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Motion Analysis of U11 to U16 Elite English Premier League Academy Players

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Abstract

This study examined: 1) the distances and speeds covered during match play for U11 to U16 English Premier League Academy players; 2) the differences in match performance between retained and released players; and 3) the effect of calculating speed zones in different ways when analysing match performance. Eighty-one Academy outfield players (10 to 16 years old), competing in 11-a-side matches, were analysed using a 1 Hz Global Positioning System with three speed zones (absolute, squad, individual). Pitch dimensions were: 78.7 x 54.1 m (U11 and U12); 88.0 x 64.2 m (U13); and 100.8 x 68.2 m (U14-U16). Match durations were: 20 min x 2 + 15 min x 2 or 25 min x 3 (U11); 25 min x 3 (U12 and U13); and 40 min x 2 (U14-U16). The matches were part of the regular series of inter-academy matches between Premier League Academies during a season. Completion of at least a half of the duration of a match in two separate matches (mean ± SD = 3.1 ± 0.8 matches: range: 2-4 matches) was the criterion for inclusion in the study. Total match running distance increased with age from ~5700 $m \cdot h^{-1}$ (U11) to ~6700 $m \cdot h^{-1}$ (U15) ($p<0.01$). Using the absolute speed zones it was possible to discern differences in high intensity (> 6.0 $m \cdot s^{-1}$) distance covered with age (U11: 29 $m \cdot h^{-1}$, U16: 164 $m \cdot h^{-1}$, $p<0.01$). Using the squad speed zones it was possible to discern differences between retained and released players in the U11/U12s (moderate speed running) and in the U15/U16s (walking, jogging and low speed running) ($p<0.01$). Thus, total and high intensity running distances increase with age and walking, jogging, low speed running and moderate speed running distances are greater in retained than released players and these differences are best identified through the use of absolute and squad speed zones, respectively.

Key words:

Association football, High intensity running, Intermittent exercise, Talent identification.

Introduction

Match analysis of elite and non-elite youth soccer players has been conducted in different countries including Brazil (Pereira Da Silva, Kirkendall & Leite De Barros Neto, 2007), Denmark (Stroyer, Hansen & Klausen, 2004), Italy (Castagna, D'Ottavio & Abt, 2003), Qatar (Buchheit, Mendez-Villanueva, Simpson & Bourdon, 2010a) and San Marino (Castagna, Impellizzeri, Cecchini, Rampinini & Barbero Alvarez, 2009) with just one previous study conducted in the UK (Harley et al., 2010) on 11 to 16 years old soccer players from two professional clubs. These studies have established that boys cover between 6000 and 9000 m in a 60-90 min match with ~3 to ~30% of this distance being covered at high speeds (4.2-5.0 $m \cdot s^{-1}$) (Buchheit et al., 2010a; Castagna et al., 2009; Castagna, Manzi, Impellizzeri, Weston & Barbero Alvarez, 2010; Harley et al., 2010). The previous match analysis study in the UK did not state the division or academy status of players (Harley et al., 2010) and therefore the match distances and speeds achieved by English Academy players are unknown.

Match analysis data could be used in the talent identification and development process, but to date this is an under-researched area with most previous talent identification studies focusing on anthropometric (Gil, Ruiz, Irazusta, Gil, & Irazusta, 2007), physiological (Le Gall, Carling, Williams, & Reilly, 2010), psychological (Williams, 2000), sociological (Meylan, Cronin, Oliver, & Hughes, 2010) and technical skill (Figueiredo, Goncalves, Silva, & Malina, 2009) measurements. One such study showed no differences in anthropometric and physiological attributes between 14-16 years old England international youth soccer players who did and who did not go on to receive a professional contract (Franks, Williams, Reilly & Nevill, 1999). In contrast, another study found that elite U14-U16 French the players who later gained an international match appearance and/or a professional contract were taller and faster (40 m sprint) than players who gained neither (Le Gall et al., 2010). Thus, the findings

to date relating to whether or not players who achieve later success have particular identifiable characteristics (other than footballing ability) are equivocal. It has been suggested that as soccer is a complex sport involving performing the required skills in a rapidly changing environment, under fatiguing conditions, a shift towards a more match specific protocol or actual match play is necessary to contribute towards the identification of talented players (Ali, 2011; Unithan, White, & Georgiou, 2012; Williams, 2000). Hence there is a need to examine if match performance is a discriminator of the success of youth soccer players and one way of achieving this is to examine the differences in match performance between players who are subsequently retained or released by academies.

Most match analysis studies on youth soccer players have used a Global Positioning System (GPS) to examine the match distances and speeds achieved (Buchheit et al., 2010a; Buchheit, Mendez-Villanueva, Simpson & Bourdon, 2010b; Castagna et al., 2009; Castagna et al., 2010; Harley et al., 2010). These studies included U12 to U18 players who were shown to cover 6000-9000 m during a 60-90 min match. When the distances were calculated relative to an hour of a match, the players covered 6000-7000 $m \cdot h^{-1}$ (Buchheit et al., 2010a; Castagna et al., 2009; Harley et al., 2010). Most studies have also reported on the distance covered in particular speed zones or how much time is spent in particular speed zones. How the speed zones were defined varies between studies, but often the zones were created based on absolute speeds (the same speed zones for all players regardless of age), squad speed zones (the creation of a set of speed zones for each age group, e.g., U13s, U18s) or individual speed zones where the zones were calculated based on the top running speed of each individual player (Buchheit et al., 2010a; Buchheit et al., 2010b; Harley et al., 2010). However, no study has described match performance using these three methods in the same study and the relative value of these methods with respect to talent identification and development is unknown.

Thus, aims of the present study were: 1) to examine the distances and speeds covered during match play for U11 to U16 English Premier League Academy players; 2) to examine the difference in match performance between players who were later retained or released by academies; and 3) to establish the effect of calculating speed zones in different ways when analysing match performance.

Methods

Participants

The participants were 81 English Premier League Academy outfield players from a club in the Midlands and their chronological age ranged from 10.9 to 16.2 years. The players were grouped by age into U11 to U16 squads. The age, height, body mass and 5 m flying sprint time for each squad are shown in Table 1 and the distribution of playing positions is presented in Table 2 and 3. The players who were retained in the Academy for more than two seasons after the season in which the match analysis was completed were categorised as the retained group and players released from the Academy within two seasons or less after the season in which the match analysis took place were categorised as the released group (Table 4). The players generally participated in three 1.5 hour technical training sessions (except U15 and U16 squads as one session was fitness training involving a mixture of endurance and/or sprint training) and one match per week during the season. Two coaches were in charge of each training session and they held UEFA (Union of European Football Associations) 'A' or 'B' coaching licenses.The U15 and U16 players were combined to form one squad and they trained and competed in the matches together. Players were provided with a written and verbal explanation of the study including all tests and measurements to be taken. Each player signed an informed assent form and completed a health screen questionnaire prior to participation in the study. Each player's parent, guardian or care-giver signed a consent form prior to the start of the study. Players were free to withdraw from the study without giving any reasons and without any penalty regarding their academy position and this was explained to them verbally and in writing. Participants were withdrawn from the study if they did not have a satisfactory health status. The study was approved by a University Ethical Committee.

Match analysis

Soccer matches were analysed using a 1 Hz GPS (SPI Elite, GPSport, Australia). This system required players to wear a small backpack on their back which contained the device; players wore this equipment throughout the match. The validity of 1 Hz GPS (SPI elite, GPSport, Australia) has previously been assessed in games players (N = 9). They covered a circuit (487 m) 14 times in a trial and the circuit involved moving at different speeds including walking to sprinting and 4 types of agility runs (8.5-52.3 m) with 90° to 180° change of directions (total of 56 agility runs during a trial). When the participants were completing the agility runs, the time was measured using photoelectric timing gates (Brower timing, USA). There was only a 2.5 m difference between the actual distance covered by the participants in the trial (6818.0 m) and the total distance measured by the devices. Moreover, there was less than a 2 % difference between the mean speeds estimated by running time measured using the timing gates and mean speeds estimated by the GPS devices during the agility runs (MacLeod, Morris, Nevill & Sunderland, 2009). The reliability of the GPS has been reported elsewhere (Gray, Jenkins, Andrews, Taaffe, & Glover, 2010). The matches were 11-a-side and were played on flat grass pitches. Pitch dimensions were: 78.7 x 54.1 m (U11 and U12); 88.0 x 64.2 m (U13); and 100.8 x 68.2 m (U14-U16). Match durations were: 20 min x 2 + 15 min x 2 or 25 min x 3 (U11); 25 min x 3 (U12 and U13); and 40 min x 2 (U14-U16). The matches were part of the regular series of inter-academy matches between Premier League Academies during a season. Completion of at least a half of the duration of a match in two separate matches (mean ± SD = 3.1 ± 0.8 matches: range: 2-4 matches) was the criterion for inclusion in the study. Mean values from matches were calculated for each player. The GPS was accessing a mean of 7.7 ± 1.4 satellites with a mean horizontal dilution of precision of 1.27 ± 0.45 throughout all the matches analysed.

Sprint test

A 10 m sprint test with a split time at 5 m was conducted to obtain "flying" 5 m sprint time at the start of the season in which the match analysis took place. The test was conducted indoors and the surface was a new generation synthetic sports turf. A photoelectric timing gate (Brower timing, USA) was placed at 0, 5 and 10 m and, the time was recorded nearest to 0.01 s. The players sprinted from 1 m behind the first timing gate with their preferred foot front. No backward movements or bouncing were allowed just before initiating the sprint. Each player completed three sprints and the fastest sprint time was selected for the calculation of speed zones.

Match activities

Match activities were analysed using three different sets of speed zones, absolute, squad and individual. Five categories were created in each set of speed zones and were calculated based on "flying" 5 m sprint speed from 5-10 m of 10 m sprint test (Table 1) as the mean sprint distance of U15 elite Brazilian soccer players was 8.6 m when the analysis was conducted with observations of match activities and stride length (Pereira Da Silva et al., 2007). The distances covered in each speed zone were calculated using Team AMS software version 1.2 (GPSport, Australia).

Absolute speed zone

For the absolute speed zone, the "flying" 5 m sprint speed of the **fastest player** in this study (7.5 $m \cdot s^{-1}$) was used to create one set of speed zones that subsequently were used to categorise all the players' performances. The range of speed from 0.0 $m.s^{-1}$ to 7.5 $m \cdot s^{-1}$ (speed of the fastest player) was split into 5 equal categories as was similarly done in previous studies (e.g., jogging: 3-8 $km \cdot h^{-1}$, Medium intensity running: 8-13 $km \cdot h^{-1}$, high intensity running: 13-18 $km \cdot h^{-1}$) (Buchheit et al., 2010a; Castagna et al., 2010) and they were labelled as speed zone 1

(slowest), 2, 3, 4 and 5 (fastest). Any speeds recorded faster than 7.5 $m \cdot s^{-1}$ were also included in the speed zone 5. These zones were not named (e.g., jogging, moderate speed running etc) because for the younger players in the academy, speed zone 3 may have represented 'high speed' running but for the oldest player, zone 3 could have represented 'moderate speed' running for example (Table 5).

Squad speed zone

Five speed zones **specific to each squad** were calculated based on a mean of "flying" 5 m sprint speed for each age group. The five speed categories were calculated by splitting the speed zones of 0.0 $m \cdot s^{-1}$ to two standard deviations below the squad mean of "flying" 5 m sprint speed into 5 equal categories and they were labelled as standing and walking, jogging, low speed running, moderate speed running and high speed running based on similar designations from earlier studies (Castagna et al., 2010; Harley et al., 2010). Any running speeds recorded faster than the fastest speed zone were also categorised as high speed running (Table 5).

Individual speed zone

Speed zones **specific to each player** were calculated based on each individual's "flying" 5 m sprint speed. The five speed categories were calculated by splitting the speed zones of 0.0 $m \cdot s^{-1}$ to the "flying" 5 m sprint speed of each player into 5 equal categories and they were labelled as standing and walking, jogging, low speed running, moderate speed running and high speed running based on similar designations from earlier studies (Castagna et al., 2010; Harley et al., 2010). Any running speeds recorded faster than the fastest speed zone were also categorised as high speed running (Table 5).

Statistical analyses

Given the difficulty in establishing normality in small sample sizes (and the likelihood that even if tests (e.g. Shapiro-Wilk, Andersen-Darling) failed to reject the null hypothesis this actually indicates little about the normality of the sample being investigated given the likely high false negative rate) normality was assessed visually by ensuring equal distributions of data points either side of the mean. One way analysis of variance with Tukey post hoc test was used to compare different age groups. An independent sample t-test was used to compare differences between the retained and released groups. Variance was examined in all the independent t-tests by "Levene's Test for Equality of Variances" and in one-way ANOVA analysis using the "Homogeniety of variance test". The effect sizes (*d*) for these differences were also calculated as (mean A – mean B)/ (pooled SD). Effect size values of 0.2, 0.5 and above 0.8 were considered to represent a small, moderate and large differences, respectively (Vincent, 2005). Pearson's product moment correlation was used to examine the relationship between age and match performance. The level of statistical significance was set at $p < 0.05$. Results are presented as mean ± standard deviation (SD) and PASW 18.0 was used for all the statistical analyses.

Results

Distances covered during match play for all players

Total distance covered during match play for U11 to U16 squad players

The total match running distance during a match increased with age from ~5800 m for the U11 squad to ~7700 m for the U15 squad (~33%, $p < 0.01$) and when it was expressed in metres per hour, the distance increased with age from ~5700 $m \cdot h^{-1}$ for the U11 squad to ~6700 $m \cdot h^{-1}$ for the U15 squad (~18%, $p < 0.05$). Moreover, a positive relationship was found between age and total match running distance ($m \cdot h^{-1}$) ($r = 0.68$, $p < 0.01$).

Match running performance in terms of distances covered and percentage of time spent in each speed zone for U11 to U16 squad players

(i) Using absolute speed zones

The distances covered in speed zones 1 to 5 for the U11 to the U16 age groups are shown in Table 6. All players covered most distance during speed zones 1 and 2 (0-1.5 $m \cdot s^{-1}$, 1800-2200 $m \cdot h^{-1}$ and 1.6-3.0 $m \cdot s^{-1}$, 2100-2400 $m \cdot h^{-1}$, respectively) and all players spent most time in speed zones 1 and 2 (51-62% and 26-29%, respectively). However, for speed zones 3, 4 and 5 (3.1-4.5 $m \cdot s^{-1}$, 4.6-6.0 $m \cdot s^{-1}$ and > 6.0 $m \cdot s^{-1}$, respectively), the distance covered was 28%, 80% and 500% greater for the U15 or U16 squad than the U11 squad (zone 3: ~1300 to ~1700 $m \cdot h^{-1}$, zone 4: ~350 to ~630 $m \cdot h^{-1}$, zone 5: ~30 to ~160 $m \cdot h^{-1}$, $p < 0.01$ for all). Moreover, there was a positive relationship between age and match running distance during speed zones 3, 4 and 5 ($r = 0.54$, 0.52 and 0.70, respectively, $p < 0.01$ for all) and between age and the percentage of time spent in speed zones 3, 4 and 5 ($r = 0.52$, 0.60 and 0.64, respectively, $p < 0.01$ for all).

(ii) Using squad speed zones

The distances covered in the standing/walking, jogging, low, moderate and high speed zones are shown in Table 6. All players covered most distance in the jogging and low speed running speed zones (1600-2200 $m \cdot h^{-1}$ and 1500-2000 $m \cdot h^{-1}$, respectively). However, the players spent most of their playing time in the standing/walking (38-43%) and jogging (30-34%). Jogging and low speed running distances increased from age 11 to age 15 or 16 (from ~1700 to ~2100 $m \cdot h^{-1}$ and ~1600 to ~1900 $m \cdot h^{-1}$, respectively, $p < 0.01$ for both) whereas moderate and high speed running distances were more constant across the different age groups (~900 $m \cdot h^{-1}$ and ~500 $m \cdot h^{-1}$, respectively from age 11 to age 15 or 16).

(iii) Using individual speed zones

All players covered most distance in the jogging and low speed running speed zones (1900-2300 $m \cdot h^{-1}$ and 1600-1900 $m \cdot h^{-1}$, respectively). However, the players spent around half of their playing time in the standing and walking speed zone (46-51%). Using these individual speed zones (as opposed to the absolute or squad speed zones), the distances covered and times spent in each zone were more similar across the squads, with the main differences being between the U11s and other age groups for walking and between the youngest and oldest squads for jogging (Table 6).

Distances covered during match play for retained and released players

Total distance covered during match play for retained and released players aged U11/U12

When match running distances were standardised into metres per hour, the retained group covered a 7% greater total match running distance compared to the released group (5952 ± 283 $m \cdot h^{-1}$ vs 5568 ± 280 $m \cdot h^{-1}$, $p < 0.05$).

Match running performance in terms of distance covered and percentage of time spent in each speed zone for retained and released players aged U11/U12

(i) Using absolute speed zones

When the analysis was conducted using the absolute speed zone, the retained group tended to cover a 14% (168 m) greater distance than the released group during speed zone 3 ($p = 0.08$). When match running distances were standardised into metre per hour, the retained group covered a 13% (154 m) greater distance during speed zone 3 than the released group ($p < 0.01$, Table 7). The retained group spent 3% less time ($p < 0.05$) than the released group in the slowest (zone 1) speed zone.

(ii) Using squad speed zones

When match performance was analysed using squad speed zones, the retained group covered a 16% (131 m) greater distance than the released group during moderate speed running ($p < 0.05$). When match running distances were standardised into metres per hour, the retained group tended to cover a 10% (156 m) greater distance than the released group during low speed running ($p = 0.08$, $d = 0.8$) and covered a 15% (~130 m) longer distance during moderate speed running compared to the released group ($p < 0.05$, Table 7). The retained group spent 4% less time than the released group standing and walking ($p < 0.01$) and the retained group spent a 0.9% longer time in moderate speed running compared to the released group ($p < 0.05$).

(iii) Using individual speed zones

Using the individual speed zone analysis, there were fewer differences between the retained and released squads. The only difference was that retained group covered an 11% (175 m) greater distance compared to the released group during low speed running when match running distances were standardised into metre per hour, ($p < 0.05$, Table 7).

Match running performance in terms of distance covered and percentage of time spent in each speed zone for retained and released players aged U13/U14

There were no statistical differences in total match distance covered or in the distances and times spent in each speed zone for retained and released groups (Table 8).

Total distance covered during match play for retained and released players aged U15/U16

The retained group received 16% more pitch time than the released group (71.5 ± 11.7 min vs 61.7 ± 13.3 min, $p < 0.05$) and covered a 17% greater total match running distance than the released group (7901 ± 1264 m vs 6750 ± 1428 m, $p < 0.05$).

Match running performance in terms of distance covered and percentage of time spent in each speed zone for retained and released players aged U15/U16

(i) Using absolute speed zones

When the analysis was conducted using absolute speed zones, the retained group showed a tendency to cover a 17% (403 m) greater distance than the released group during speed zone 2 ($p = 0.06$, $d = 0.7$) (Table 9).

(ii) Using squad speed zones

When the matches were analysed using squad speed zones, the retained group covered a 22% (226 m), 16% (355 m) and 20% (353 m) greater distance than the released group during walking, jogging and low speed running, respectively ($p < 0.05$ for all) (Table 9).

(iii) Using individual speed zones

Using the individual speed zone analysis, the retained group covered a 24% (351 m) greater distance than the released group during walking ($p < 0.05$) and tended to cover a 16% (369 m) and 19% (353 m) greater distance than the released group during jogging ($p = 0.07$, $d = 0.7$) and low speed running ($p = 0.05$, $d = 0.8$) (Table 9).

Discussion

The main findings of the present study were that the total match distance covered by academy players and the distance covered at speeds faster than 6.0 $m \cdot s^{-1}$ increased with age; the retained group covered a greater match running distance and a greater distance at low to moderate speeds than the released group; the differences in match running performance with age were most clearly identified using absolute speed zones and; the differences in match running performance between retained and released players were most clearly identified when squad speed zones were used. Moreover, the significant differences found in the current study were accompanied by at least a moderate effect size (0.6-1.2) (Hopkins, Marshall, Batterham & Hanin, 2009). Therefore, all differences found in the current study are not only statistically significantly different, but also represent meaningful differences in performance.

In the present study English Premier League Academy players covered a total distance of ~5700 $m \cdot h^{-1}$ for the U11 squad to ~6700 $m \cdot h^{-1}$ for the U15 squad. These distances are similar to those previously reported for players from Qatar and England (Buchheit et al., 2010a; Harley et al., 2010). However, the current study showed a strong positive relationship between total match distance ($m \cdot h^{-1}$) and age, whereas Harley and colleagues (2010) did not discern such a relationship (Harley et al., 2010). This may be due to differences in playing standards between the studies as the Harley paper did not state the division or academy status of the players. In the present study, the differences in total match running distances between the U11 and U12 squads, U13 squad and U14, U15 and U16 squads could be partly caused by differences in the area per player due to differences in pitch dimensions. A previous study which employed a 6-a-side match (5 field players and a goalkeeper) showed that total match running distance was significantly longer when the area per player was 273 m^2 compared to

when the area per player was 175 m^2 (area per player was calculated without goalkeepers) (Casamichana & Castellano, 2010). The area per player for the current study was 213 m^2 for the U11 and U12 squads, 282 m^2 for the U13 squad and 344 m^2 for the U14, U15 and U16 squads and therefore, the differences in area per player due to the differences in pitch dimension may have influenced total match running distances.

In the present study, using absolute speed zones, there was an increase in running distance at high speeds (> 6.0 $m \cdot s^{-1}$) from the U11 to U16 squad and a strong relationship between running distance at high speeds and age. However, a previous study showed no such relationship between running distance at high speeds (> 5.3 $m \cdot s^{-1}$) and age, but this might have been because of the slower top speed zone in the earlier study (Buchheit et al., 2010a). This finding in the current study, of a very strong relationship between match running distance at high speeds and age in elite youth soccer players suggests that an important characteristic of older academy players is their ability to cover increased distances at high speeds. In senior players this characteristic (the distance covered at high speeds) has been shown to differentiate the standard of play between elite and sub-elite players (Mohr, Krustrup, & Bangsbo, 2003). In addition, a previous study has shown that differences in the area per player have no influence on high speed running distances when the area per player was 175 and 273 m^2 (Casamichana & Castellano, 2010). Hence, the differences in pitch dimensions and area per player between squads in the present study were not likely to have influenced the high speed running distances achieved by the players in each age group.

However, using squad speed zones very few differences in match performance between different age groups were detected. This finding is consistent with a previous study which only used squad speed zones and suggests that work rate profiles of the U11-U16 squads

from English Premier League Academy are similar when match distances are analysed according to speed zones which were corrected relative to sprint speed of each squad (Harley et al., 2010). Similarly, very few differences in match running performance between different age groups were identified when performance was analysed with individual speed zones in the present study which is consistent with an earlier suggestion that analysis of match running distances using individualised speed thresholds weakens the identification of between player differences (Abt & Lovell, 2009). Therefore, absolute speed zones are recommended to compare the match running performance of several age groups to monitor development with age. In the current study, the sprint speed of the fastest participant in the academy was employed to create the speed zones and such a procedure facilitated a clear observation of where the players were in terms of the development process.

In the current study, the retained group covered a greater total distance than the released group in the U11/U12s (~400 $m \cdot h^{-1}$ during a match). This finding suggests that total match distance covered within an age group squad may help to identify which players may progress in the academy system. However, it is important to note that the decision making regarding which players were retained and which players were released was undertaken subjectively by coaches. Thus, the current study only reveals one possible element which coaches may have consciously or unconsciously taken into account when they were selecting players and the findings are not suggesting that selection or retention or release should be based only or mainly on match running performance. Interestingly, no differences in total match running distances between retained and released groups were found in the U13/U14s and U15/U16s. In the U13/U14s, differences between players in maturational stage may have had a major impact on match running performance. In soccer, early maturers have been reported to demonstrate advantages in body size, speed, power and endurance (Malina, Eisenmann,

Cumming, Ribeiro, & Aroso, 2004; Figuereido et al., 2009) and total match distance is probably another element which is positively influenced by maturity. In addition, it is possible that by the time the players reach the U13 squad, players who cannot meet the physical demands of the game were possibly already released from the club and hence no differences in total match distance was found between retained and released groups in the U13 and above age groups. Furthermore, in the U15/U16s, although there were no differences in total match distance between retained and released groups when the distance was standardised into metre per hour ($m \cdot h^{-1}$), the retained group covered a greater distance during a match ($m \cdot match^{-1}$) and gained a longer playing time compared to the released group. As the retained group was provided with a longer playing time, which has led to a longer total match running distance ($m \cdot match^{-1}$) compared to the released group, it may be suggested that coaches had already decided who to retain at the club.

In the U11/U12s from the current study, in addition to covering a greater distance during a match (absolute and relative), the retained players also spent a higher proportion of time undertaking moderate speed running than the released group when squad speed zones were employed. High speed running is a key element in elite senior soccer players and elite senior soccer players have been shown to cover a longer distance than sub-elite soccer players by high speed running when the same speed zones (squad speed zones) were employed for the group of players (Mohr et al., 2003; Mohr, Krustrup, Andersson, Kirkendal, & Bangsbo, 2008). Moreover, 13 to 18 years old elite youth soccer players have been reported to cover 8-14% of total match running distance by high speed running (Buchheit et al., 2010a) and such a proportion is similar to that of senior elite soccer players (Bradley et al., 2009; Di Salvo et al., 2009; Rampinini et al., 2007). Hence, the importance of high speed running in elite youth soccer may be similar to that of elite senior soccer but the U11/U12 boys from the current

study showed a difference in moderate speed running distance. This is possibly because the anaerobic energy supplying pathways are not fully developed in 10-12 years old boys (Eriksson & Saltin, 1974; Lexell, Sjöström, Nordlund & Taylor 1992). Moreover, in the current study, the retained group of the U11/U12s spent a lower proportion of the match duration in a speed zone of 0.0-1.5 $m \cdot s^{-1}$ and during standing and walking compared to the released group when absolute or squad speed zones were employed. This finding is consistent with an earlier study which showed that elite professionals spent a lower proportion of match time in low speeds (< 2.2 $m \cdot s^{-1}$) compared to the sub-elite players (Mohr et al., 2003). These outcomes suggest that the retained group could produce more high speed running with less recovery time compared to the released group and that such an ability is a key factor in soccer performance (Buchheit et al., 2010b).

Tactically, the English Premier League Academy in the current study favoured the use of short passes to penetrate opposition during attacks as opposed to the use of many forward long balls. Moreover, the academy in the current study generally employed a 4-4-2 system. Such preferences in tactical style and playing system may have influenced the findings related to the differences in match running performance between retained and released groups. Clubs with different tactical styles and/or playing systems may demonstrate different results to the current study.

In the current study, both the U11/U12s and U15/U16s displayed more differences in match running performance between retained and released groups when squad speed zones were employed compared to when individual speed zones were used. Furthermore, a greater number of differences in match running performance between retained and released players were observed when the analysis took place using squad speed zones rather than absolute

speed zones. Thus, while absolute speed zones are of value for comparison between squads of different ages when a comparison of match running performance is made between groups of players from the same squad, it is recommended to undertake the analysis with squad specific speed zones to maximise the detection of differences between players.

A possible limitation of the current study was the variation in pitch dimensions between the squads. However, the coaches decide the pitch sizes for matches and thus in competitive matches for U11 to U16 age groups, it is not possible to control this variable. Moreover, some players missed matches during the season limiting the number of players available for the match analysis. Hence, the distribution of playing positions were not even between the age groups and as playing position influences match running distances in elite youth soccer players (Buchheit et al., 2010a), the findings of the current study may have been influenced by the differences in distribution of playing positions between the age groups.

In conclusion, total match running distance and high speed running distance improve with age and match running performance distinguishes retained and released groups in an English Premier League Academy. Moreover, the development in match running distance with age was best detected when absolute speed zones were employed in the analysis and differences in match running performance between retained and released groups were best demonstrated when the analysis was conducted using squad speed zones. Therefore, analysis of match running performance is a useful tool to monitor the development of English Premier League Academy players and to distinguish between those players who at a later date may be retained or released by the academy. Thus, match analysis data may make a valuable contribution, together with other variables, insight and expertise, to the talent identification and development process.

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Tables

Table 1. Number of players, age, height, body mass and sprint test performances of the players from the U11-U16 squads (N = 81, mean ± SD).

	N	Age (years)		Height (cm)		Body mass (kg)		5 m flying sprint speed ($m \cdot s^{-1}$)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
U11	18	11.3	0.2	146.0	3.9	37.6	4.7	5.9	0.3
U12	12	12.1	0.4	151.9	5.4	43.7	5.7	6.2	0.4
U13	12	13.1	0.3	160.7	7.8	49.4	7.3	6.5	0.5
U14	10	13.9	0.3	169.2	8.2	56.1	8.7	6.6	0.5
U15	13	14.9	0.3	176.3	5.8	66.4	5.5	6.8	0.3
U16	16	15.8	0.3	179.0	5.2	70.1	6.2	6.8	0.3

Table 2. Distribution of playing position for the U11-U16 squads

	Central defenders	Wide defenders	Central midfielders	Wide midfielders	Striker
U11	1	5	4	4	4
U12	2	2	3	1	4
U13	2	3	3	2	2
U14	2	2	3	1	2
U15	2	0	5	2	4
U16	3	4	3	3	3

Table 3. Distribution of playing position for the retained and released groups.

		Central defenders	Wide defenders	Central midfielders	Wide midfielders	Striker
U11/U12	Retained	0	2	6	2	4
	Released	3	5	1	3	4
U13/U14	Retained	2	0	4	2	1
	Released	2	5	2	1	3
U15/U16	Retained	4	1	7	1	3
	Released	1	3	1	4	4

Table 4. Number of players, age, height, body mass and sprint test performances of retained and released groups from U11/U12s, U13/U14s and U15/U16s age groups (N = 81, mean ± SD).

		N	Age (years)		Height (cm)		Body mass (kg)		5 m flying sprint speed ($m \cdot s^{-1}$)	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD
U11/U12	Retained	14	11.6	0.5	149.6	6.0	41.6	6.4	6.2	0.4
	Released	16	11.6	0.5	147.2	4.6	38.6	5.2	5.9	0.3
U13/U14	Retained	9	13.3	0.5	168.5	7.8	55.7	8.1	6.6	0.3
	Released	13	13.6	0.5	169.7	8.5	56.4	9.0	6.5	0.4
U15/U16	Retained	16	15.3	0.6	177.1	7.3	64.6	6.1	6.7	0.3
	Released	13	15.6	0.4	177.0	3.5	69.8	5.9	6.8	0.3

Table 5. Absolute, squad and individual speed zones presented in $m \cdot s^{-1}$.

		Speed zones ($m \cdot s^{-1}$)				
		1	2	3	4	5
Absolute speed zone		0.0 - 1.5	1.6 - 3.0	3.1 - 4.5	4.6 - 6.0	> 6.0
		Speed zones ($m \cdot s^{-1}$)				
		Standing and walking	Jogging	Low speed running	Moderate speed running	High speed running
Squad speed zone	U11	0.0 - 1.1	1.2 - 2.1	2.2 - 3.2	3.3 - 4.2	> 4.2
	U12	0.0 - 1.1	1.2 - 2.2	2.3 - 3.2	3.3 - 4.3	> 4.3
	U13	0.0 - 1.1	1.2 - 2.2	2.3 - 3.3	3.4 - 4.4	> 4.4
	U14	0.0 - 1.2	1.3 - 2.3	2.4 - 3.5	3.6 - 4.6	> 4.6
	U15 and U16	0.0 - 1.2	1.3 - 2.4	2.5 - 3.7	3.8 - 4.9	> 4.9
Individual speed zone	Slowest	0.0 - 1.1	1.2 - 2.2	2.3 - 3.3	3.4 - 4.4	> 4.4
	Fastest	0.0 - 1.5	1.6 - 3.0	3.1 - 4.5	4.6 - 6.0	> 6.0

Table 6. Distance covered in each speed zone ($m \cdot h^{-1}$) by the U11-U16 squads according to **absolute, squad and individual** speed zones.

	Speed zone 1/ Standing and walking		Speed zone 2/ Jogging		Speed zone 3/ Low speed running		Speed zone 4/ Moderate speed running		Speed zone 5/ High speed running	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Absolute speed zone										
U11	2011	151	2166	271	1334	181	349	183	29	22
U12	2119	104	2277	288	1257	192	363	136	52	71
U13	2004	185	2319	280	1427	328	420	152	72	39
U14	1908	186	2242	235	1595[b]	239	515	141	118[a]*	66
U15	1830[b]*	226	2282	252	1709[a]*[b]*	227	629[a]*[b]*[c]	184	148[a]*[b]*[c]	61
U16	1927	190	2343	261	1675[a]*[b]*	282	578[a]*[b]*	128	164[a]*[b]*[c]*	71
Squad speed zone										
U11	994	93	1665	191	1609	240	887	129	493	138
U12	1084	93	1924[a]*	185	1501	162	888	157	493	216
U13	1006	242	1974[a]*	196	1726	218	893	286	504	203
U14	1109	95	1853	136	1831[b]	319	926	159	554	140
U15	1035	77	2114[a]*[d]*	128	1964[a]*[b]*	251	1056[a]	164	537	138
U16	1047	142	2115[a]*[bd]*	155	1886[ab]*	284	977	214	503	122
Individual speed zone										
U11	1237	233	1956	218	1618	241	768	202	265	105
U12	1592[a]*	262	2040	251	1611	191	644	124	229	108
U13	1454	212	2172	258	1692	302	649	162	218	70
U14	1523[a]	228	2042	114	1826	321	729	205	257	83
U15	1513[a]	198	2271[a]*	228	1898[a]	258	870[b]	200	330	114
U16	1504[a]	279	2272[a]*	229	1789	310	800	192	316	99

[a]significantly different to U11 at $p < 0.05$. [b]significantly different to U12 at $p < 0.05$. [c]significantly different to U13 at $p < 0.05$. [d]significantly different to U14 at $p < 0.05$. *$p < 0.01$.

Table 7. Match performance of the **U11/U12s** according to absolute, squad and individual speed zones.

		Speed zone 1/ Standing and walking			Speed zone 2/ Jogging			Speed zone 3/ Low speed running			Speed zone 4/ Moderate speed running			Speed zone 5/ High speed running		
		Mean	SD	*d*	Mean	SD	*d*	Mean	SD	*d*	Mean	SD	*d*	Mean	SD	*d*
Distance (m)																
Absolute	Retained	2064	357	0.2	2290	497	0.4	1382[a]	249	0.7	344	121	-0.1	47	55	0.5
	Released	2006	335		2097	394		1214	250		357	153		29	23	
Squad	Retained	1016	177	0.0	1819	340	0.4	1646	420	0.5	949*	169	0.8	520	172	0.4
	Released	1020	212		1685	284		1472	274		818	165		461	131	
Individual	Retained	1445	341	0.5	2055	462	0.4	1703	396	0.6	728	202	0.1	237	114	-0.2
	Released	1284	306		1894	302		1510	290		702	204		258	103	
Distance ($m \cdot h^{-1}$)																
Absolute	Retained	2065	131	0.3	2291	287	0.6	1382*	174	0.9	344	148	-0.1	47	66	0.4
	Released	2029	148		2122	259		1228	171		361	180		29	23	
Squad	Retained	1016	100	-0.2	1819	190	0.5	1646[a]	250	0.8	949*	141	1.0	520	210	0.3
	Released	1033	100		1705	250		1490	161		827	109		466	124	
Individual	Retained	1445	353	0.5	2056	257	0.6	1703*	245	0.9	728	198	0.1	237	118	-0.2
	Released	1299	210		1917	198		1528	165		710	179		261	96	

Retained vs released. *$p < 0.05$. [a]$p = 0.08$.

Table 8. Match performance of the **U13/U14s** according to absolute, squad and individual speed zones.

		Speed zone 1/ Standing and walking			Speed zone 2/ Jogging			Speed zone 3/ Low speed running			Speed zone 4/ Moderate speed running			Speed zone 5/ High speed running		
		Mean	SD	*d*	Mean	SD	*d*	Mean	SD	*d*	Mean	SD	*d*	Mean	SD	*d*
Distance (m)																
Absolute	Retained	1927	358	0.0	2236	417	0.0	1465	402	0.0	431	209	-0.2	89	47	0.0
	Released	1912	371		2232	410		1464	391		464	121		90	57	
Squad	Retained	1086	361	0.4	1921	312	0.2	1718	359	-0.1	836	306	-0.3	463	218	-0.5
	Released	986	160		1849	337		1740	348		922	293		548	155	
Individual	Retained	1464	302	0.1	2115	322	0.2	1698	447	0.0	653	266	-0.1	214	89	-0.3
	Released	1440	287		2035	400		1718	408		678	163		240	74	
Distance ($m \cdot h^{-1}$)																
Absolute	Retained	1986	210	0.2	2305	298	0.1	1510	248	0.1	444	164	-0.2	92	41	0.0
	Released	1947	173		2273	240		1491	337		472	142		92	66	
Squad	Retained	1119	262	0.6	1981	206	0.6	1770	241	0.0	862	232	-0.3	477	193	-0.5
	Released	1004	126		1882	149		1772	294		939	236		558	158	
Individual	Retained	1509	203	0.2	2180	249	0.5	1750	289	0.0	673	193	-0.1	221	66	-0.3
	Released	1466	233		2072	180		1749	339		690	180		244	84	

Table 9. Match performance of the **U15/U16s** according to absolute, squad and individual speed zones.

		Speed zone 1/ Standing and walking			Speed zone 2/ Jogging			Speed zone 3/ Low speed running			Speed zone 4/ Moderate speed running			Speed zone 5/ High speed running		
		Mean	SD	*d*	Mean	SD	*d*	Mean	SD	*d*	Mean	SD	*d*	Mean	SD	*d*
Distance (m)																
Absolute	Retained	2232	463	0.7	2773[b]	529	0.7	1986	376	0.5	702	212	0.4	173	81	-0.1
	Released	1960	401		2370	613		1770	458		632	157		180	80	
Squad	Retained	1267*	284	0.9	2524*	418	0.8	2319*	430	0.8	1188	267	0.5	603	178	0.3
	Released	1041	209		2169	510		1933	522		1057	277		549	140	
Individual	Retained	1844*	409	1.0	2706[c]	412	0.7	2210[a]	431	0.8	966	275	0.3	372	144	0.2
	Released	1493	281		2337	618		1857	501		879	273		344	123	
Distance ($m \cdot h^{-1}$)																
Absolute	Retained	1873	215	-0.2	2326	272	0.1	1666	238	-0.2	589	166	-0.2	145	64	-0.5
	Released	1907	203		2305	237		1722	285		615	146		175	66	
Squad	Retained	1063	112	0.4	2118	136	0.1	1946	248	0.2	997	193	-0.2	506	136	-0.2
	Released	1012	123		2110	152		1881	297		1028	203		534	122	
Individual	Retained	1547	211	0.4	2270	207	0.0	1854	279	0.2	810	193	-0.2	312	113	-0.2
	Released	1453	282		2274	253		1807	312		855	204		335	95	

Retained vs released. *$p < 0.05$. [a]$p = 0.05$. [b]$p = 0.06$. [c]$p = 0.07$.