

Age-related differences in anthropometric characteristics and performance of youth soccer players: A comparison between U14 and U16 athletes

EVANGELIA PANAGIOTIDI¹, ATHANASIOS POULIOS², LAMBROS TSIOKANOS³, STERGIOS N. KOMSIS⁴, ELISAVET KALATHA⁵, PAPPAS AGGELOS⁶, VASILIOS GERODIMOS⁷, ATHANASIOS JAMURTAS⁸, ATHANASIOS TSIOKANOS⁹
^{1,2,3,4,5,6,7,8,9} University of Thessaly, School of Physical Education and Sports Sciences, Karies, Trikala, GREECE.

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Abstract

Coaches and scientists have long been interested in the athletic development of young soccer players, investigating data such as anthropometric characteristics and performance indicators that playing an important role in talent identification. This study aimed to evaluate, and compare anthropometric measures, body composition, and performance indicators among U14 (13–14 years old) and U16 (15–16 years old) youth soccer players during the pre-competitive period. 12 pre-adolescent and 12 adolescent soccer players were participated. Height, body weight (BW), body mass index (BMI), body fat percentage (BF), fat mass (FM), muscle mass (MM), fat-free mass (FFM), flexibility, agility, squat and countermovement jumps (SJ and CMJ), YO-YO Intermittent Recovery 1 test (YO-YOIR1), sprint test (10 and 30m) and the repeated sprint ability (RSA) were evaluated. The statistical analysis revealed differences in height ($p=.000$), BW ($p=.008$), BF% ($p=.008$), FFM ($p=.001$), MM ($p=.001$), vertical jump ability ($p=.001$), 10-m sprint ($p=.011$) and RSA ($p=.019$). No differences were detected in other performance and body composition indicators ($p>.05$). In conclusion, the adolescent athletes demonstrated better performance in sprinting and jumping ability compared with the pre-adolescent athletes, despite both age groups having remained inactive and consequently untrained for an extended period.

Keywords: Soccer, Body composition, Performance, Development ages.

Introduction

Soccer is one of the most popular sports worldwide, characterized by alternating high- and low-intensity actions (Zivkovic et al., 2013). Energy production depends on aerobic metabolism ($>85\%$), with the remaining 15% covered by anaerobic pathways (Bangsbo, Mohr, & Krstrup, 2006). Professional soccer players exhibit average height of 1.77 ± 0.15 m and body weight (BW) of 74 ± 1.6 kg, while elite players have a mean body fat percentage (BF) of approximately 10% (Bangsbo et al., 2006; Reilly, 1997). Total match distance averages ~ 10 km, varying by playing position, with midfielders covering the greatest distances (Modric, Versic, Sekulic, & Liposek, 2019; Tumilty, 1993). Players cover 119–286 m with ball possession (Di Salvo et al., 2007). Continuous running would require ~ 35 ml/kg/min oxygen uptake at 70% HRmax, but high-intensity actions increase these values (Mohr, Krstrup, Andersson, Kirkendal, & Bangsbo, 2008). VO2max ranges from 56–69 ml/kg/min (Mohr, Krstrup, & Bangsbo, 2003), with position-specific differences (Modric et al., 2019). Yo-YoIR1 performance reaches 2,190 m in elite players (Oberacker, Davis, Haff, Witmer, & Moir, 2012), while blood lactate ranges from 2.1–6.9 mmol/L post-match (Krstrup et al., 2006). Elite players demonstrate squat jump (SJ) values of ~ 35 cm and counter-movement jump (CMJ) values of ~ 40 cm (Poulios et al., 2019). Flexibility (squat and reach test) values average 24.7 ± 6.9 cm in adult players (Abate Daga, Panzolini, Allois, Baseggio, & Agostino, 2021), while sprint and repeated sprint ability (RSA) are crucial performance determinants (Poulios et al., 2018).

During adolescence, hormonal changes drive significant anthropometric and physical development. BW has increased from 30.8 kg (age 9.2) to 73 kg (age 18.1), and height from 135.2 cm to 181.3 cm (Heita Goto, 2012). BF ranges from 11–13%, while fat-free mass (FFM) increases from 27.8 kg (U10) to 52.8 kg (U16) (Heita Goto, 2012; P.T., 2014). Match HR averages 155–172 bpm ($\sim 85\%$ HRmax) (Bangsbo et al., 2006). U14 and U16 players demonstrate distinct speed zone profiles (Heita Goto, 2012; Markovic & Mikulic, 2011), with total match distance ranging from 4,056 m (U9) to 7,697 m (U16) (Heita Goto, 2012). Sprint times for 10–30 m range from 1.70–4.48 s, while jumping performance improves progressively from U9 (SJ: 24.5 cm, CMJ: 24.6 cm) to U17 (SJ: 51.3 cm, CMJ: 53.4 cm) (Heita Goto, 2012). Sprint and jumping abilities improve markedly at ages 14–15 (Pearson, Naughton, & Torode, 2006).

Biological maturation critically influences youth soccer performance. Players born earlier in the year may have physical advantages compared with those born later (Carling, le Gall, Reilly, & Williams, 2009). More mature players often show better height, endurance, sprinting, and jumping performance, and may cover more high-speed distance in U13–U14 players (H. Goto, Morris, & Nevill, 2019). Skeletal maturity can be assessed using the Tanner-Whitehouse and Greulich-Pyle methods (R. M. Malina et al., 2018; Satoh, 2015). Peak height velocity (PHV) represents the period of fastest height growth during adolescence and is linked to changes in motor control, which can be assessed with the BESS and Y-Balance tests (John, Rahlf, Hamacher, & Zech, 2019; Peña-González, Fernández-Fernández, Cervelló, & Moya-Ramón, 2019). Within the same age group, players born in the first quarter of the year (Q1) may perform better than Q2 players in vertical jump and 10 m and 40 m sprints (Carling et al., 2009). Therefore, chronological age does not always reflect biological maturity, highlighting the importance of allowing enough development time for less mature players (Carling et al., 2009). The present study aimed to collect, record, and evaluate anthropometric and physiological characteristics, as well as performance indicators (body composition, cardiorespiratory fitness, sprint ability, RSA, explosive power, agility, and flexibility) in pre-adolescent (U14) and adolescent (U16) soccer players during the pre-competitive period, comparing the two age groups. The study also examined the association between the different measures using correlation analysis, providing a better understanding of the development of youth soccer players.

Material & Methods

Participants

A power analysis was also performed to determine the appropriate sample size, using an effect size of >0.055 , an alpha error probability of 0.05, and a statistical power of 0.80. The analysis indicated that a sample of 12 participants was sufficient to obtain reliable conclusions. Twenty-four ($n=24$) soccer players participated in the present study (U-16, adolescents $n=12$ and U-14, pre-adolescents $n=12$). The athletes were members of a soccer academy and participated in a local league (table 1). All soccer players were in excellent condition, as there was no injury and they were able to perform the protocols. The athletes and their parents were informed about the research procedures, completed the medical history forms, and signed the informed consent and assent forms. Finally, the testing procedures were presented, and it was clarified to the participants that they could withdraw from the procedure at any time they wished by informing the person responsible for the study. Regarding participation in the study, the soccer players were required to meet the following criteria: they had not presented any musculoskeletal problem or illness in the recent past, and they had not taken any supplement or medication during the last six months.

Table 1. Participants' Characteristics

Variable	U-14 ($n=12$)	U-16 ($n=12$)
Age (years)	12.6 $\pm$ 0.7	14.6 $\pm$ 0.4
Training Experience (years)	4.0 $\pm$ 0.6	5.9 $\pm$ 1.3
HRmax (bpm)	205 $\pm$ 11	212 $\pm$ 11
VO2max (ml/kg/min)	42 $\pm$ 1.0	40.7 $\pm$ 1.3

HRmax, maximum heart rate; VO2max, maximum oxygen uptake; n, number; U-14, pre-adolescent; U-16, adolescent.

Study design

The study was conducted over a three-day testing period. On the first day, participants received detailed information regarding the study procedures and testing protocols, completed the informed consent form and the parental/guardian consent form, and provided relevant medical history information. On the second day, participants underwent an assessment of their anthropometric characteristics and body composition, followed by the evaluation of flexibility using the sit-and-reach test, agility test, sprint test (10 and 30-m) and RSA. On the third day, participants completed a familiarization session involving the use of the ball, followed by a high-intensity test using an intermittent exercise protocol (Yo-Yo Intermittent Recovery Test Level 1; Yo-Yo IR1) to assess their intermittent endurance capacity.

Assessment of anthropometric characteristics

The participants' height was measured using a stadiometer (SECA). They were instructed to stand upright on the platform of the stadiometer, with their heels together and their feet positioned at a 60° angle, while looking straight ahead. The buttocks and upper back were positioned vertically against the stadiometer's vertical column. BW was also measured using a Tanita DC-320S device (Tanita Corp., Tokyo, Japan). Participants were instructed to wear as little clothing as possible, stand in the center of the scale, and position their heels on the designated areas of the platform. The measurement displayed on the device was then recorded (Souglis et al., 2015).

Evaluation of body composition

The assessment of BF, FM (kg), BMI, MM, and FFM was performed using the bioelectrical impedance analysis (BIA) method with the Tanita DC-320S device (Tanita Corp., Tokyo, Japan). Prior to the measurements, participants received standardized instructions from a dietitian regarding the appropriate amount of water to consume. Subsequently, they stood on the platform wearing only sports shorts and, after correctly positioning their heels, feet, and palms on the designated contact points, the electrical resistance of the different body tissues were measured and recorded (Sun et al., 2005).

Performance evaluation

The flexibility assessment was conducted using a sit and reach box to evaluate hamstring flexibility by measuring the joints' range of motion. The participant sat barefoot with feet flat against the box and knees fully extended, while placing their palms one on top of the other facing downward. They then slowly bent forward, pushing the indicator on the box as far as possible and holding the maximum reach for 2–3 seconds. Two attempts were performed with a 10–20 second rest interval between them, and the best attempt was recorded by the examiner (Chillón et al., 2010).

Vertical jump assessment was performed using a mat contact platform (Chronojump Bosco System, software 1.9.0, Barcelona, Spain). For the countermovement jump (CMJ), the participant started from an upright standing position with hands kept on the hips throughout the jump and performed three maximal attempts after the examiner's signal; flight time was measured by a digital timer connected to the platform to calculate jump height, with the best technically correct attempt recorded. For the squat jump (SJ), the participant began from a semi-squat position, again with hands on the hips, and performed three maximal attempts, with the highest jump being recorded (Ispiridis et al., 2008).

Sprint ability and RSA was assessed using a Chronojump (software 1.9.0, Barcelona, Spain) infrared timing system (accuracy 0.01 s) on a natural grass field. After the examiner's signal, the participant ran a 30 m sprint as fast as possible, then returned to the start with a light jog and assumed the starting position a few seconds before the next sprint (recovery time for 25s). A total of five sprints were performed, and the following variables were recorded: best 10 and 30-m times, mean 30-m time of five sprints, as well as the fatigue index (FI) and the rate of decline (Ramos-Campo, Rubio-Arias, Carrasco-Poyatos, & Alcaraz, 2016).

Agility with ball was assessed using the Soccer Agility Drill test, which involves a predetermined cross-shaped course with cones placed 2 m apart. After the examiner's signal, the player moved at speed while controlling the ball, navigating through the cones along the set course, and had to stop the ball upon reaching the finish line to stop the timer. A knocked-over cone invalidated the attempt. Each participant performed three trials, with times recorded using the Chronojump infrared timing system (accuracy 0.01 sec, Software 1.9.0, Barcelona, Spain) on a natural grass field (Fiorilli et al., 2017).

The Yo-Yo IR1 is a maximal shuttle run test between two lines 20 m apart. The participant starts at the starting line, runs to the opposite line and back, with a 10-second active recovery period at the start line, during which they walk around a cone placed 5 m away. The running speed progressively increases, guided by audio signals from a sound source; the participant must reach each line in sync with the beeps. The test ends when the participant can no longer keep pace with the signals, and the total distance covered (meters), mean speed, and current heart rate are recorded, determining the VO₂max using a formula (Markovic & Mikulic, 2011).

Statistical Analysis

The variables obtained were statistically analyzed using the SPSS 15.0 for Windows statistical software package. The statistical analysis included descriptive statistics (mean and standard deviation) to present the values of the variables examined. Pearson's product-moment correlation coefficient was used to examine the relationships between the variables. An independent-samples *t*-test was performed to identify differences between the two age groups in anthropometric characteristics body composition and performance indicators. For all comparisons and correlations, the level of statistical significance was set at $p < .05$.

Results

Statistically differences (**Table 2**) were noted in BW ($t(22) = -2.927$, $p < .05$), with U16 being 21.8% heavier than U14. Statistically significant differences were observed in height ($t(22) = -4.696$, $p < .05$), with U16 being 9.3% taller than U14. Statistically significant differences were observed in BF ($t(22) = 2.941$, $p < .05$), as U16 had 43.0% lower BF% compared to U14.

Statistically significant differences were observed in FFM between the two age groups ($t(22) = -3.989$, $p < .05$), with U16 having 27.7% greater FFM than U14. Statistically significant differences were also observed in MM ($t(22) = -3.997$, $p < .05$), with U16 showing 28.0% greater MM compared to U14. No statistically significant differences were observed in BMI ($t(22) = -0.365$, $p = .719$) and FM ($t(22) = 1.273$, $p = .216$) compared U14 and U16.

Table 2. Anthropometric and Body composition indicators

Variable	U14 (mean±SD)	U16 (mean±SD)
BW (kg)	47.8±8.6	58.2±8.8 [#]
Height (m)	1.62±0.1	1.77±0.1 [#]
BMI (kg/m ²)	18.0±1.5	18.3±2.4
BF (%)	10.7±3.8	6.1±3.8 [#]
FM (kg)	5.1±2.3	3.7±2.9
FFM (kg)	42.6±7.5	54.4±6.9 [#]
MM (kg)	40.4±7.2	51.7±6.5 [#]

BW, body weight; BMI, body mass index; BF, body fat; FM, fat mass; FFM, fat free mass; MM, muscle mass, U16, adolescent group; U14, pre-adolescent group; SD, standard deviation; [#], significant difference between U14 and U16.

No statistically significant differences (**Table 3**) were observed in flexibility ($t(22) = -0.417$, $p = .681$), agility ($t(22) = 0.568$, $p = .576$), Yo-YoIR1 ($t(22) = -1.925$, $p = .067$), HRmax ($t(22) = 0.177$, $p = .861$) and VO2max ($t(22) = -1.925$, $p = .067$) between U16 and U14 (Table 1).

Table 3. Flexibility and endurance capacity

Variable	U14 (mean±SD)	U16 (mean±SD)
Sit and reach (cm)	26.1±4.6	27.3±8.4
Agility test (sec)	14.3±1.2	13.9±2.3
YO-YOIR1 (m)	520±158	666±211
HRmax (bpm)	205±11	212±11
VO2max	42±1.0	40.7±1.3

YO-YOIR1, YO-YOintermittent recovery 1; HRmax, maximum heart rate; VO2max, maximum oxygen uptake; n, number; SD, standard deviation; U-14, pre-adolescent; U-16, adolescent.

Statistically significant differences were also observed in SJ between the two age groups ($t(22) = -3.663$, $p < .05$), with U16 showing 25.8% greater jump height than U14 (**Figure 1**). Statistically significant differences were observed in CMJ ($t(22) = -3.664$, $p < .05$), such as U16 jumping 28.2% higher than U14 (**Figure 2**).

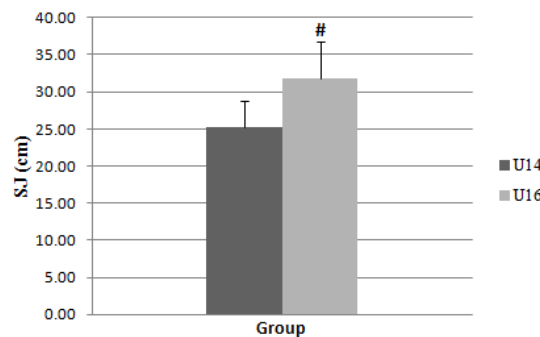


Figure 1. Squat jump height in U14 and U16. SJ, squat jump; U-14, pre-adolescent; U-16, adolescent; [#], significant difference between U14 and U16.

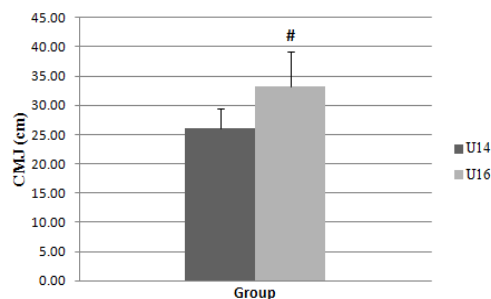


Figure 2. Counter-movement jump height in U14 and U16. CMJ, counter-movement jump; U-14, pre-adolescent; U-16, adolescent; [#], significant difference between U14 and U16.

Statistically significant differences (**Table 4**) were observed in best 10-m sprint time between the two age groups ($t(22) = 2.794, p < .05$), with U16 being 5.0% faster than U14. Statistically significant differences were found in 30-m FI between the two age groups ($t(22) = -2.540, p < .05$), with U16 having 57.0% higher fatigue index compared to U14. Statistically significant differences were found in 30-m Sdec between the two age groups ($t(22) = -3.332, p < .05$), with U16 having 60.6% higher rate of decline compared to U14. No statistically significant differences were found in mean 10-m ($t(22) = 0.967, p = .344$) and mean 30-m ($t(22) = 1.522, p = .142$) sprint time between U14 and U16. No statistically significant differences were found in best 30-m sprint time between the two age groups ($t(22) = 1.348, p = .191$). No statistically significant differences were observed in 10-m FI% between the two age groups ($t(22) = -1.930, p = .067$). No statistically significant differences were observed in 10-m Sdec % between the two age groups ($t(22) = -1.969, p = .062$).

Table 4. Sprint and repeated sprint ability test

Variable	U14 (mean±SD)	U16 (mean±SD)
10-m sprint (sec)	2.0±0.1	1.9±0.1 [#]
30-m sprint (sec)	5.1±0.3	4.9±0.5
10-m FI (%)	15.3±4.5	22.2±11.4
30-m FI (%)	12.8±4.4	20.1±8.8 [#]
10-m Sdec (%)	8.6±2.6	11.9±5.0 [#]
30-m Sdec (%)	7.1±2.3	11.4±2.3 [#]
Mean 10-m sprint (sec)	2.1±0.1	2.1±0.1
Mean 30-m sprint (sec)	5.4±0.2	5.2±0.3

m, meter; FI, fatigue index; Sdec, rate of decrement; SD, standard deviation; U-14, pre-adolescent; U-16, adolescent; [#], significant difference between U14 and U16.

Correlations

Regarding anthropometric indicators, very high correlations were observed between BW and height ($r = .81, p < .01$), and between BW and FFM ($r = .96, p < .01$). Very high correlations were also observed between height and FFM ($r = .90, p < .01$), as well as between BF% and FM ($r = .91, p < .01$). Regarding sprint performance, very high correlations were observed between mean 30-m sprint time and mean 10-m sprint time ($r = .92, p < .01$), as well as between mean 30-m sprint time and best 10-m sprint time ($r = .83, p < .01$). Regarding fatigue, very high correlations were observed between the 10-m FI and the 30-m FI ($r = .88, p < .01$), between the 10-m FI and the 10-m Sdec ($r = .94, p < .01$), and between the 10-m FI and the 30-m Sdec ($r = .80, p < .01$). Very high correlations were also observed between the 30-m FI and the 10-m Sdec ($r = .83, p < .01$), as well as between the 30-m FI and the 30-m Sdec ($r = .94, p < .01$).

Discussion

The present study examined age-related differences in body composition and performance parameters between U14 and U16 soccer players during the pre-competitive period. The findings revealed significant improvements primarily in anthropometric characteristics and explosive power, while most cardiovascular and agility-related indicators showed no statistically significant differences between the two age groups.

The significant differences in body composition between U14 and U16 are consistent with expected physiological changes associated with adolescent development. U16 were 21.8% heavier and 9.3% taller than U14, reflecting the natural growth phase during this developmental stage. The significant increases in fat-free mass (+27.7%) and muscle mass (+28.0%) in the U16 group can be attributed to the anabolic effects of increased sex hormone production, particularly testosterone, which promotes muscle hypertrophy and skeletal growth during adolescence (R. Malina, Rogol, Cumming, Coelho-e-Silva, & Figueiredo, 2015)). Additionally, BF values in the present study (6.1% for U16 and 10.7% for U14) are remarkably low and consistent with elite youth soccer player values. Previous research reported 11.9% for U14 players (Rebello et al., 2013), while fat-free mass values (54.5 kg for U16 and 42.7 kg for U14) compare favorably with earlier studies reporting 53.5±6.7 kg and 44.4±7.6 kg, respectively (Leão et al., 2022). These findings indicate that participants from this recognized academy exhibit excellent body composition profiles comparable to elite youth athletes.

The very high correlations among anthropometric indicators confirm their association during growth. BW showed very high correlations with height ($r = .81$) and FFM ($r = .96$), while height correlated very highly with FFM ($r = .90$), and BF with FM ($r = .91$). These strong interrelationships confirm that anthropometric changes during adolescence are systemic. Despite marked differences in weight and height, no significant BMI differences were observed (only 1.7% difference), suggesting proportional increases in mass and height. However, the significant decrease in body fat percentage (-43.0%) and fat mass (-27.5%) in U16 indicates a favorable body composition profile in older adolescents, characterized by lower adiposity and higher lean mass, consistent with previous research (Baxter-Jones, Faulkner, Forwood, Mirwald, & Bailey, 2011). These findings reporting that older participants exhibit greater height and mass values (Robert M Malina, Bouchard, & Bar-Or, 2004), and reinforce the need for distinction between chronological age and biological growth (Philippaerts et al., 2006).

Statistically significant differences in CMJ and SJ performance, with U16 players demonstrating 28.2% and 25.8% higher jump heights, are likely due to neuromuscular adaptations associated with growth acceleration. Increased MM (+28.0%) FFM (+27.7%) provide greater force production capacity, as muscle cross-sectional area is a primary determinant of strength and power (Maffiuletti et al., 2016). Lower BF may also improve power-to-weight ratio (Buchheit, Mendez-Villanueva, Quod, Quesnel, & Ahmaidi, 2010). Jump performance values (CMJ: 33.3 cm for U16, 26.0 cm for U14; SJ: 31.8 cm for U16, 25.3 cm for U14) are comparable to previous elite youth player research (34.3 cm and 25.2 cm for CMJ; 35.1 cm and 29.3 cm for SJ) (Matos & Winsley, 2007). However, some elite studies reported higher values (50.6 cm for U16, 43.7 cm for U14) (Rebello et al., 2013), suggesting participants in the present study may not yet have reached elite international levels.

While mean sprint times over 10-m and 30-m showed no statistical differences (U16 being 0% and 3.7% faster), best 10-m sprint time reached statistical significance with U16 being 5.0% faster. Very high correlations between sprint measures ($r = .92$ between mean 10-m and 30-m; $r = .83$ between mean 30-m and best 10-m) confirm their association. These findings show that acceleration and speed improve with age, as reported in previous study (Meylan, Cronin, Oliver, Hopkins, & Contreras, 2014). Sprint performance (best 30-m: 4.94 sec for U16, 5.17 sec for U14) was lower than previous elite youth research (4.29 sec and 4.60 sec, respectively) (Mujika, Santisteban, Impellizzeri, & Castagna, 2009), possibly due to training background and competition level differences. Significantly higher FI in U16 for 10-m (+45.1%) and 30-m (+57.0%), and higher rate of decline for 10-m (+38.4%) and 30-m (+60.6%), suggest that while adolescents possess greater peak speed, they experience more rapid performance decrements during repeated sprints. This means that older players achieved higher absolute velocities, resulting in greater relative drop-off when fatigued (Girard, Mendez-Villanueva, & Bishop, 2011), or that greater MM creates higher metabolic demands (Dupont et al., 2010).

The Soccer Agility Drill times (13.96 s for U16 and 14.39 s for U14) were classified as “low” based on elite adult norms (Bangsbo et al., 2006). However, these results represent adolescent players, not elite adults. The small difference between groups (-2.8% in favor of U16) was not significant, suggesting that agility with the ball may depend more on technical skills and training than on biological maturation (Jovanovic, Sporis, Omrcen, & Fiorentini, 2011).

While U16 demonstrated 28.1% greater Yo-Yo IR1 distance and 3.2% higher VO₂max, differences were not statistically significant, likely due to inter-individual variability and small sample size. Yo-YoIR1 performance (666 m for U16, 520 m for U14) was lower than Croatian first-league youth players (1,538 m and 1,000 m) (Mohr et al., 2003), possibly reflecting pandemic-induced training disruption. Estimated VO₂max (42 ml/kg/min for U16, 40 ml/kg/min for U14) falls within typical youth soccer ranges but below elite adult levels. HRmax values (205 bpm for U14, 204 bpm for U16) align with previous youth research (P.T., 2014). Very high correlations within anthropometric measures ($r = .81-.96$) confirm established relationships between body size, lean mass, and adiposity during growth. High correlations among sprint measures ($r = .83-.92$) suggest shared neuromuscular determinants. Extremely high correlations among fatigue markers ($r = .80-.94$) indicate consistent fatigue characteristics across distances, with practical implications for individualized conditioning programs.

Practical Implications

These findings highlight that while adolescent soccer players exhibit superior anthropometric profiles and explosive power, cardiovascular capacity, agility, and RSA follow more complex development not directly related to age. Coaches should emphasize comprehensive development programs addressing strength, power, cardiovascular capacity, and technical skills (Lloyd & Oliver, 2012). Higher fatigue in U16 players suggests that repeated sprint training could be useful for young players (Bishop, Girard, & Mendez-Villanueva, 2011). The large differences between players also show the need for individualized training.

Limitations

Small sample size ($n=24$) may have limited statistical power. VO₂max was estimated from the Yo-Yotest and not measured directly in a lab, which may have affected the accuracy of the results. The study did not check the biological maturity of the players (e.g., bone age or growth spurt stage), so it is unclear how much of the differences were due to maturation rather than age. Information about training background, previous injuries, and diet was not collected, even though these factors can affect body composition and performance. Future studies should measure maturation directly, use lab tests for fitness, and follow players over several years.

Conclusions

The differences between U14 and U16 soccer players are mainly related to puberty, with improvements in body size and explosive power as players get older. Body composition was similar to that of elite youth players, suggesting good training at the academy. The lack of significant differences in cardiovascular capacity, agility, and RSA suggests that these abilities depend more on training than age. The strong correlations between performance measures show that these abilities are closely related. These findings highlight the importance of age-appropriate training that supports cardiovascular capacity and RSA while taking advantage of the natural improvements in strength and power during adolescence.

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