



Spanish Elite Soccer Reserve Team Configuration and the Impact of Physical Fitness Performance

by

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The aim of this study was threefold: 1) to assess the configuration of an elite reserve soccer team, 2) to compare physical fitness performance of promoted and new players according to the playing position, and 3) to analyze the level of competitive participation attained by these players. We considered physical fitness tests (5 m and 15 m sprint, countermovement jump [CMJ] and aerobic endurance) performed by 192 players (age = 20.2 ± 2.3 years) enrolled in the reserve team of a Spanish La Liga club from 1994 to 2013. The players were classified according to the previous club criterion (promoted from the soccer academy and new players signed from other clubs), b) their playing position, and c) the competitive level attained until the 2016/2017 season (Spanish 1st and 2nd Divisions and the remaining competition levels). The proportion of promoted and new players was similar ($p = 0.47$). Overall, no substantial differences (unclear-small) were found in physical fitness performance between promoted and new players. Considering the playing position, promoted lateral defenders (LDs) showed better sprinting (ES = moderate) and CMJ (ES = moderate) performance than new LDs. In addition, promoted central midfielders (CMs) demonstrated better performance in the 5 m sprint and the CMJ (ES = moderate) than new CMs. The percentage of players who later competed in the Spanish 1st and 2nd Divisions was greater in promoted players compared to new players ($p = 0.006$). Physical fitness performance did not determine the selection of new players in a soccer elite reserve team. We may conclude that soccer academies should prioritize the selection and the training process of youth soccer players.

Key words: soccer, talent identification, neuromuscular performance, aerobic endurance.

Introduction

Previous research states that the opportunity for financial profit seems to influence the recruitment of players for the 1st team (Relvas et al., 2010). That is, the greater and the more successful a club is, the larger its budget for signing new players from other clubs (Bourke, 2003). Due to the hierarchical structure of the market of the production and consumption of soccer players (Bourke, 2003), many professional clubs, in much less wealthy situations, have founded soccer academies with the primary objective of developing players to the professional level (Mills et al., 2012). This may also reflect the shift from a market-based solution to the problem of finding skilled labor towards another one based

on internal hierarchical arrangements (i.e., grow-your-own policies) (Bourke, 2003). This option can be even more interesting in countries like Spain, where the poor financial wealth of the whole system (Barajas and Rodríguez, 2013) has increased the differences between the teams of the Spanish Liga.

Soccer academies consider both the training process to facilitate the highest performance progress of the players and the identification and selection of the most promising young talent (Güllich, 2014). Due to the fact that talent identification in soccer is a dynamic (Vaeyens et al., 2006) and complex (Reilly et al., 2000; Zuber et al., 2016) process that requires a multivariate approach (Reilly et al., 2000), the decisions made by technical staff and soccer

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scouts are very difficult. Expert coaches consider that both environmental and intrapersonal factors (i.e., resilience, goal-directed attributes, intelligence, and awareness) influence elite player development (Mills et al., 2012), but none of these, nor physical fitness performance, can be assessed in players in other clubs. At most, soccer scouts can estimate these factors based on their own subjective assessments of performance during the games and statistical reports produced by private (Barris and Button, 2008; Castellano et al., 2014; Sarmiento et al., 2014) or institutional entities after matches at the top competitive level (i.e. technical, tactical and physical fitness performance variables).

One of the pivotal stages in soccer academies is the transition from the reserve team to high level soccer (Mills et al., 2012), this final period being critical in the progress of every player's career (Vaeyens et al., 2005). In these types of teams, as in previous training stages, the main aim is to optimize the soccer competence of players. However, managers of the soccer academies also give great value to attaining the highest possible competition level for their elite reserve players because the match is an important session within the training process. This usually requires the inclusion of complementary new players from other clubs in order to make the squad stronger and the project successful, and many soccer scouts, usually former professional soccer players, emphasize the importance of motor abilities (Christensen, 2009) in the selection of those players. However, no study has analyzed whether soccer scouts, in a subjective way (Dadelo et al., 2014; Williams and Reilly, 2000), attach any importance to physical fitness performance in the selection of elite-oriented soccer players who should be prepared to compete at the elite level in the near future.

Therefore, the aim of this study was threefold: 1) to assess the configuration of an elite reserve soccer team, 2) to compare the physical fitness performance of promoted and new players according to the playing position, and 3) to analyze the level of competitive participation attained by these players.

Methods

Design and Participants

This research was carried out in a Spanish

La Liga Club which has been running its own elite Academy since 1982. One hundred and ninety-two young soccer players (20.2 ± 2.3 years; body height = 1.80 ± 0.06 m; body mass = 74.2 ± 6.0 kg) belonging to the same reserve team of a Spanish *La Liga* club from 1994 to 2013 participated in this study. We considered any player that competed in the Spanish 3rd Division (2^a-B) during that period, having played at least five games at this competitive level, and with a minimum of 8 years of soccer experience. All the included players were classified in two groups: a) promoted: players promoted from the soccer academy of the same club to the reserve team, and b) new players: players who were signed from other clubs to play in the reserve team. Moreover, players were classified in relation to their playing position (Bradley et al., 2009; Carling et al., 2012; Lago et al., 2010; Los Arcos and Martins, 2018): goalkeeper (G), lateral defender (LD), central defender (CD), lateral midfielder (LM), central midfielder (CM), and attacker (A). In addition, the competitive level attained by the 2016/2017 season by both promoted and new players was registered: Spanish 1st and 2nd Divisions and the remaining competition levels.

In addition, we were able to collect all the results of physical fitness tests (linear 5 and 15 m sprints, CMJ and an endurance running test), carried out in the period between the 1994/1995 and 2012/2013 seasons as part of the customary training process, in accordance to the protocol approved beforehand by the Institutional Review Committee of the Sports and Youth Institute of Navarre (Spain) and the Declaration of Helsinki (2013). For our purposes, we kept the mean value of all the tests performed by each player in their first year in the reserve team during the in-season period.

Firstly, we calculated the proportion of promoted and new players according to the playing position. Moreover, we analyzed the previous level of competition achieved by new players. Then, we compared physical fitness performance between promoted and new players: a) taking the 18 seasons together, b) according to three consecutive periods (Period 1 (P1) = 1994–2000, Period 2 (P2) = 2000–2006, Period 3 (P3) = 2006–2012) (Castillo et al., 2018; Martínez-Santos et al., 2016; Tønnessen et al., 2013), and c) by the playing position. Finally, we compared the

proportion of players in each group (promoted vs. new players) that eventually competed in Spanish professional elite soccer (1st and 2nd Spanish Divisions).

Procedures

According to the protocols established by the club, during the in-season period of each season (T1 = September-October / T2 = December-January / T3 = February-March / T4 = May-June), players completed four times a battery of physical fitness tests that included linear 5 and 15 m sprints, CMJ and an endurance running test. Before each testing session, a standardized warm-up was performed consisting of 5-min low-intensity running, mobility exercises, strides and acceleration drills. The players were instructed to avoid any strenuous exercise in the 24 hours prior to this test session.

15 m sprint test

The sprint test consisted of three maximal sprints over 15 m with a 2 min rest interval between each trial, giving enough time to walk back to the start line and wait for the next turn, as previously described by Gorostiaga et al. (2009) and Los Arcos et al. (2014). Players started the sprint 0.5 m behind the starting point. The time was measured with accuracy of ± 0.001 s by means of photocell gates (Microgate® Polifemo, Bolzano, Italy) placed 0.4 m above the ground. The timer, automatically activated as the participants crossed the first gate at the 0.0 m mark, recorded split times at 5 and 15 m, and the fastest time taken for each distance (i.e. 5 m and 15 m) was considered for further analysis.

Countermovement jump

The participants were asked to perform a maximal countermovement vertical jump on a jumping mat (Newtest OY, Oulu, Finland), with both hands fixed on the hips. The participants started the jump from an extended leg position, going down to 90° knee flexion, immediately followed by a subsequent concentric action for maximal height and tried to land in a position as similar as possible to that at the take-off (Bosco et al., 1983). Jumping height was calculated from the flight time. Three attempts, with approximately 20 s rest intervals between jumps, were recorded. The best result was considered for further analysis.

Endurance running test

Participants performed a 4-stage

submaximal intermittent (i.e. 3-min recovery) running test around the soccer pitch (100 × 50 m). The running speeds were 12 km·h⁻¹ (10 min), 13 km·h⁻¹ (10 min), 14 km·h⁻¹ (10 min), and 15 km·h⁻¹ (5 min), for the first, second, third, and fourth stages, respectively (Gorostiaga et al., 2009). Running speeds were dictated in the form of audio cues broadcast by a pre-programmed computer (Balise Temporelle, Bauman, Switzerland). Immediately after each exercise stage, after cleaning and puncturing, a 5 µL sample of whole blood was automatically aspirated from the participant's hyperemized earlobe into a single-use enzyme-coated electrode test strip. [La] was determined via amperometric measurement and the result was displayed within 60 s by means of a portable lactate analyzer (Lactate Pro LT-1710; Arkray KDK Corporation, Shiga, Japan). In terms of reliability, the manufacturers report a coefficient of variation of 3.2% and 2.6% for lactate standard samples of 2 and 11 mmol·L⁻¹, respectively. The analyzer was calibrated according to the manufacturer's instructions before every test. The exercise lactate profile was obtained using the curve-of-best-fit procedure with a second-order polynomial function. From the equation describing the exercise blood lactate curve, the velocity associated with [La]_b of 3 mmol·l⁻¹ (V₃) was interpolated (Gorostiaga et al., 2004) and considered.

Statistical Analysis

Results are presented as mean \pm standard deviation (SD). A chi-square test was used to test the playing position and the distribution of the competitive level attained across the promoted and new players. Statistical significance was set at $p \leq 0.05$. In order to compare physical fitness performance between promoted and new players, practical significance was assessed by calculating the Cohen's d effect size (Cohen, 1988) with a modified statistical Excel spreadsheet provided by Hopkins (Hopkins, 2007). Effect sizes (ES) between < 0.2, 0.2–0.6, 0.6–1.2, 1.2–2, and 2.0–4.0 were considered trivial, small, moderate, large and very large, respectively (Hopkins et al., 2009). Probabilities were also calculated to establish whether the true (unknown) differences were lower, similar to or higher than the smallest worthwhile difference or change (0.2 x between-participant SD, based on the Cohen's effect size

principle). The quantitative chances of higher or lower differences were evaluated qualitatively as follows: < 1%, almost certainly not; 1–5%, very unlikely; 5–25%, unlikely; 25–75%, possible; 75–95%, likely; 95–99%, very likely; > 99%, almost certain. If the chances of having higher or lower values than the smallest worthwhile difference were both > 5%, the true difference was assessed as unclear.

Results

Team Configuration

Promoted players (18.7 ± 1.5 years) were younger ($ES = 1.87; \pm 0.3$, most likely large) than new players (21.6 ± 2.1 years) in their first season in the reserve team. The proportion of promoted

and new players was 48% (92 players: 8 GKs, 13 CDs, 18 LDs, 22 CMs, 12 LMs and 19 As) and 52% (100 players: 7 GKs, 16 CDs, 18 LDs, 16 CMs, 16 LMs and 27 As) of the total, respectively ($p = 0.47$). The proportion of players in each playing position was similar in both promoted and new players ($p = 0.71$).

Of the 100 new players signed by the Club, 50% came from lower categories (< Spanish 3rd Division, 2^a-B) and the other 46% from the same category (i.e., Spanish 3rd Division, 2^a-B). Only 4% (4 players) of the new players had competed previously in a higher competition category, specifically in the Spanish 2nd Division.

Table 1
Differences in sprinting and jumping performance and velocity associated with $[La]_b$ of $3 \text{ mmol}\cdot\text{l}^{-1}$ (V_3) between promoted and new players in each period.

Period	Test	Promoted players	n	New players	n	ES; CL 90%	Magnitude based inference
1994-2000	5m (s)	0.95 ± 0.02	26	0.95 ± 0.03	15	0.03; ± 0.63	32/41/27 Unclear
	15m (s)	2.28 ± 0.06	27	2.27 ± 0.06	15	-0.17; ± 0.51	11/42/46 Unclear
	CMJ (cm)	45.43 ± 4.65	27	44.69 ± 3.62	16	-0.15; ± 0.45	10/47/43 Unclear
	V_3 ($\text{km}\cdot\text{h}^{-1}$)	12.56 ± 0.56	16	12.87 ± 0.82	10	0.52; ± 0.89	73/18/9 Unclear
2000-2006	5m (s)	0.95 ± 0.02	36	0.97 ± 0.04	28	0.53; ± 0.59	82/15/2 Likely small
	15m (s)	2.30 ± 0.04	36	2.30 ± 0.07	28	0.17; ± 0.63	47/37/17 Unclear
	CMJ (cm)	45.65 ± 3.91	36	45.03 ± 4.26	27	-0.15; ± 0.44	9/48/49 Unclear
	V_3 ($\text{km}\cdot\text{h}^{-1}$)	12.55 ± 0.66	34	12.48 ± 0.81	24	-0.10; ± 0.50	16/47/37 Unclear
2006-2012	5m (s)	0.96 ± 0.03	29	0.97 ± 0.02	58	0.38; ± 0.36	80/19/0 Likely small
	15m (s)	2.30 ± 0.05	29	2.32 ± 0.06	58	0.41; ± 0.37	82/17/0 Likely small
	CMJ (cm)	44.47 ± 4.14	29	42.83 ± 4.58	58	-0.38; ± 0.38	1/21/79 Likely small
	V_3 ($\text{km}\cdot\text{h}^{-1}$)	12.39 ± 0.61	25	12.54 ± 0.89	46	0.25; ± 0.47	57/37/6 Unclear

Legend: ES = effect size; CL = confidence limits.

Table 2
Differences in sprinting and jumping performance and velocity associated with $[La]_b$ of 3 mmol l^{-1} (V_3) between promoted and new players by playing position.

Player Position	Test	Promoted players	n	New players	n	ES; CL 90%	Magnitude based inference
G	5m (s)	0.94 ± 0.03	8	0.96 ± 0.03	7	0.55; ±0.82	77/17/6 Unclear
	15m (s)	2.28 ± 0.08	8	2.31 ± 0.09	7	0.35; ±0.85	62/24/14 Unclear
	CMJ (cm)	45.71 ± 6.10	8	44.08 ± 4.46	7	-0.24; ±0.71	15/32/54 Unclear
LD	5m (s)	0.95 ± 0.02	18	0.97 ± 0.03	17	1.03; ±0.71	97/2/0 Very likely moderate
	15m (s)	2.27 ± 0.04	18	2.32 ± 0.06	17	1.18; ±0.68	99/1/0 Very likely moderate
	CMJ (cm)	46.27 ± 4.15	18	43.51 ± 4.28	17	-0.63; ±0.55	1/9/91 Likely moderate
CD	V_3 (km·h ⁻¹)	12.49 ± 0.63	16	12.60 ± 1.15	13	0.17; ±0.84	48/29/23 Unclear
	5m (s)	0.96 ± 0.02	13	0.97 ± 0.03	16	0.95; ±0.79	94/5/1 Likely moderate
	15m (s)	2.30 ± 0.04	13	2.32 ± 0.07	16	0.41; ±0.76	68/23/9 Unclear
LM	CMJ (cm)	45.06 ± 3.79	13	43.60 ± 4.57	16	-0.36; ±0.65	8/26/66 Unclear
	V_3 (km·h ⁻¹)	12.64 ± 0.81	11	12.50 ± 0.70	13	-0.15; ±0.61	17/39/45 Unclear
	5m (s)	0.95 ± 0.02	12	0.95 ± 0.03	16	0.11; ±0.66	40/38/22 Unclear
CM	15m (s)	2.28 ± 0.05	12	2.28 ± 0.06	16	0.01; ±0.72	32/36/31 Unclear
	CMJ (cm)	44.19 ± 4.06	12	43.94 ± 4.67	16	-0.06; ±0.65	25/39/36 Unclear
	V_3 (km·h ⁻¹)	12.85 ± 0.50	11	12.99 ± 0.90	12	0.26; ±0.97	54/25/21 Unclear
A	5m (s)	0.96 ± 0.02	22	0.98 ± 0.03	16	0.60; ±0.66	85/13/2 Likely moderate
	15m (s)	2.32 ± 0.05	22	2.33 ± 0.07	16	0.17; ±0.65	47/36/17 Unclear
	CMJ (cm)	44.25 ± 3.46	22	41.14 ± 3.87	16	-0.87; ±0.58	0/3/97 Very likely moderate
A	V_3 (km·h ⁻¹)	12.47 ± 0.46	19	12.40 ± 0.78	12	-0.15; ±0.91	25/28/46 Unclear
	5m (s)	0.96 ± 0.03	19	0.97 ± 0.03	27	0.27; ±0.46	59/36/5 Possibly small
	15m (s)	2.29 ± 0.04	19	2.30 ± 0.05	27	0.24; ±0.53	55/37/8 Unclear
A	CMJ (cm)	45.86 ± 4.60	19	44.91 ± 4.41	27	-0.20; ±0.48	9/42/50 Unclear
	V_3 (km·h ⁻¹)	12.24 ± 0.62	19	12.46 ± 0.71	27	0.34; ±0.52	67/28/4 Possibly small

Legend: ES = effect size; CL = confidence limits; G = Goalkeepers; LD = Lateral defender; CD = Central defender, LM = Lateral midfielders; CM = Central midfielders; A = Attackers (A).

Promoted vs. New Players by Periods

Taking the three periods together, the differences between promoted and new players were small in the 5 m (promoted vs. new players; 0.95 ± 0.03 vs. 0.97 ± 0.03 ; ES = 0.55; ± 0.26; 99/1/0, very likely) and in the 15 m (2.29 ± 0.05 vs. 2.31 ± 0.06 ; ES = 0.35; ± 0.27; 82/17/0, likely) sprint times, as well as in the CMJ (45.21 ± 4.20 vs. 43.62 ± 4.44 ; ES = -0.38; ± 0.24; 0/12/88, likely). Besides, the differences in the velocity associated with $[La]_b$ of $3 \text{ mmol} \cdot \text{l}^{-1}$ (V_3) were unclear (12.50 ± 0.62 vs. 12.57 ± 0.85 , ES = 0.11; ± 0.32).

According to those periods, promoted players showed better performance than new

players in sprinting and jumping (ES = likely small) in the third period, differences being unclear in the remaining periods (i.e., P1 and P2) (Table 1). The differences in the V_3 were unclear in all periods.

Promoted vs. New Players by Playing Position

No substantial differences were found in physical fitness performance between promoted and new players for Gs and LMs, although promoted LDs showed very likely moderate better sprinting performance (5 and 15 m sprint times) than new players (ES = 1.03 – 1.18) and their performance in the CMJ was also likely and moderately higher. In addition, performances in

the 5 m sprint and CMJ tests were likely/very likely and moderately ($ES = 0.60 - 0.87$) higher in promoted CMs than in new CMs (Table 2).

Promotion to Elite Soccer

Significant differences ($p = 0.006$) were found between promoted and new players in the proportion attaining the competitive level. While 43% of the promoted players eventually competed in Spanish professional soccer (1st Division: 29%; 2nd Division: 14%), the proportion was just 30% for the new players (1st Division: 11%; 2nd Division: 19%).

Discussion

The aim of this study was threefold: 1) to assess the configuration of an elite reserve soccer team, 2) to compare the physical fitness performance of promoted and new players according to the playing position, and 3) to analyze the level of competitive participation attained by these players. The main findings were: a) overall, and according to the playing position, the proportions of promoted and new players were similar, b) physical fitness performance (sprinting, jumping and aerobic fitness) was similar in promoted and new players, but, according to the playing positions, promoted LDs, CD and CMs players had substantially ($ES =$ moderate) higher sprinting and jumping capacities than new players, and c) the players promoted from the junior team of the Club were more successful. These results highlight how important investing in soccer academies can be, and that physical fitness performance does not seem to determine the selection of new players for a soccer elite reserve team.

Team configuration

The high percentage of new players (52% of the total players of the elite reserve team during the 18 seasons) may be due to the need to sign players with greater soccer expertise in order to maintain the competition level (Spanish 2nd Division-B) of the reserve team. Unfortunately, we cannot compare this proportion because, to our knowledge, no similar studies are available. The distribution of promoted and new players by their playing position was similar. Although the need for players in each playing position can vary from season to season, depending on the market opportunities and the characteristics of players who are promoted from the junior team, in the

long term, the playing position was not relevant to being promoted or signed from other teams.

Promoted vs. New Players by Periods

Both when taking the whole period together and after analysis of the three periods separately (P1: 1994–2000; P2: 2000–2006 and P3: 2006–2012), the differences in physical fitness performance between promoted and new players were unclear-small (Table 1). These results suggest that physical fitness performance does not determine the selection of new players for an elite reserve team, and that this criterion, assessed subjectively, has not varied over the years. Although some match running demands have increased over the 2006–2012 period in European elite soccer (Barnes et al., 2014; Bush et al., 2015), physical fitness performance of new players was not any better than that of players promoted from the junior team during this period. It is possible that soccer scouts continued to value highly other factors, such as “game intelligence” and “personal qualities” (Christensen, 2009), in their selection of new senior players. They could have emphasized team sports time management (anticipation and decision making (Williams and Reilly, 2000)) rather than physical fitness (acceleration capacity). Besides, physical fitness performance of players who have already passed a selection process every season (Bidaurrezaga-Letona et al., 2017) was considerably high (Castillo et al., 2018; Martínez-Santos et al., 2016).

Promoted vs. New Players by Playing Position

It was found that a higher profile in sprinting and jumping (assessed by 5 m, 15 m and CMJ) can be an advantage for CDs, but not for the other playing positions, in terms of their promotion from an elite soccer reserve team to the top level of soccer in Spain (Martínez-Santos et al., 2016). However, scouts did not select faster and more powerful defenders in comparison to promoted players. Performance in the 5 m sprint was likely and moderately ($ES = 0.95; \pm 0.79$) higher in promoted CDs than in new CDs (Table 2). In addition, differences between promoted and new players in lactate concentration at selected running speeds were unclear in almost all playing positions. Soccer scouts did not select players with higher aerobic endurance performance (i.e., V3) in comparison to promoted players, but a previous study showed that this physical dimension seemed not to be relevant to access

professionalism from a reserve team in Spain (Castillo et al., 2018). Although the budget of the club limits the options of recruitment of players (Relvas et al., 2010), these results suggest that soccer scouts could seek a different type of player, possibly a better player from the tactical point of view.

Promotion to Elite Soccer

Interestingly, the odds of getting to play at the professional competitive-level were different for promoted and new players: while 43% of the players who were promoted within the club competed later in Spanish professional soccer (i.e., Spanish 1st and 2nd Divisions), only 30% of the new players achieved the professional standard of play. This difference is more acute if we consider how many of those professionals got to play in the 1st Division, two out of three of the promoted ones, but only one out of three of the

signed ones: that means double chances for promoted players. These results point to the relevance of both the training process and the identification and selection of the most promising young talent (Güllich, 2014), especially before the senior category, in order to reduce the hierarchical structure of the market (Bourke, 2003).

It can be concluded that physical fitness performance does not determine the selection of players for elite reserve teams. Soccer scouts subjectively ascribe more importance to other soccer factors than physical abilities of players. Since the success ratio was higher in players promoted from the high-level soccer academy than in adult players signed from other clubs, soccer academies should prioritize the selection and the training process of youth soccer players.

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