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ORIGINAL ARTICLE

Identifying Technical, Physiological, Tactical and Psychological Characteristics that contribute to Career Progression in Soccer

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Abstract

This study identified some key characteristics at the age of 15 yrs that contributed to successful performance at the age of 19 yrs in male soccer players representing 12 top Finnish teams y. Data were collected when players were 15-year-olds and from those same participants who were still playing at the age of 19-yrs, resulting in a final data set of 114 participants (mean age 15.41 ± 0.26 yrs). Players were divided into two groups based on their performance level at the age of 19 years. Measurements for each participant were undertaken according to four categories: technical, physiological, tactical, and psychological characteristics. Binary logistic regression analysis showed that successful performance level at the age of 19 was associated with technical skills of passing and centering, as well as agility and motivation levels assessed at the age of 15, with a correct classification of 86 %. In the Finnish athlete developmental system, based on local sports clubs, results clearly highlighted the importance of passing and centering skills, agility and motivation in the development of youth players.

Keywords: *Talent, Youth, Performance, Team sports*

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Introduction

Identification and selection of youth athletes at an early age is an extraordinary challenge due to complexity and non-linear nature of talent development (Phillips, Davids, Renshaw, & Portus, 2010). However, many national federations and club teams invest considerable resources every year to identify talented players at an early age to ensure that the most talented athletes receive high quality coaching and training conditions (Abbot & Collins, 2002; Vaeyens, Lenoir, Williams, & Philippaerts, 2008; Williams & Reilly, 2000). Identification and selection of potential athletes have often been based on coaches' or talent scouts' subjective views (Williams, & Reilly, 2000). In recent years, there has been increasing attempts to use scientific approaches to talent identification, including measures of physiological, technical, tactical, and psychological skills (Reilly, Williams, Nevil, & Franks, 2000). Cross-sectional research on youth and adult soccer players has attempted to understand which physiological (Gil, Ruiz, Irazusta, Gil, & Irazusta, 2007; Reilly, Bagsbo, & Franks, 2000; Vaeyens et al., 2006), technical (Gil et al., 2007; Reilly et al., 2000; Vaeyens et al., 2006), tactical (Kannekens, Elferink-Gemser, & Visscher, 2009; Reilly et al., 2000) and psychological characteristics (Reilly et al., 2000), contribute to current playing status in soccer.

Unfortunately, however, cross-sectional studies in which identification and selection of the youth athletes is based on current performance are associated with low predictive value and their validity and usefulness have been widely questioned (Vaeyens et al., 2008). Due to differences in maturation and development, learning abilities, experience, and rapid changes in physiological and anthropometric characteristics during adolescence (Abbot & Collins, 2002; Meylan, Cronin, liver, & Hughes, 2010; Vaeyens, et al., 2008), selection of athletes based on current performance levels may prematurely exclude late-developing athletes, who

may have potential to excel in the future (Vilar, Araújo, Davids, & Button, 2012; Williams & Reilly, 2000).

Since the ultimate aim of talent development is to develop athletes who can later progress to top level, it is crucial to find characteristics which could be used in evaluation of long-term potential for development of youth athletes (Vaeyens et al., 2008). However, very few studies have attempted to track the development of young talented athletes into adulthood (Gonaus & Müller, 2012; Hujigen, Elferink-Gemser, Post, & Visscher, 2009; Kannekens, Elferink-Gemser, & Visscher, 2011; Van Yperen, 2009). These studies have found that several physiological characteristics (Gonaus & Müller 2012), technical skills, such as dribbling (Hujigen et al., 2009), tactical skills, such as positioning and deciding (Kannekens et al., 2011), and psychological skills such as goal commitment (Van Yperen, 2009), may predict the long-term career progression of young athletes.

An interesting idea is that future career progression in soccer may be culturally-constrained, depending on social differences of sport development systems in different nations. Countries with elite sport development academies recruit individuals at a young age in order to accelerate the development process of the most talented athletes in a specialised pathway. Competition among recruited athletes is high, and athletes may not be issued a playing contract, if perceived performance levels are deemed insufficient or it is anticipated that he/she is unable to reach the top performance level in soccer (Hujigen, Elferink-Gemser, Lemmink, & Visscher., 2012). In countries with different recruitment and development systems, development processes may be slower due to less investment in high quality coaching and training environments of talented athletes. The Finnish sport system exemplifies less formal developmental systems, in which athletic development is based around sport clubs, rather than elite academies or schools. In the sports club environment, the most talented athletes practice and play in the same environment as other athletes, and there are usually

fewer resources for specific development of these athletes as individuals because they are part of a heterogeneous group.

Developing players who have potential for success later in their soccer career is the interest of every development system in different countries, especially in those with fewer resources available. Due to challenges in evaluating players' long-term potential based on current performance level, it is crucial to find characteristics which could distinguish between an athlete's adolescent performance level and future performance potential (Vaeyens et al., 2008). However, there have been few studies using a multidimensional approach to identify factors that might contribute to future career progression in soccer club environments. The aim of this study was to examine which characteristics at the age of 15 contribute to successful performance level at the age of 19 in a soccer club environment

Methods

Participants

Participants were male soccer players representing 12 top Finnish teams in their age category. Data were collected in 2010, when players were 15-year-olds. Data from the players who still played soccer in 2014, when they were 19-year-olds, were analyzed in this study, resulting in a final data set of 114 players (mean age 15.41 ± 0.26). These players were divided into two groups based on their performance level at the age of 19 years. The Elite group (n =23) comprised players who were regularly playing in men's first division or higher in Finland during competitive season 2014. The Sub-Elite group (n =91) comprised players who were playing men's second division or lower in Finland during competitive season 2014. Participants' mean ages, anthropometric data, starting age for soccer practice and practice

characteristics at the age of fifteen are presented in Table I. An independent samples t-test revealed that the Elite players were significantly heavier than Sub-Elite players at 15 yrs, $t(112) = -2.024$, $P = .0145$.

Procedure

Participants and parents/guardians were first informed of procedures to be used in the study, following which they provided their informed consent prior to participation. Data collection occurred in the athletes' own practice environments in autumn 2010, after the competitive season in Finland. Measurements for each participant were undertaken according to four categories: technical, physiological, tactical, and psychological characteristics.

Technical characteristics. Two soccer-specific technical skill tests recommended by the Football Association of Finland were used to examine the players' technical skills. The first test measured dribbling and passing skills (Figure 1). The test started when a player took a first touch, and ended when the finishing line was crossed. The task was to dribble as quickly as possible. The second test measured passing and centering skills (Figure 2). The test started with the player's first touch, and ended with the final pass/cross or if maximum time (90 seconds) had passed. The task was to score as many points as possible (max. 16 points). Players were allowed to have two practice trials and the best out of two competitive trials was selected to present players' technical skills. The reliability of technical tests were tested with a one week interval test-retest which showed a correlation coefficient of $r = .0.76$ ($P < 0.001$) for dribbling and passing, and $r = .70$ ($P < 0.001$) for passing and centering, among a group of 37 soccer players aged 14 to 15 years old.

Physiological characteristics. Speed, agility, explosive leg strength (countermovement jump), and endurance (YoYo Test Level 1) were measured to examine players' physical fitness characteristics. A 30m all-out run from stationary start and agility test were measured with photocells (Newtest Oy, Finland). In both tests, players started 0.70 m behind the

photocells which triggered the timer. An 8-figure test track, recommended by the Football Association of Finland, was used as an agility test (Figure 3). The coefficient of variation in sprinting time tests has shown to be approximately 2 % (Moir, Button, Glaister, & Stone, 2004). Mirkov et al. (2008) have reported 0.84 intraclass correlation coeffiecient and 2.5 % error of measurement for similar type of agility test (Mirkov, Nedeljkovic, Kukolj, Ugarkovic, & Jaric, 2008). Explosive leg strength was measured by countermovement jumping on a jump mat (Newtest Oy, Finland). The coefficient of variation on countermovement jump test is shown to be 2.4 % (Moir et al., 2004). Endurance performance was measured using the YoYo Endurance Test Level (Bangsbo, 1996). An intraclass coefficient of 0.93 has been reported in the test-retest reliability measure for 20-meter shuttle test among 12 to 15 year-old children (Liu, Plowman, & Looney, 1992). The best of two trials was selected for further analysis in all physical fitness tests except in the 1-trial endurance test.

Tactical characteristics. A Tactical Skills Inventory for Sports (TACSIS; Elferink-Gemser, Visscher, Richart, & Lemmink, 2004), with subscales of declarative and procedural knowledge, was used to assess players' tactical skills. The TACSIS consists of 22 items representing four dimensions: Positioning and Deciding (9 items), Knowing about Ball Actions (4 items), Knowing about Others (5 items), and Acting in Changing Situations (4 items). Players responded to 22 items with a 6-point Likert scale regarding sport performance, from 1 *(very poor or almost never)* to 6 *(excellent or always).* Players were asked to compare themselves with top Finnish players in the same age category. In previous research the TACSIS was shown to have good psychometric characteristics (Elferink-Gemser et al., 2004). In the current study, the internal consistencies of the four TACSIS sub-scales indicated satisfactory levels, with Cronbach's alpha coefficients ranging from .73 to .92.

Psychological characteristics. The Psychological Skills Inventory for Sports (PSIS-R-5; Mahoney, Gabriel, & Perkins, 1987) was used to assess the players' psychological skills.

The scale consists of 29 items, representing four dimensions: Motivation (8 items), Confidence (8 items), Concentration (7 items), and Mental Preparation (6 items). These 29 items were responded to on a 5-point Likert scale, from 1 *(almost never)* to 5 *(almost always)*. Items worded negatively were recoded by reversing the 1-5 formats. A high score on each scale corresponds to a proposed high value for a psychological skill. In previous research the PSIS-R-5 was shown to have sufficient psychometric characteristics (Mahoney et al., 1987). In the current study, the four PSIS-R-5 scales indicated good internal consistency, with Cronbach's alpha coefficients ranging from .71 to .87.

Data analysis

Independent samples T-tests were conducted to investigate group differences in technical, physiological, tactical, and psychological characteristics. Cohen's *d* was used to estimate Effect sizes (ES) in independent samples T-tests, classified according to Cohen's (1988) suggestion of effect sizes up to .20 being small, up to .50 as moderate, and up to .80 evidencing large effect.

Binary logistic regression analysis was performed to identify technical, physiological, tactical and psychological characteristics that may contribute to performance level in soccer at the age of 19. Before the regression analysis, all variables were divided into tertiles (low, moderate, high) based on results of the players in this study. Thereafter, binary logistic regression analysis was performed using the enter procedure, with the lowest group as a reference point. Model accuracy was assessed using the Hosmer and Lemeshow test (Hosmer & Lemenshow, 1989).

Results

Independent samples t-test revealed significant differences between Elite and Sub-Elite players at the age of 15 in dribbling and passing $t(112) = 2.497$, $P = .014$, and passing and centering $t(112) = -3.621$, $P = .000$. Differences were also found on speed 30m $t(49.39)$

=3.673, *P* =.001, agility *t*(112) =4.108, *P* =.000, and endurance *t*(112) =-2.527, *P* =.013. With respect to the tactical characteristics, Acting in changing situations, *t*(112) =-2.073, *P* =.040 discriminated Elite and Sub-Elite groups. Finally, there were statistically significant difference between groups in Motivation *t*(52.995) =-4.405, *P* =.000. In all comparisons, Elite players outscored the Sub-Elite players at the age of 15 (Table II).

Table III displays the binary logistic regression analysis results. The model showed that elite performance level at the age of 19 was associated with passing and centering, agility and motivation measured at the age of 15. These variables together explained 43 % (Nagelkerke) of the variance in performance level at the age of 19. The correct classification of the performance level at the age of 19 based on passing and centering, agility and motivation together was 86 %. Hosmer and Lemeshow test was not significant (*P* =0.256), indicating that the model fitted the data well. For players scoring moderately in passing and centering, the odds ratio indicated 8.53 times greater chance of becoming an elite player at the age of 19, than players scoring low, whereas for players scoring high, this chance was 9.79 times greater (Table III). For players scoring high in agility, the odds ratio indicated 10.02 times greater chance of becoming an elite player at the age of 19 than low scoring players. For players scoring moderately in motivation, the odds ratio indicated 7.45 times greater chance of becoming elite at the age of 19 than players scoring low, whereas for players scoring high, this chance was 9.63 times greater.

Discussion

The present study examined technical, physiological, tactical, and psychological characteristics of youth soccer players at the age of 15 yrs, and made a comparison between players who reached the elite performance level in the Finnish sport system at the age of 19 yrs, and those who did not. Due to cultural and social differences in the Finnish sport development system, the career progression of youth Finnish soccer players may be different

than soccer players in other countries. The main finding of this study was that in the Finnish sport development system, elite performance level at the age of 19 was associated with passing and centering, agility, and motivation measured at the age of 15. The correct classification of Elite and Sub-Elite level players based on these three measures was 86 %. This finding suggests that these technical, physiological, and psychological characteristics may be valuable in predicting long-term development in youth soccer players in the Finnish sport development system.

Previous work by Gonaus and Müller (2012) suggested that physiological characteristics may be used in prediction of future career progression in youth soccer across different age groups. In the current study, youth soccer players who reached the elite performance level at the age of 19 outscored other players in speed 30 m, agility, and endurance at the age of 15. In addition, players scoring high in agility were about ten times more likely to reach the elite performance level at the age of 19, than players scoring low. This finding is in line with earlier studies, showing the importance of agility and speed in soccer (Gil et al., 2007; Hujigen et al., 2012), and also support the findings of Gonaus and Müller (2012) about the predictive value of agility in future career progression in soccer. It should be noted, however, that use of physiological data in predicting future performance has been questioned due to advantaging early-maturing athletes compared to late-maturing peers in these characteristics (Malina, Eisenmann, Cumming, Ribeiro, & Aroso, 2005; Vaeyens, Philippaerts, & Malina, 2005). In this study, elite players were significantly heavier than sub-elite players which may explain some of the differences between groups in physiological characteristics.

Assessing technical skills instead of physiological characteristics may decrease advantages of early-maturing athletes compared to late-maturing peers (Williams & Reilly, 2000). Previous studies have shown that dribbling the ball is a discriminatory technical skill

in youth soccer players of different performance levels (Hujigen et al., 2009; Hujigen et al., 2012) and may even be predictive of future success (Hujigen et al., 2009). In the current study, both technical skills tests (dribbling and passing, passing and centering), discriminated youth players who reached the elite level at the age of 19 from those who did not. In addition, youth soccer players who scored in the moderate or highest category in passing and centering were about eight to ten times more likely to reach the elite level at the age of 19 than players scoring in the lowest category.

The role of psychological skills, such as motivation, in elite athlete development has been highlighted in many studies (Durand-Bush & Salmela, 2002; Singer & Orbach, 1999; Ward, Hodges, Williams, & Starkes, 2007). High motivation has been shown to facilitate skill acquisition, enabling athletes to invest requisite time for practice and commitment to development (Singer & Orbach, 1999; Ward, et al., 2007). In our study, motivation discriminated between Elite and Sub-Elite players. In addition, youth soccer players who scored in the moderate or highest category in motivation, at 15 yrs, were about seven to ten times more likely to reach the elite performance level at the age of 19, than players scoring in the lowest category.

Although the correct classification of elite performance level at 19 yrs based on technical, physiological, and psychological characteristics in this study was high, the variables together explained 43 % of the variance in the performance level at this age, suggesting that also other things affect future career progression of young players. In this study, players were followed up only until they were 19 yrs, and their technical, physiological tactical and psychological chacteristics were assessed only once at 15 yrs. Concerning these issues, it is possible that some players characterised as sub-elite might develop quickly during late adolescence and reach the elite level in adulthood, even if they were sub-elite at 19 yrs.

Together these results provide important insights on understanding of career progression in youth soccer. In the Finnish soccer developmental system, based on local sports clubs, results clearly highlighted the importance of passing and centering skills, agility, and motivation in the development of youth players. By supporting the development of these skills during childhood and early adolescence, youth soccer players may have better opportunities for reaching elite performance level later in their sport careers.

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360 Table I. General characteristics (means, SDs) of Elite and Sub-Elite youth soccer players

Groups	**Elite (n=23)**	**Sub-Elite (n=91)**	**Effect size (*d*)**
Age (years)	15.48 ± 0.23	15.39 ± 0.27	.38
Height (cm)	176.71 ± 7.85	173.72 ± 7.40	.39
Weight (kg)	66.14 ± 9.04	61.92 ± 8.91	.47*
Starting age for soccer practice (years)	5.24 ± 1.00	5.52 ± 1.27	.25
Soccer practice / week (hours)	12.47 ± 4.17	12.78 ± 4.68	.07
Additional practice / week (hours)	3.67 ± 2.59	3.31 ± 2.05	.16

361 * $P < 0.05$, Cohen's *d*

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364 Table II. Technical, physiological, tactical, and psychological characteristics (means ± SD) of
365 Elite and Sub-Elite soccer players at the age of 15, independent samples t-test

Groups	**Elite (n=23)**	**Sub-Elite (n=91)**	**Effect size (*d*)**
Technical characteristics			
Dribbling and passing (s)	41.41 ± 3.44*	43.72 ± 4.08*	.61*
Passing and centering (s)	8.07 ± 3.09***	5.52 ± 2.99***	.84***
Physiological characteristics			
Speed 30m (s)	4.41 ± 0.15**	4.55 ± 0.23**	.76**
Agility (s)	6.58 ± 0.20***	6.82 ± 0.27***	1.02***
CMJ (cm)	36.52 ± 4.42	35.20 ± 4.50	.30
Endurance (m)	2501 ± 325*	2301 ± 359*	.61*
Tactical characteristics			
Positioning and deciding	4.49 ± 0.69	4.28 ± 0.68	.31
Knowing about ball actions	4.46 ± 0.70	4.23 ± 0.71	.33
Knowing about others	4.11 ± 0.80	3.98 ± 0.63	.18
Acting in changing situations	4.62 ± 0.69*	4.26 ± 0.76*	.50*
Psychological characteristics			
Motivation	4.35 ± 0.43***	3.85 ± 0.67***	.89***
Confidence	3.59 ± 0.70	3.41 ± 0.66	.27
Concentration	4.05 ± 0.51	3.78 ± 0.58	.48*
Mental preparation	2.98 ± 0.84	2.87 ± 0.80	.13

366 * P <0.05, ** P <0.01, ***P <0.001, Cohen's d

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368 Table III. Binary logistic regression with the lowest group as a reference point

		Range of scores	B	S.E.	Wald	df	P-value	OR
Passing and centering	Low	0-4						
	Moderate	5-7	2.144	.918	5.447	1	.020	8.530
	High	8-15	2.281	.905	6.348	1	.012	9.787
Agility	Low	7.53-6.85						
	Moderate	6.84-6.62	.209	.949	.049	1	.825	1.233
	High	6.61-6.21	2.305	.849	7.364	1	.007	10.020
Motivation	Low	2.13-3.75						
	Moderate	3.76-4.38	2.009	.877	5.251	1	.022	7.454
	High	4.39-5.00	2.265	.939	5.822	1	.016	9.628

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371 Figure 1. Illustrations showing dribbling and passing test track.

372 Figure 2. Illustrations showing passing and centering test track.

373 Figure 3. Illustrations showing agility test track.

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