DIFFERENCES IN PHYSICAL CHARACTERISTICS BETWEEN YOUTH FEMALE SOCCER PLAYERS SELECTED TO ELITE AND COMPETITIVE-LEVEL TEAMS

J. Villalobos and J. Andrew Doyle

Georgia State University, Atlanta, GA

INTRODUCTION: Competitive soccer challenges players' capacities to sprint, change direction, jump, dribble, and strike. Adult players' proficiency in each of these activities has been shown to vary according to level of competition. However, physical capacities of young female soccer players selected to different competitive-level teams remains largely unexplored. **PURPOSE:** To compare physical characteristics of youth female soccer players selected to elite versus competitive-level teams. **METHODS:** Female soccer players (n=60) were grouped according to their current level of competition and participation in "Elite" national, regional or "Competitive" state leagues. During the competition season, 35 Elite (Age: 13.2 ± .1 years; Height: 157.7 ± 8.1 cm; Mass: 50.9 ± 7.8 kg;) and 25 Competitive (Age: 13.2 ± .1 years; Height: 156.4 ± 7.8 cm; Mass: 51.5 ± 11.7 kg;) completed testing in 2 sessions with a minimum 24 hr recovery period between sessions. Session 1 involved a 7-site skinfold test, a DEXA scan, and a maximal effort treadmill test to measure VO2max. Session 2 consisted of field testing performed in the following order: 2 x 30 m Sprint, Illinois Agility Test, and Yo-Yo Intermittent Recovery Test (YOYOIR1). Kenovia software was used for video analysis of players' sprint velocity. An independent t test was used to examine group differences in percent body fat (%), fat mass, lean mass, and bone mass (g), absolute VO2max (L/min), relative VO2max (ml/kg/min), ventilation threshold (VT) (L/min), velocities at VO2 max (vVO2) and VT (vVT) (km/hr), 30 m sprint time (s) and peak velocity (km/hr), Illinois Agility time (s), and YOYOIR1 distance (m). **RESULTS:** Elite players had significantly higher absolute and relative VO2max, faster vVO2, vVT, 30 m sprint time and peak velocity, Illinois Agility time, and greater YOYOIR1 distance (Table 1; $p < 0.05$). No significant differences were observed between elite and competitive-level players for body fat (DEXA: 23.2 ± 4.6 vs. 26.9 ± 8.7 %), fat mass (11,483.9 ± 3,362.5 vs. 13,948.1 ± 7,466.4 g), lean mass (37,014.2 ± 5,521.9 vs. 34,755.9 ± 4,527.6 g), or bone mass (2,112 ± 403.6 vs. 2,079.2 ± 547.6 g). **CONCLUSIONS:** Elite-level U14 female soccer players exhibit significantly greater sprint/running velocities, aerobic and anaerobic capacities better suited for the physical, technical, and tactical demands of match competition. **PRACTICAL APPLICATION:** These results highlight clear differences between elite and competitive-level youth female soccer players' physical characteristics. Coaches may consider using physical testing in addition to skill-based assessment for talent identification. Emphasis should also be given to the design and implementation of specific training in effort to enhance players' physical development.

Introduction

Soccer is recognized as a physically demanding sport requiring players to continuously perform intermittent bursts of activities such as sprinting, changing direction and pace, jumping, tackling, dribbling, passing, and striking during match play (Meylan et al., 2010). Levels of proficiency in these activities varied by players' age, gender, and level of competition. Performance capacity, including VO2max and repeated sprint ability, had been shown to be closely related to standard of play in adult female soccer players (Bangsbo et al., 2008; Bradley et al., 2014; Haugen et al., 2014). However, differences in physical performance capacity among young female soccer players selected to different competitive-level teams had remained largely unexplored.

Youth soccer coaches are responsible for overseeing player development and identifying talented players' readiness for advancement. Existing player development and selection processes appeared to be overly subjective and based primarily on coaches' prior playing and coaching experience. An effort is therefore needed to support coaches' expertise with objective measures of physical and technical soccer performance characteristics specific to youth players' age, gender, and level of competition. Providing coaches with standardized performance references helped ensure players were appropriately placed on teams that best support their development.

The structure of soccer tryouts poses unique challenges for coaches who evaluate and select players for different competitive-level teams within limited time frames. As a result, coaches could unintentionally misjudged players' psychological, tactical, technical, and physical abilities, potentially leading to inappropriate team placement and suboptimal player development. Whether youth soccer players' performance characteristics supported coaches' selection decisions also remain unclear. The purpose of this study was to compare physical performance differences between female youth soccer players selected to different competitive-level teams.

Methods

Participants

Sixty female soccer players under the age of 14 years who were registered with the U.S. Soccer Federation Development Academy (DA), Elite Clubs National League (ECNL), and/or U.S. Youth Soccer Association Georgia clubs participated in this study. Participants provided descriptive information including age, birthdate, years of soccer training, playing position, and current competitive level. All participants completed a battery of physical fitness and biometric assessments. Anthropometric measurements included stature, body mass, body mass index, and body fat percentage. Prior to

participation, players provided written assent approved by the Georgia State University Institutional Review Board, and parents or legal guardians provided written informed consent. Players who were not age-eligible, unregistered, inactive, or injured at the time of testing were excluded.

Design and Procedures

This study employed a cross-sectional design to examine differences in physical performance characteristics between elite and competitive youth female soccer players. Participants were classified as elite or competitive based on current team placement. Players selected to DA or ECNL teams were classified as elite, whereas players registered with state-level Georgia soccer clubs were classified as competitive.

Participants completed two experimental testing sessions separated by a minimum of 24 hours. All testing procedures were explained and demonstrated prior to data collection. Laboratory testing was conducted at Georgia State University's Applied Physiology Laboratory, and field-based testing was conducted at Marathon Park on natural grass. Participants were instructed to refrain from strenuous physical activity and caffeine consumption for 24 hours prior to testing and to consume a light meal 3–4 hours before testing.

Session 1 consisted of body composition assessments and a maximal aerobic capacity test. Body composition was assessed using a 7-site skinfold measurement protocol and dual-energy X-ray absorptiometry (DEXA). Skinfold thickness was measured at the triceps, abdominal, midaxillary, subscapular, quadriceps, chest, and suprailiac sites using Lange skinfold calipers. Percent body fat was estimated using equations recommended by the American College of Sports Medicine. DEXA scanning was used to determine bone mineral content, body fat percentage, and lean mass using a pre-calibrated system.

Maximal oxygen consumption (VO_2max) was assessed using an incremental treadmill protocol. Participants refrained from eating for four hours prior to testing and avoided vigorous exercise on the testing day. Expired gases were analyzed continuously using a calibrated metabolic cart. Heart rate was monitored throughout testing. The protocol began with a standardized warm-up followed by incremental increases in treadmill speed until volitional exhaustion. VO_2max was determined as the highest averaged oxygen uptake value or the presence of a plateau despite increased workload.

Session 2 consisted of field-based performance testing, including two 30-m sprints, the Illinois Agility Test, and the Yo-Yo Intermittent Recovery Test Level 1 (Yo-Yo IR1). Sprint performance was recorded using video analysis software, and the fastest

sprint time was used for analysis. The Illinois Agility Test was completed twice, with the fastest trial retained. Yo-Yo IR1 performance was recorded as total distance completed.

Statistical Analysis

Statistical analyses were performed using SPSS version 25.0. Data normality was assessed using the Shapiro–Wilk test. Independent samples t-tests were conducted to examine differences between elite and competitive groups. Pearson product-moment correlation coefficients were calculated to assess relationships between laboratory-measured VO_2max and Yo-Yo IR1 performance. Statistical significance was set at $p < .05$.

Results

Participant characteristics and soccer experience are presented in Table 1. Elite and competitive players did not differ in age or total years of soccer experience. However, elite players demonstrated significantly greater academy experience and position-specific experience compared with competitive players ($p < .05$).

Table 1
U14 Female Players' Previous Soccer Experience

Variable	Elite (n = 34)	Competitive (n = 26)
Age (yrs)	13.2 ± 0.5	13.2 ± 0.5
Soccer experience (yrs)	7.0 ± 1.6	6.05 ± 2.3
Academy experience (yrs)	4.4 ± 1.0*	2.2 ± 1.2
Position experience (yrs)	3.8 ± 1.8*	1.9 ± 1.1

Note. Values are presented as mean ± standard deviation. *$p < .05$.

Anthropometric and body composition characteristics are shown in Table 2. No significant differences were observed between elite and competitive players for height, body mass, body fat percentage, fat mass, lean mass, or bone mineral content ($p > .05$).

Table 2

U14 Female Players' Anthropometric and Body Composition Characteristics

Variable	Elite	Competitive
Height (cm)	157.7 ± 8.1	156.4 ± 7.8
Body mass (kg)	50.9 ± 8.0	51.5 ± 11.7
7-site skinfold body fat (%)	22.3 ± 3.6	24.3 ± 6.1
DEXA body fat (%)	23.2 ± 4.6	26.9 ± 8.7
Fat mass (g)	11,483.9 ± 3,362.5	13,948.1 ± 7,466.4
Lean mass (g)	37,014.2 ± 5,521.9	34,755.9 ± 4,527.6
Bone mineral content (g)	2,112.0 ± 403.6	2,079.2 ± 547.6

Note. Values are presented as mean ± standard deviation.

Performance characteristics are presented in Table 3. Elite players exhibited significantly greater aerobic capacity, including higher absolute and relative VO_2max, greater velocities at VO_2max and ventilatory threshold, faster 30-m sprint times, superior Illinois agility performance, and greater Yo-Yo IR1 distance compared with competitive players ($p < .05$).

Table 3

U14 Female Players' Performance Characteristics by Level of Competition

Variable	Elite	Competitive
VO_2max ($L \cdot min^{-1}$)	2.40 ± 0.4*	2.16 ± 0.4
Relative VO_2max ($ml \cdot kg^{-1} \cdot min^{-1}$)	47.4 ± 5.5*	42.7 ± 5.3
Velocity at VO_2max ($km \cdot hr^{-1}$)	15.3 ± 1.2*	14.0 ± 1.5
Ventilatory threshold ($L \cdot min^{-1}$)	1.6 ± 0.4	1.5 ± 0.3
Velocity at VT ($km \cdot hr^{-1}$)	11.6 ± 1.8*	10.2 ± 1.2

30-m sprint time (s)	5.22 ± 0.3*	5.70 ± 0.2
Illinois agility test (s)	17.3 ± 0.7*	18.0 ± 0.7
Yo-Yo IR1 distance (m)	695 ± 234.7*	475.6 ± 173.5

Note. Values are presented as mean ± standard deviation. *p < .05.

Correlation analyses examining relationships between laboratory-measured VO_2max and Yo-Yo IR1 performance are presented in Tables 4–6. Pearson product–moment correlations revealed significant positive relationships between Yo-Yo IR1 distance and both relative VO_2max ($ml \cdot kg^{-1} \cdot min^{-1}$) and absolute VO_2max ($L \cdot min^{-1}$) when data were pooled across groups (Table 4).

Table 4

Pearson Product–Moment Correlations Between Laboratory-Measured VO_2max and Yo-Yo IR1 Performance

Variable	1	2	3
1. Relative VO_2max ($ml \cdot kg^{-1} \cdot min^{-1}$)	—		
2. Absolute VO_2max ($L \cdot min^{-1}$)	.61*	—	
3. Yo-Yo IR1 distance (m)	.33*	.35*	—

Note. Values represent Pearson correlation coefficients (r). *p < .05.

When analyzed by competitive level (Table 5), no statistically significant relationships were observed between Yo-Yo IR1 performance and VO_2max within either the elite or competitive groups. However, moderate associations were observed for absolute VO_2max in elite players and relative VO_2max in competitive players, suggesting potentially meaningful group-specific trends.

Table 5

Pearson Product–Moment Correlations Between VO_2max and Yo-Yo IR1 Performance by Competitive Level

Variable	1	2	3
Elite Group			
1. Relative VO_2max	—		
2. Absolute VO_2max	.62*	—	
3. Yo-Yo IR1 distance	.12	.32	—
Competitive Group			
1. Relative VO_2max	—		
2. Absolute VO_2max	.58*	—	
3. Yo-Yo IR1 distance	.42	−.08	—

Note. Values represent Pearson correlation coefficients (r). *p < .05.

Fisher r-to-z comparisons indicated that the magnitude of the correlations did not differ significantly between elite and competitive players. Post hoc power analyses demonstrated low statistical power to detect medium-sized differences between correlations (Table 6), indicating that nonsignificant findings may be attributable to limited sample size rather than the absence of meaningful effects.

Table 6

Effect Sizes and Power Estimates for Fisher r-to-z Correlation Comparisons

Comparison	Elite r	Competitive r	Cohen's q	Observed Power
Relative VO_2max vs. Yo-Yo IR1	.12	.42	0.34	0.16

Absolute VO_2max vs. Yo-Yo IR1	.32	−.08	0.42	0.21

Note. Cohen's q represents effect size for differences between correlations. Observed power estimates were calculated using α = .05 (two-tailed).

Discussion

The purpose of this study was to compare physical performance characteristics between youth female soccer players selected to elite and competitive-level teams and to examine relationships between laboratory-measured aerobic capacity and field-based intermittent running performance. The primary findings indicate that elite players demonstrated superior aerobic capacity, sprint speed, agility, and intermittent endurance performance compared with competitive players, despite no differences in anthropometric or body composition characteristics. These results suggest that performance-related physiological qualities, rather than body size or composition, distinguish competitive level in U14 female soccer players.

Consistent with previous research in adult and elite soccer populations, aerobic capacity emerged as a key differentiating factor between competitive levels. Bangsbo et al. (2008) and Krustrup et al. (2003) demonstrated that higher VO_2max and Yo-Yo Intermittent Recovery Test performance are associated with greater match-running demands and higher standards of play. The present findings extend this relationship to youth female soccer players, supporting the Yo-Yo IR1 as a valid field-based assessment of aerobic fitness.

Elite players also demonstrated faster sprint times and superior agility performance, aligning with evidence that speed and change-of-direction ability are critical determinants of elite soccer performance (Bradley et al., 2014; Haugen et al., 2014). The absence of body composition differences suggests neuromuscular and aerobic adaptations are more influential than morphological factors during this developmental stage.

Practical Applications

Objective measures of aerobic capacity, sprint speed, agility, and intermittent endurance meaningfully differentiated competitive level in youth female soccer players. Coaches are encouraged to incorporate standardized field-based tests such as the Yo-Yo IR1, sprint testing, and agility assessments alongside technical evaluations to support

evidence-informed talent identification. Training programs should prioritize aerobic development and high-intensity running capacity rather than anthropometric characteristics.

Applied Sport Science Summary

Physical Characteristics that differentiate U14 Female Soccer Players

KEY FINDING	APPLIED COACHING IMPLICATIONS
Higher VO2max (aerobic) & YO-YO IR1 (intermittent) performance	Prioritize Aerobic and Intermittent Endurance Development
Faster Sprint & Agility performance	Integrate acceleration and change of direction training
No Body Composition Differences	Focus on functional performance over body size
YO-YO IR1 correlates with VO2 max	Use YO-YO IR1 as practical monitoring tool

Future Directions

Future research should use longitudinal designs to examine training-induced physical adaptations associated with progression to higher levels of competition. Integrating physical performance testing with match-derived workload data may further clarify the physiological demands required for elite youth soccer participation.

Limitations

This study's findings are limited by sample size and to the sex, age and ability level of the players examined. The proposed model and findings from this study are not necessarily applicable to young and older soccer players.

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