Comparison of Match Technical Performance in the U13 to U18 Elite Soccer Players

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The aim of the current study was to examine the match technical performance of the under-13 (U13), U14, U15, U17 and U18 elite soccer players. Fifty seven players from the same academy of a Japanese professional soccer club took part in the study and were video-recorded during the official league matches. All matches were 11-a-side and technical performance was analysed. Total of 118 complete match samples were obtained and each participant took part in 2.1 ± 1.3 matches. The U17 and U18 squads demonstrated the greater number of tackles and touches than the U13 and U14 squads during a match (ES = 0.60-0.70). The U15, U17 and U18 squads showed the greater number of passes, successful passes and ball involvement compared to the U13 and U14 squads during a match (ES = 0.59-0.80). Pass accuracy improved with age from the U13 (67.8 ± 15.3%) to U18 squads (82.1 ± 5.1%) (ES = 0.67-1.00). A positive strong relationship between age and pass accuracy was observed (r_s = 0.50). Therefore, in elite youth soccer players: 1) the greater number of technical events is performed during match play as they age; and 2) pass accuracy during match play improves with age.

Keywords: Association football, intermittent sports, pass accuracy, skills, talent identification

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1. Introduction

Match analysis has been widely conducted in both adult and youth elite soccer players to establish physical demands of match play (Buchheit et al., 2010; Goto et al., 2015a; Goto et al., 2015b; Sarmento et al., 2014). In recent years, technical performance during match play in professional soccer players has been intensely studied (Bradley et al., 2011; Bradley et al., 2013; Bush et al., 2015b; Carling and Dupont, 2011; Liu et al., 2016; Rampinini et al., 2009; Russell et al., 2013; Schuth et al., 2016; Varley et al., 2017) and many studies employed semi-automated match analysis system (Prozone Sports Ltd, Leeeds, UK) (Bradley et al., 2011; Bradley et al., 2013; Bush et al., 2015; Schuth et al., 2016; Varley et al., 2017). The technical performance variables (number of counts per match except pass accuracy) commonly included in these analysis were: clearances (2.3-3.7); crosses (0.3-2.1); dribbles (0.3-0.9); headers (2.2-2.5); passes (21.0-52.3); pass accuracy (69.1-84.2%); shots (0.9-2.5); tackles (1.0-3.5); and ball involvement (34.5-86.0) (Bradley et al., 2011; Bradley et al., 2013; Carling and Dupont, 2011; Liu et al., 2016; Rampinini et al., 2009; Russell et al., 2013). Moreover, an influence of playing formation, match location (home or away), playing position, match outcome (win, lose or draw) and strength of the team and the opposition (league position) on technical performance of professional soccer players has been investigated (Bradley et al., 2011; Bush et al., 2015a; Liu et al., 2016; Rampinini et al., 2009; Schuth et al., 2016). However, only one match analysis study reported technical performance of youth soccer players during match play to the author's knowledge. The study conducted a match analysis to investigate technical performance during two international tournaments and participants were the under-17 (U17) players from 19 teams who were competing in top division league of their countries. The technical performance (number of counts per match except pass accuracy) reported by the study included: crosses (0.7-1.0); passes (37.7-45.1); pass accuracy (76.3-81.5%); shots (1.1-1.6); tackles (3.9-4.1); and ball involvement except headers (114.6-134.4) (Varley et al., 2017).

Match technical performance data of elite youth soccer players are potentially useful for talent

identification and player development. However, this is an under-researched area and the most previous talent identification studies focused on anthropometric (Gil et al, 2007), physiological (Figueiredo et al., 2009; Le Gall et al, 2010; Vaeyens et al., 2006), psychological (Figueiredo et al., 2009; Williams, 2000), sociological (Meylan et al., 2010) and technical skill (Figueiredo et al., 2009; Huijgen et al., 2013; Huijgen et al., 2010; Vaeyens et al., 2006) measurements. In the previous studies, technical skill of 10 to 18 year old elite, sub-elite and/or non-elite youth soccer players has been assessed by closed skill tests, and dribbling speed, pass accuracy and shooting accuracy have been shown to develop with age (Figueiredo et al., 2009; Huijgen et al., 2013; Huijgen et al., 2010; Vaeyens et al., 2006). However, soccer is a complex sport which involves performing the required skills in a rapidly changing environment with constant restrictions in time and space, and requires to execute sport-specific skills under fatiguing conditions (Mohr et al., 2003; Vaeyens et al., 2006). Hence, performing one aspect of the soccer match in isolation (e.g., passing) from a static position may only be a representation of learned " technique" rather than "skill" and a shift towards a more match specific protocol or actual match play is necessary to contribute towards the identification of talented players (Ali, 2011; Unnithan et al., 2012; Wilson et al., 2016). Therefore, the aim of the current study was to examine the match technical performance of the elite youth soccer players.

2. Methods

2.1. Research design

The current study was an observational study with a cross-sectional design and compared technical performance of the U13, U14, U15, U17 and U18 age groups.

2.2. Participants

The participants were 57 outfield players from the same academy of a Japanese professional soccer club and their chronological age ranged from 12.7 to 18.6 years. The participants' age on match day was calculated based on their date of birth and the age was calculated nearest to 0.1 years. The players were grouped by age into the U13, U14, U15, U16, U17 and U18 squads. During an average week, the U13-U15 squads trained four times, the U16-U18 squads trained five times and all squads played a match. For all squads, all training sessions were two hours and a fitness based session was conducted once or twice in each week and the rest of training sessions were technical sessions. The fitness based sessions involved a mixture of endurance and/or sprint training. The U16, U17 and U18 players were combined to form one squad and they trained and competed in the matches together. Due to this reason, the U16 players were hardly selected to play in the matches and only a small amount of match samples were available for the U16 players. Hence, the U16 squad was removed from the current analysis.

One coach was in charge of each squad and the coaches held a Japan Football Association official coaching licence (official class 'S', 'A' or 'B' coaching licence). Two players from the U15 squad, two players from the U17 squad and one player from the U18 squad were representing Japan in their respective age group.

The mean (± SD) age, height, body mass and playing position distribution of each squad are shown in **table 1 and 2**. 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 players' 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.

2.3. Match analysis

For each age group, the official league matches were analysed and the matches were recorded using a video camera 5 m away from halfway line of the pitch and 3 m above the ground level. A total of 18 matches were analysed and 118 complete match samples were obtained from the analysis. The mean (± SD) number of observations for each participant

Table 1 Number of participants, and age, height and body mass of players from the U13, U14, U15, U17 and U18 squads (mean ±SD)

		U13	U14	U15	U17	U18
N		11	11	11	12	12
Age (years)	Mean	13.3	14.2	15.1	17.0	18.0
	SD	0.2	0.3	0.3	0.3	0.3
Height (cm)	Mean	159.4	162.1	167.0	170.7	169.4
	SD	8.6	8.9	4.1	7.8	7.4
Body mass (kg)	Mean	48.8	49.9	55.6	63.9	60.1
	SD	8.1	8.0	5.5	3.5	6.0

Table 2 Distribution of playing position for the U13, U14, U15, U17 and U18 squads

	U13	U14	U15	U17	U18
Central defenders	1	2	3	2	2
Wide defenders	2	3	2	4	2
Central midfielders	2	2	2	4	3
Wide midfielders	2	2	2	1	3
Strikers	4	2	2	1	2

was 2.1 ± 1.3 matches and technical performance was analysed using Prozone match insight (Prozone Sports Ltd, Leeds, the UK) (**table 3**). All matches were 11-a-side and pitch dimension was 105 x 68 m. Match durations were 60 min for U13 squad, 70 min for the U14 squad, 80 min for the U15 squad and 90 min for the U17 and U18 squads. Match technical performance data were presented in both absolute and relative values (except pass accuracy). Relative values were calculated by adjusting absolute values for match playing time (counts per hour).

Table 3 Technical performance measures and their definitions

Blocks	An opposing player, in close proximity, prevents the ball from reaching its intended target. This can take place anywhere on the pitch.
Clearances	A defensive touch undertaken by a player under pressure from the opposition or with no intended target.
Tackles	Dispossession or attempted dispossession of an opponent by physical challenge or pressure when actual challenge/tackle is attempted.
Touches	Any touch other than a pass/shot/cross etc taken by a player with any part of his body except his head, includes mis-controls of the ball.
Passes	Any attempt by a player to play the ball to a team-mate.
Successful passes	Passes performed by a player and successfully received by another player of the same team.
Pass accuracy	The percentage of successful passes.
Crosses	Any ball played from a wide area into the box with the aim of creating a goal scoring opportunity.
Headers	Any touch of the ball with a player's head.
Shots	Any attempt at goal with any part of the body.
Dribbles	Any run with the ball that involves either (I) Multiple touches with a directional change or (II) Beating an opponent.
Ball involvement	Sum of all technical performance events.

2.4. Statistical analysis

A Kolmogorov-Smirnov test was employed to examine whether or not the distribution was normal. The test showed that normality distribution was violated and due to having too many zeros, transformation could not be employed. Hence, the Kruskal-Wallis test followed by pairwise comparison with adjusted P-values were performed to assess age group related differences (Field, 2013). The effect sizes (r) for the differences were calculated wherever appropriate and the values (r) were considered as trivial ($r < 0.01$), small to medium (0.1 to 0.3), medium to large (0.3 to 0.5) and large to very large ($r > 0.5$) (Cohen, 1988). Speaman's rank correlation (r_s) was employed to examine the relationship between age and technical performance. The magnitude of correlation coefficients was considered as trivial ($r_s = 0.0$), small ($r_s = 0.1$), moderate ($r_s = 0.3$), large ($r_s = 0.5$), very large ($r_s = 0.7$), nearly perfect ($r_s = 0.9$) and perfect ($r_s = 1$) (Hopkins, 2006). The level of statistical significance was set at $p < 0.05$. Results are presented as mean ± standard deviation (SD) (**Table 4-6** include median) and all the statistical analyses were performed using IBM SPSS statistics (version 22.0).

Table 4 Technical performance of the U13, U14, U15, U17 and U18 squads during a match (counts) (mean, median and SD)

		U13	U14	U15	U17	U18	H(4)	Significance
Blocks	Mean	1.1	0.9	1.1	0.7	0.7	1.92	P = 0.751
	Median	1.0	1.0	1.9	0.9	0.9		
	SD	0.6	0.5	0.9	0.6	0.5		
Clearances	Mean	1.4	1.9	1.4	2.5	1.6	7.80	P = 0.099
	Median	0.7	1.4	1.9	3.4	2.4		
	SD	1.6	1.8	1.2	1.5	1.5		
Tackles	Mean	0.9[bc]	0.9[bc]	2.1	2.9	3.4	18.42	P = 0.001
	Median	0.5	1.0	1.9	2.5	3.3		
	SD	0.9	0.7	1.6	1.7	2.2		
Touches	Mean	11.9[bc]	11.8[bc]	21.0	28.6	29.7	21.13	P < 0.001
	Median	12.6	11.7	19.5	26.0	28.9		
	SD	3.4	4.5	14.6	12.7	15.0		
Passes	Mean	20.0[a*b*c]	18.2[a*b*c]	42.7	39.1	37.7	27.92	P < 0.001
	Median	21.6	15.3	41.7	34.1	36.9		
	SD	6.4	7.4	16.1	11.6	16.5		
Successful passes	Mean	14.2[a*b*c]	13.4[a*b*c]	34.2	32.8	31.0	28.41	P < 0.001
	Median	15.5	10.9	34.1	28.0	30.0		
	SD	5.5	5.6	14.0	11.3	14.1		
Crosses	Mean	0.9	0.7	0.6	1.4	1.8	5.42	P = 0.247
	Median	1.0	0.9	0.0	0.7	1.1		
	SD	0.9	0.6	1.1	1.6	2.2		
Headers	Mean	3.3	3.2	4.0	5.9	4.3	2.65	P = 0.618
	Median	2.6	2.9	3.7	6.6	2.9		
	SD	2.5	1.2	2.4	4.0	3.5		
Shots	Mean	1.5	1.3	1.2	0.9	1.5	1.21	P = 0.877
	Median	0.6	0.6	0.9	0.4	1.2		
	SD	1.7	1.7	1.1	1.2	1.7		
Dribbles	Mean	5.8	4.1	10.6	5.1	5.7	5.21	P = 0.267
	Median	4.8	4.0	5.7	3.8	5.2		
	SD	3.8	3.0	7.7	3.9	3.8		
Ball involvement	Mean	46.9[ab*c]	43.5[a*b*c*]	85.7	88.9	87.8	27.63	P < 0.001
	Median	47.1	40.9	85.3	81.6	83.1		
	SD	11.7	14.4	31.7	25.9	32.9		

[a]significantly different to U15 at P < 0.05, [b]signifiantly different to U17 at P < 0.05, [c]significanlty different to U18 at P < 0.05, [*]P < 0.01. H(4) = test statistic (degrees of freedom).

Table 5 Technical performance of the U13, U14, U15, U17 and U18 squads during an hour of a match (counts) (mean, median and SD)

		U13	U14	U15	U17	U18	H(4)	Significance
Blocks	Mean	1.1	0.9	1.1	0.7	0.7	4.89	P = 0.299
	Median	1.0	0.8	1.4	0.6	0.6		
	SD	0.6	0.5	0.9	0.6	0.5		
Clearances	Mean	1.4	1.9	1.4	2.5	1.6	4.47	P = 0.346
	Median	0.7	1.2	1.4	2.3	1.6		
	SD	1.6	1.8	1.2	1.5	1.5		
Tackles	Mean	0.9	0.8	1.6	1.9	2.3	12.96	P = 0.011
	Median	0.5	0.8	1.4	1.6	2.2		
	SD	0.9	0.6	1.2	1.2	1.5		
Touches	Mean	11.9	10.2[bc]	15.8	19.0	19.8	13.21	P = 0.010
	Median	12.6	10.0	14.6	17.3	19.3		
	SD	3.4	3.9	10.9	8.5	10.0		
Passes	Mean	20.0	15.6[a*b]	32.0	26.1	25.1	14.97	P = 0.005
	Median	21.6	13.1	31.3	22.7	24.6		
	SD	6.4	6.3	12.1	7.7	11.0		
Successful passes	Mean	14.2[c]	11.5[a*b*c]	25.6	21.9	20.7	18.01	P = 0.001
	Median	15.5	9.4	25.6	18.7	20.0		
	SD	5.5	4.8	10.5	7.6	9.4		
Crosses	Mean	0.9	0.6	0.4	0.9	1.2	3.86	P = 0.426
	Median	1.0	0.8	0.0	0.5	0.7		
	SD	0.9	0.5	0.8	1.1	1.4		
Headers	Mean	3.3	2.7	3.0	3.9	2.9	1.40	P = 0.844
	Median	2.6	2.5	2.8	4.4	1.9		
	SD	2.5	1.0	1.8	2.7	2.4		
Shots	Mean	1.5	1.1	0.9	0.6	1.0	2.35	P = 0.671
	Median	0.6	0.5	0.7	0.2	0.8		
	SD	1.7	1.4	0.8	0.8	1.1		
Dribbles	Mean	5.8	3.5	7.9	3.4	3.8	6.49	P = 0.165
	Median	4.8	3.5	4.3	2.5	3.5		
	SD	3.8	2.5	5.8	2.6	2.6		
Ball involvement	Mean	46.9	37.3[a*b]	64.2	59.3	58.5	13.49	P = 0.009
	Median	47.1	35.0	64.0	54.4	55.4		
	SD	11.7	12.4	23.8	17.3	21.9		

[a]significantly different to U15 at $P < 0.05$, [b]signifiantly different to U17 at $P < 0.05$, [c]significanlty different to U18 at $P < 0.05$, [*]$P < 0.01$. H(4) = test statistic (degrees of freedom).

Table 6 Pass accuracy of the U13, U14, U15, U17 and U18 squads during a match (%) (mean, median and SD)

		U13	U14	U15	U17	U18	*H*(4)	Significance
Pass accuracy	Mean	67.9[ab*c*]	73.2[b*c*]	78.6	82.7	82.1	15.12	P = 0.004
	Median	70.2	76.0	80.5	83.0	83.1		
	SD	15.3	10.1	5.9	5.0	5.1		

[a]significantly different to U15 at $P < 0.05$, [b]Signifiantly different to U17 at $P < 0.05$, [c]significanlty different to U18 at $P < 0.05$, [*]$P < 0.01$. H(4) = test statistic (degrees of freedom).

3. Results

Technical performance of each squad in a match is presented in **table 4**. The U17 and U18 squads demonstrated the greater number of tackles and touches than the U13 and U14 squads ($P < 0.05$ for all, $r = 0.60$-0.70). The U15, U17 and U18 squads showed the greater number of passes, successful passes and ball involvement compared to the U13 and U14 squads ($P < 0.05$ or $P < 0.01$, $r = 0.59$-0.80).

Technical performance adjusted for match playing time is presented in **table 5**. The U18 squad tended to tackle more frequently than the U13 ($P = 0.09$, $r = 0.55$) and U14 ($P = 0.06$, $r = 0.58$) squads. The U17 and U18 squads demonstrated the roughly 200% greater number of touches than the U14 squad ($P < 0.05$ and $r = 0.60$ for both). Focusing on the number of successful passes, the U15 squad tended to show the greater frequency than the U13 squad in an hour of a match ($P = 0.08$, $r = 0.56$). Moreover, compared to the U14 squad, the U15 ($P < 0.01$, $r = 0.77$), U17 ($P < 0.01$, $r = 0.63$) and U18 ($P = 0.10$, $r = 0.54$) squads performed or tended to perform 80-120% greater number of successful passes in an hour of a match. The U15 and U17 squads demonstrated the 60-70% greater number of ball involvement than the U14 squad in an hour of a match (vs U15: $P < 0.01$, $r = 0.68$, vs U17: $P < 0.05$, $r = 0.59$). In addition, pass accuracy for the U15 was ~10% greater than the U13 squad ($P < 0.05$, $r = 0.67$) and the accuracy for the U17 and U18 squads was 15-20% greater than the U13 and U14 squads ($P < 0.01$ for all, $r = 0.86$-1.00) (**figure 1, table 6**).

There was a positive relationship between age and the number of tackles ($r_s = 0.55$), touches ($r_s = 0.56$), passes ($r_s = 0.48$), successful passes ($r_s = 0.51$) and ball involvement ($r_s = 0.55$) in a match ($P < 0.01$ for all). When technical performance was adjusted for match playing time, there was a positive relationship between age and the number of tackles ($r_s = 0.47$, $P < 0.01$), touches ($r_s = 0.41$, $P < 0.01$), successful passes ($r_s = 0.40$, $P < 0.05$) and ball involvement ($r_s = 0.30$, $P < 0.05$). Moreover, a positive relationship between age and pass accuracy was observed ($r_s = 0.50$, $P < 0.01$).

4. Discussion

The present study was the first to examine the match technical performance of the U13, U14, U15, U17 and U18 elite soccer players. The key findings of the current study were that: 1) the U17 and U18 players perform the greater number of tackles, touches, passes and successful passes, and gain the higher number of ball involvement compared to the U13 and U14 players in a match; and 2) pass accuracy improves with age.

To the author's knowledge, match technical performance of elite youth soccer players has previously been examined by only one study. The study included the U17 elite players from 19 teams who were competing in the top divisions from several countries and their match performance in just two international tournaments was analysed. The study reported (number of counts per hour of a match except pass accuracy) a similar number of tackles (2.6-2.7), passes (25.1-30.1), crosses (0.5-0.7) and shots (0.7-1.1) per hour of a match, and pass accuracy (76.3-81.5%), paying attention to the comparable participants in the current study with a similar age (Varley et al., 2017).

The number of tackles, touches, passes, successful passes and ball involvement in a match increased with age from the U13 to U18 squads in the current study. Moreover, there was a strong relationship between age and these technical performance variables. These

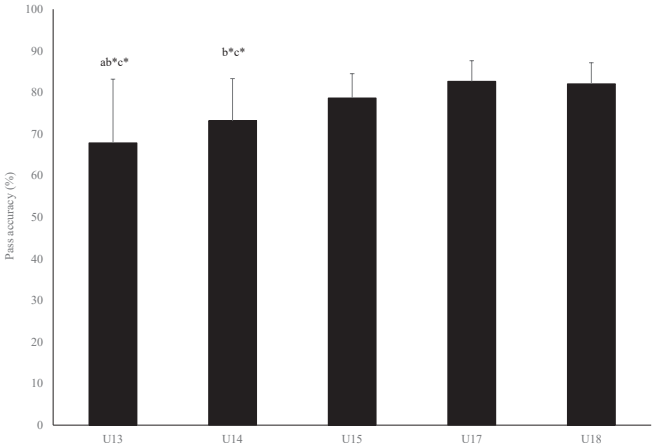

Fig 1 Pass accuracy of each squad during match play. [a]significantly different to U15 at $P < 0.05$, [b]significantly different to U17 at $P < 0.05$, [c]significanlty different to U18 at $P < 0.05$, *$P < 0.01$

are interesting findings even though the findings are likely to be due to the increase in playing time with age as the most of differences disappeared when match technical performance was adjusted for playing time. In the soccer academies, coaches often move outstanding players up to an older age group and such actions are possibly beneficial to further develop the players. Because moving up through age groups would potentially provide the longer playing time and greater number of technical events in a match whilst gaining an experience to play with taller, faster and better skilled players as demonstrated by the current and previous studies (Figueiredo et al., 2009; Hastie et al., 2013; Huijgen et al., 2010; Hulse et al., 2013; Vaeyens et al., 2006). Hence the current findings would provide coaches some valuable information for player development.

The current results showed that pass accuracy improves with age and is strongly related to age, in the U13 to U18 elite soccer players. The previous studies which assessed pass accuracy of 10 to 18 year old elite soccer players using closed skill tests reported an improvement in pass accuracy with age (Figueiredo et al., 2009; Huijgen et al., 2013; Vaeyens et al., 2006). Moreover, an importance of pass accuracy has been demonstrated in the previous studies of elite youth (Varley et al., 2017) and professional (Liu et al., 2016) soccer players. The U17 elite players who belonged to teams with a greater success during two tournaments demonstrated a better first time pass accuracy in matches compared to the players who belonged to teams with a less success (Varley et al., 2017). Moreover, when pass accuracy of the top and bottom three teams from the Spanish First Division Professional Football League (La Liga BBVA) was compared, a significantly greater pass accuracy was reported for the top three teams compared to the bottom three teams (Liu et al., 2016). Hence, the pass accuracy is a crucial element for successful soccer players, and coaches and sports scientists should focus on such attribute when identify a talent and develop elite soccer players.

The current study demonstrated a potential increase in the relative number of tackles, successful passes and ball involvement with age in the U13-U18 elite soccer players and these technical variables showed a moderate to strong relationship with age. The previous studies have revealed that the number of tackles, successful passes and ball involvement differentiate success in Italian and Spanish professional soccer leagues (Liu et al., 2016; Rampinini et al., 2009) and in international tournaments of elite youth soccer players (Varley et al., 2017). Hence, the elite players are required to perform both attacking and defending actions repetitively and demonstrate ability to engage high number of ball related activities during a match. Therefore, coaches and sports scientists are advised to consider both attacking and defending events especially passing and tackling when identifying talent and developing players.

It was demonstrated that dribbling frequency in a match play was constant over the age groups in both absolute and relative terms. This is an interesting finding as previous studies reported dribbling technique improves with age and distinguishes elite and non-elite youth soccer players (Figueiredo et al., 2009; Huijgen et al., 2010; Vaeyens et al., 2006). However, the studies assessed the dribbling technique using closed skill tests which decided the score based on the completion time of the dribbling course. In the nature of these tests, scores heavily depend on sprinting ability rather than facets of perceptual, cognitive and motor skill that form soccer skills (Bate, 1996). Moreover, successful dribbling frequency distinguished the league success of the team in the Spanish First Division Professional Football League (La Liga BBVA) (Liu et al., 2016). However, the study did not report an overall dribbling frequency comparable to the current study. Therefore, dribbling may be an important attribute for talent identification but a further consideration for methodology of dribbling performance analysis during match play in elite youth soccer is warranted.

In the current study, the distribution of playing position between the squads was not controlled. Playing position influences match-to-match variability of technical performance and the largest variation has been shown in number of passes in central defenders and number of tackles in strikers (Bush et al., 2015b). Moreover, interchanging playing positions influences number of tackles, clearances, dribbles, touches and passes as well as pass accuracy during a match (Schuth et al., 2016). Therefore, the future study should investigate technical performance of elite youth soccer players whilst controlling the distribution of playing position.

There is a few limitations to the current study. The previous studies demonstrated that playing position, playing formation, match location (home or away), match outcome (win, lose or draw) and strength of the team and opposition (league position) influences match physical and technical performances. However, the current study could not control such variables due to the small sample size. Hence, an investigation of technical performance of young elite soccer players whilst controlling the variables which may influence match performance is required. Although the current study could not control such variables, this study would still be the first to investigate the development of technical match performance in elite youth soccer players as technical match performance of only the U17 age group has been reported previously (Varley et al., 2017) and the current findings potentially support coaches and sports scientist to identify talent and develop players.

In conclusion, the number of technical events during match play increases as the players age and pass accuracy during match play improves with age, in elite youth soccer players. Therefore, conducting match analysis to gain technical match performance data will possibly make a valuable contribution, together with other variables such as insight and expertise, to the talent identification and player development.

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