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1 ORIGINAL ARTICLE

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

4

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15 Abstract

16 This study identified some key characteristics at the age of 15 yrs that contributed to successful performance at
17 the age of 19 yrs in male soccer players representing 12 top Finnish teams. Data were collected when players
18 were 15-year-olds and from those same participants who were still playing at the age of 19-yrs, resulting in a
19 final data set of 114 participants (mean age 15.41 ± 0.26 yrs). Players were divided into two groups based on
20 their performance level at the age of 19 years. Measurements for each participant were undertaken according to
21 four categories: technical, physiological, tactical, and psychological characteristics. Binary logistic regression
22 analysis showed that successful performance level at the age of 19 was associated with technical skills of passing
23 and centering, as well as agility and motivation levels assessed at the age of 15, with a correct classification of
24 86%. In the Finnish athlete developmental system, based on local sports clubs, results clearly highlighted the
25 importance of passing and centering skills, agility and motivation in the development of youth players.

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

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45 Introduction

46 Identification and selection of youth athletes at an early age is an extraordinary
47 challenge due to complexity and non-linear nature of talent development (Phillips, Davids,
48 Renshaw, & Portus, 2010). However, many national federations and club teams invest
49 considerable resources every year to identify talented players at an early age to ensure that the
50 most talented athletes receive high quality coaching and training conditions (Abbot & Collins,
51 2002; Vaeyens, Lenoir, Williams, & Philippaerts, 2008; Williams & Reilly, 2000).
52 Identification and selection of potential athletes have often been based on coaches' or talent
53 scouts' subjective views (Williams, & Reilly, 2000). In recent years, there has been increasing
54 attempts to use scientific approaches to talent identification, including measures of
55 physiological, technical, tactical, and psychological skills (Reilly, Williams, Nevil, & Franks,
56 2000). Cross-sectional research on youth and adult soccer players has attempted to understand
57 which physiological (Gil, Ruiz, Irazusta, Gil, & Irazusta, 2007; Reilly, Bagsbo, & Franks,
58 2000; Vaeyens et al., 2006), technical (Gil et al., 2007; Reilly et al., 2000; Vaeyens et al.,
59 2006), tactical (Kannekens, Elferink-Gemser, & Visscher, 2009; Reilly et al., 2000) and
60 psychological characteristics (Reilly et al., 2000), contribute to current playing status in
61 soccer.

62 Unfortunately, however, cross-sectional studies in which identification and selection of
63 the youth athletes is based on current performance are associated with low predictive value
64 and their validity and usefulness have been widely questioned (Vaeyens et al., 2008). Due to
65 differences in maturation and development, learning abilities, experience, and rapid changes
66 in physiological and anthropometric characteristics during adolescence (Abbot & Collins,
67 2002; Meylan, Cronin, liver, & Hughes, 2010; Vaeyens, et al., 2008), selection of athletes
68 based on current performance levels may prematurely exclude late-developing athletes, who

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

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

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

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

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

106 **Methods**

107 *Participants*

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

117 characteristics at the age of fifteen are presented in Table I. An independent samples t-test
118 revealed that the Elite players were significantly heavier than Sub-Elite players at 15 yrs,
119 $t(112) = -2.024, P = .0145$.

120 *Procedure*

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

126 *Technical characteristics.* Two soccer-specific technical skill tests recommended by
127 the Football Association of Finland were used to examine the players' technical skills. The
128 first test measured dribbling and passing skills (Figure 1). The test started when a player took
129 a first touch, and ended when the finishing line was crossed. The task was to dribble as
130 quickly as possible. The second test measured passing and centering skills (Figure 2). The test
131 started with the player's first touch, and ended with the final pass/cross or if maximum time
132 (90 seconds) had passed. The task was to score as many points as possible (max. 16 points).
133 Players were allowed to have two practice trials and the best out of two competitive trials was
134 selected to present players' technical skills. The reliability of technical tests were tested with a
135 one week interval test-retest which showed a correlation coefficient of $r = 0.76$ ($P < 0.001$) for
136 dribbling and passing, and $r = 0.70$ ($P < 0.001$) for passing and centering, among a group of 37
137 soccer players aged 14 to 15 years old.

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

142 photocells which triggered the timer. An 8-figure test track, recommended by the Football
143 Association of Finland, was used as an agility test (Figure 3). The coefficient of variation in
144 sprinting time tests has shown to be approximately 2 % (Moir, Button, Glaister, & Stone,
145 2004). Mirkov et al. (2008) have reported 0.84 intraclass correlation coefficient and 2.5 %
146 error of measurement for similar type of agility test (Mirkov, Nedeljkovic, Kukulj, Ugarkovic,
147 & Jaric, 2008). Explosive leg strength was measured by countermovement jumping on a jump
148 mat (Newtest Oy, Finland). The coefficient of variation on countermovement jump test is
149 shown to be 2.4 % (Moir et al., 2004). Endurance performance was measured using the YoYo
150 Endurance Test Level (Bangsbo, 1996). An intraclass coefficient of 0.93 has been reported in
151 the test-retest reliability measure for 20-meter shuttle test among 12 to 15 year-old children
152 (Liu, Plowman, & Looney, 1992). The best of two trials was selected for further analysis in
153 all physical fitness tests except in the 1-trial endurance test.

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

165 *Psychological characteristics.* The Psychological Skills Inventory for Sports (PSIS-R-
166 5; Mahoney, Gabriel, & Perkins, 1987) was used to assess the players' psychological skills.

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

175 *Data analysis*

176 Independent samples T-tests were conducted to investigate group differences in
177 technical, physiological, tactical, and psychological characteristics. Cohen's *d* was used to
178 estimate Effect sizes (ES) in independent samples T-tests, classified according to Cohen's
179 (1988) suggestion of effect sizes up to .20 being small, up to .50 as moderate, and up to .80
180 evidencing large effect.

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

188 **Results**

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

192 =3.673, $P = .001$, agility $t(112) = 4.108$, $P = .000$, and endurance $t(112) = -2.527$, $P = .013$. With
193 respect to the tactical characteristics, Acting in changing situations, $t(112) = -2.073$, $P = .040$
194 discriminated Elite and Sub-Elite groups. Finally, there were statistically significant
195 difference between groups in Motivation $t(52.995) = -4.405$, $P = .000$. In all comparisons, Elite
196 players outscored the Sub-Elite players at the age of 15 (Table II).

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

211 Discussion

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

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

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

239 Assessing technical skills instead of physiological characteristics may decrease
240 advantages of early-maturing athletes compared to late-maturing peers (Williams & Reilly,
241 2000). Previous studies have shown that dribbling the ball is a discriminatory technical skill

242 in youth soccer players of different performance levels (Hujigen et al., 2009; Hujigen et al.,
243 2012) and may even be predictive of future success (Hujigen et al., 2009). In the current
244 study, both technical skills tests (dribbling and passing, passing and centering), discriminated
245 youth players who reached the elite level at the age of 19 from those who did not. In addition,
246 youth soccer players who scored in the moderate or highest category in passing and centering
247 were about eight to ten times more likely to reach the elite level at the age of 19 than players
248 scoring in the lowest category.

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

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

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

272

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358
359

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 (<i>d</i>)
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*

362

363

364 Table II. Technical, physiological, tactical, and psychological characteristics (means \pm 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 (<i>d</i>)
Technical characteristics			
Dribbling and passing (s)	41.41 \pm 3.44*	43.72 \pm 4.08*	.61*
Passing and centering (s)	8.07 \pm 3.09***	5.52 \pm 2.99***	.84***
Physiological characteristics			
Speed 30m (s)	4.41 \pm 0.15**	4.55 \pm 0.23**	.76**
Agility (s)	6.58 \pm 0.20***	6.82 \pm 0.27***	1.02***
CMJ (cm)	36.52 \pm 4.42	35.20 \pm 4.50	.30
Endurance (m)	2501 \pm 325*	2301 \pm 359*	.61*
Tactical characteristics			
Positioning and deciding	4.49 \pm 0.69	4.28 \pm 0.68	.31
Knowing about ball actions	4.46 \pm 0.70	4.23 \pm 0.71	.33
Knowing about others	4.11 \pm 0.80	3.98 \pm 0.63	.18
Acting in changing situations	4.62 \pm 0.69*	4.26 \pm 0.76*	.50*
Psychological characteristics			
Motivation	4.35 \pm 0.43***	3.85 \pm 0.67***	.89***
Confidence	3.59 \pm 0.70	3.41 \pm 0.66	.27
Concentration	4.05 \pm 0.51	3.78 \pm 0.58	.48*
Mental preparation	2.98 \pm 0.84	2.87 \pm 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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