and multiplied by 100 to generate a composite score. In addition, the absolute reach difference between left and right legs was calculated to assess reach symmetry. These specific variables were our primary variables of interest, with the normalized reach directions being averaged between left and right sides.

To compare performance on the YBT-LQ among the groups, we conducted a statistical analysis using 1-way analyses of variance. Statistical significance was set at $P < .05$. Post hoc testing was completed using the Tukey honestly significant difference test to determine where specific differences existed among competition levels. We used SPSS (version 17; SPSS Inc, Chicago, IL) for the statistical analysis.

RESULTS

Limb-length (LL) differences were apparent across the levels of competition ($P < .01$). The PRO group exhibited longer LLs (95.2 ± 5.3 cm) than the HS group (91.6 ± 4.5 cm). The LLs in the COL group (93.5 ± 5.1 cm) were not different from those in the PRO group. A similar finding was observed for height ($P < .01$; Table 1). As expected, the PRO group was older than the COL group, which was older than the HS group ($P < .01$). No differences were observed among groups for weight ($P < .01$).

With respect to normalized reach distances, differences were apparent among the groups (Table 2). As expected, the COL and PRO groups exhibited greater reach distances than did the HS soccer players in the posteromedial and posterolateral directions ($P < .01$ for both; Figure B and C). Surprisingly, the HS group exhibited greater reach in the anterior direction compared with the COL and PRO groups ($P = .03$; Figure A). These differences between reach directions led to the composite reaches being less in the HS group than in the COL and PRO groups, but the finding was not significant ($P = .08$; Figure D).

No differences existed among competition levels for reach asymmetry in any of the reach directions ($P < .05$; Table 2). The values for reach asymmetry were similar among the reach directions independent of group.

DISCUSSION

Few researchers have examined how dynamic balance changes across performance levels in athletes involved in a given sport.²² A review of the literature²² has provided

Table 2. Descriptive Statistics and Statistical Results for the Variables of Interest on the Lower Quarter Y-Balance Test Across the Different Levels of Soccer Competition

Variable	Competition Level (Mean ± SEM)			P Value
	High School (n = 38)	College (n = 37)	Professional (n = 44)	
Average reach, %LL				
Anterior	76.2 ± 1.0	72.8 ± 1.0	72.2 ± 1.3	.03
Posteromedial	111 ± 1.5	115.2 ± 1.3	118.5 ± 1.2	<.01
Posterolateral	108.2 ± 1.5	114.6 ± 1.1	114.7 ± 1.6	<.01
Composite	98.4 ± 1.1	100.9 ± 0.9	101.8 ± 1.2	.08
Average reach difference, cm				
Anterior	3.4 ± 0.1	2.8 ± 0.1	3.3 ± 0.1	.62
Posteromedial	3.9 ± 0.1	3.5 ± 0.1	3.8 ± 0.1	.83
Posterolateral	4.3 ± 0.1	4.2 ± 0.1	3.2 ± 0.1	.20

Abbreviation: %LL, percentage of leg length.

support suggesting that differences in balance ability are apparent both across sports and across performance levels within a given sport. The results of our study support these findings. In general, PRO soccer players exhibited greater dynamic balance during the YBT-LQ than did HS soccer players. This was apparent for all directions except the anterior reach, during which the PRO group exhibited less dynamic balance than did the HS group. These results may

have application for clearing athletes for sport participation based on returning to a normal value for dynamic balance.

The COL and PRO players exhibited greater dynamic balance during the posteromedial reach, posterolateral reach, and composite reach of the YBT-LQ than did the HS players. The values we recorded are similar to previous results on the YBT-LQ, thus validating the testing protocol.^{17,18,23,24} The overall findings are similar to

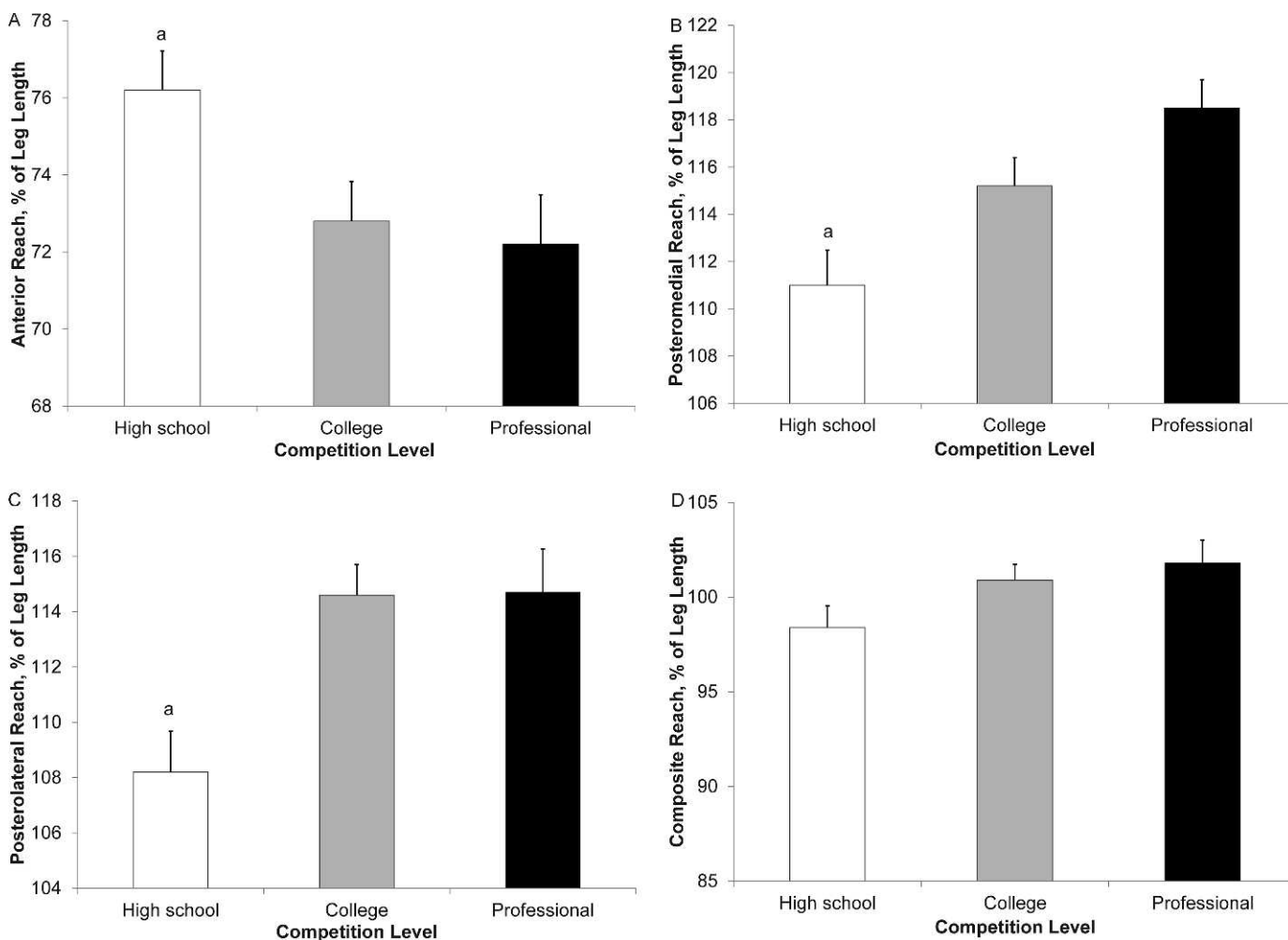


Figure. Results from the Lower Quarter Y Balance Test in the A, anterior, B, posteromedial, and C, posterolateral reach directions and D, the composite reach for male soccer players at 3 competition levels. Data are presented as percentage of leg length, mean ± SEM. ^a Difference in the high school group compared with both the collegiate and professional groups.

findings in other athletic populations that more experienced athletes demonstrated increased dynamic balance. This is likely due to some combination of range of motion, movement abilities, strength, and proprioception, as observed in prior research. Previous investigators²⁵ have suggested that a greater amount of hip motion is required for the posterior reach directions of the Y-Balance Test. This increased motion increases the requirement for the posterior chain musculature to eccentrically control hip flexion. Increased hamstrings recruitment has been observed electromyographically with reaching in the posterior directions.²⁶

Although the COL and PRO players performed better in the posterior reach directions, they did not perform as well in the anterior reach compared with the HS players. The COL and PRO groups scored approximately 4% less on the anterior reach in comparison with the HS group. Previous authors^{27,28} have suggested that individuals with chronic ankle instability score lower on a similar dynamic balance test (the Star Excursion Balance Test) compared with uninjured controls. Because ankle injuries are one of the most common injuries in soccer, poor scores in the older players may be due to the residual effects of multiple ankle injuries.²⁹ However, we did not collect data on prior ankle injuries and so cannot establish any direct relationship. With regard to the anterior reach specifically, this direction has previously been suggested to require the greatest amount of closed chain dorsiflexion.⁹ Not surprisingly, people with a prior ankle injury exhibit less closed chain dorsiflexion in the injured ankle with the knee bent than on the uninjured side.³⁰ Future investigators should examine the ability of the YBT-LQ to predict ankle injuries in this population.

The limitations of our work should be recognized. The study is inherently limited because we only assessed males, and future researchers should determine if similar relationships exist in females. Information on each athlete's injury history might have been helpful in understanding the differences observed for the different reach directions. However, although the injury histories might have assisted in explaining the data, they would not have negated the fact that the longer an individual plays a sport, the greater the risk of injury becomes. Too, it would have been beneficial to assess loaded ankle range of motion to see if this was a significant factor in the anterior reach differences. In addition, we did not ask about playing histories, but we can expect PRO players to have participated in soccer longer than COL or HS players. Also, it would be interesting to see how these athletes compare with athletes in other types of activities (eg, cross-country, crew, swimming, general fitness) to understand how these relationships may change with different types of lower extremity perturbations.

In summary, COL and PRO male soccer players tended to perform similarly on the YBT-LQ, whereas HS male soccer players performed differently. Interestingly, the higher-level soccer players (COL and PRO) performed better for only 2 of the 3 reach directions compared with the HS players. Our results suggest that YBT-LQ scores vary with the level of competition in male soccer players. This may indicate that competition-level-specific normative values are important in determining an individual's performance on the YBT-LQ. Establishing normative values will be beneficial in identifying injury-risk thresh-

olds and return-to-participation criteria after a lower extremity injury that may reduce proprioceptive ability. It will also be interesting to determine if this trend is observed in females as well as in other sports.

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