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Classification of junior Ethiopian football players using anthropometric and physical fitness attributes: Developing a predictive model

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Resumen

Objetivo: El objetivo del presente estudio fue desarrollar un modelo predictivo que identifique la condición física y antropométrica que prediga mejor el estado y las posiciones de juego (N=400; 15–17 años) en el programa de desarrollo del fútbol juvenil masculino etíope. **Métodos.** La medición antropométrica en términos de masa, altura, grasa corporal relativa y composición corporal derivada se realizó utilizando las pautas de la Sociedad Internacional para el Avance de la Cineantropometría (ISAK). El estado físico se midió mediante pruebas de velocidad (10 metros, 20 metros y 40 metros planos), la prueba de agilidad de Illinois, la prueba de salto vertical y el VO2 máximo estimado. Se utilizó ANOVA factorial para probar las relaciones entre la residencia de los jugadores, la posición y los respectivos términos de interacción. Además, se utilizó el análisis discriminante para identificar las variables que contribuyeron a las selecciones. Resultados. Los jugadores de residencias de campamentos deportivos fueron significativamente diferentes en todos los atributos antropométricos, así como en los atributos de condición física en p<0.05 excepto en el VO2 máx. El porcentaje de jugadores correctamente clasificados en los grupos originales fue ligeramente inferior al porcentaje calculado tras el análisis realizado para la muestra total (86%) y tras el cálculo por posiciones (86-90%). **Conclusión.** El estudio concluyó que la velocidad evaluada en 10 m, 40 m, salto vertical y altura fueron los atributos discriminados de los jugadores por unidad residencial en los jugadores de fútbol juveniles etíopes. Se recomienda que los atributos antropométricos y de aptitud física sean importantes en la evaluación y selección de jugadores de fútbol jóvenes con potencial para una selección de rendimiento de alto nivel.

Palabras Clave: Antropometría, Aptitud física, Selección, Desarrollo de talentos,

Abstract

Aim: The aim of the present study was to develop a predictive model that identifies the anthropometric and physical fitness characteristics that best predicts the status and playing positions of players (N=400; 15–17 years) in the Ethiopian male youth soccer development programme. **Methods:** Anthropometric measurement in terms of mass, height, relative body fat, and derived body composition was conducted using the International Society for the Advancement of Kinanthropometry (ISAK) guidelines. Fitness was measured by sprint tests (10 meters, 20 meters and 40 meters flat), the Illinois agility test, vertical jump test and estimated VO_2 max. Factorial ANOVA was used to test the relationships between players' residence, position, and respective interaction terms. Additionally, discriminant analysis was used to identify the variables that contributed to the selections. **Results:** Players residing in a Sports Camp (academy) vs. their homes were significantly different in all anthropometric attributes as well as physical fitness attributes at $p<0.05$ except VO_2 max. The percentage of players who were correctly classified in the original groups was slightly lower than the percentage calculated after the analysis was performed for the total sample (86%) and after calculation by position (86 – 90%). **Conclusion:** The study concluded that speed assessed in10m, 40m, vertical jump, and height were the discriminate attributes of Ethiopian junior football players selected or not selected to an elite group residential sports camp. It is recommended that anthropometrical and physical fitness attributes are considered in the assessment and selection of young football players with the potential for higher-level performance selection.

Keywords: Anthropometry, Physical Fitness, Selection, Talent development

Introduction

The recruitment and early selection of players into a specialised football development programme and centres of excellence have been considered as an essential factor for the long-term development of footballing careers (le Gall et al 2010). This knowhow has led to an increase in football academies and centres of excellence globally. Due to the fact that there are great financial benefits that can be achieved through promoting talented players from the youth teams into the senior first team, the role of sports scientists appointed by a professional football club is important to help identify and develop future players (Russell and Tooley 2011). The measurement of performance, however, is complex and requires a multifaceted approach including the measurement of anthropometric, physiological, technical, cognitive-perceptual and psychosocial variables (Reilly et al 2000). In addition, Svensson and Drust (2005) and Brahim et al. (2013) reported success in soccer based on the players' anthropometric and physical fitness variables such as weight, height, strength, aerobic, anaerobic capacities, flexibility, speed, agility, power, and coordination. These attributes in combination with other factors such as level of experience, technical and tactical skills, as well as psychological factors including level of motivation can be used as potential markers of success (Hoff 2005; Reilly et al 2000). In addition, in a team sport such as soccer, body size, body composition and level of fitness are important in providing distinct advantages for specific playing positions. This is particularly salient at the highest levels of performance where there is a high degree of player specialization (Gil et al.2007a). Taking this into account, in most football studies, players are classified into 4 positions of play; goalkeepers, defenders, midfielders and forwards or attackers (Brahim et al. 2013; Lago-Peñas et al 2014; Rebelo et al. 2013). Players of various playing positions have a very distinct workload during a match (Clemente et al.2013).

The production line of young footballers operates non-stop, with player's dreams and aspirations of making it to the top and emulating their superheroes (Stratton et al. 2004). With the increasing emphasis on talent development and the minimization of potential injuries among adolescent athletes, there is a consensus between coaches and sport scientists that a comprehensive, sport-specific investigation would aid in more clearly defining the required levels of physiological fitness and sports skills specific to youth football (Reilly et al. 2000). Players must possess moderate to high aerobic and anaerobic power, have good agility, joint flexibility and muscular development, and generate high torques during fast movements (Reilly et al. 2000). Many experts in the field, such as football coaches, managers, and scientists, believe that the success of the sport is associated with the anthropometric and fitness characteristics of players (Brahim et al. 2013).

In economically developed countries, successful football performance is attained through careful studies of anthropometric and physiological attributes (Russell and Tooley 2011). The cross-sectional study carried out by Gil et al. 2010), on the anthropometric and fitness characteristics of 161 young football players aged between 14-16 years old, from Clairefontaine Institute National du Football (National Institute of Football) in France, showed that heavier and taller players were typically selected to play for the next age group comprising of 17-19 year olds. Another cross-sectional study on selecting young football players based on anthropometric and physiological attributes was conducted on 194 young football players aged between 14-17 years by Gil et al.(2007b) at the Arenas Club de Getxo (Bizkaia, Spain), found that selected midfielders were significantly heavier and taller than those that were not selected. Regarding the percentage of body fat (%BF), higher body fat was observed among non-selected defenders than those that were selected. Reilly et al.(2000) in their studies, also showed that there were significant differences between the selected and non-selected football players in their anthropometric and physiological characteristics. They found that selected players were taller, leaner, and faster, had better endurance and fat percentages of between 10–12%. Therefore, understanding young football players' anthropometric and fitness attributes gives sport science experts, coaches, and players a better working knowledge in the talent identification process, follow-up of their progress and ultimately success in their careers (Masocha 2013).

However, identifying and selecting gifted players into the youth football development program in Ethiopia has been left to football coaches, leading to their subjective and preconceived judgement of the players, which has led to the stagnation of the talent development process in the country. This is surprising, considering that the Ethiopian Sports Commission has launched more than 200 football projects throughout the country (Commission 2011), and a number of football teams in the country run Centres of Excellence. Hence, the process of talent identification became highly biased and unprofessional. Thus, in this study, an attempt is made to develop a predictive model that identifies the anthropometric and physical fitness attribute (s) that best predicts the status and playing positions of Ethiopian junior football players.

Materials and Methods

Subjects

The participants were young football players (N=400) aged between 15 and17 years in the Ethiopian football development program under the supervision of the Ethiopian Sports Commission. The Ethiopian sports commission categorizes under 17s into two. The first category refers to those players that are selected as an elite group residing in sports camps or “units” (N=120). The second category are players who are also part the development program but not identified or selected as an elite group and who reside in their homes (N=280). All players and their parents or guardians gave their signed informed consent before the commencement of the study, which was in conformity with the ethical standards of the Declaration of Helsinki and was approved by the Biomedical Research Ethical Committee of the College of Health Sciences, at the University of KwaZulu-Natal (BE289/15).

Data collection procedures

Anthropometry:

All the measurements were made according to the guidelines outlined by the International Society for the Advancement of Kinanthropometry (ISAK) and carried out by ISAK level 2 anthropometrists. Each participants’ body mass was measured in kilograms (kg) using a digital scale (Gima®) while their height was measured in cm by a stadiometer (Gima®). The body mass index (BMI) was calculated as weight (in kg) divided by height in meter ^{2} (m^2). Skinfold thickness of the triceps, subscapular and abdominal muscles were measured using a Harpenden Skinfold Caliper (British Indicators Ltd, Luton). at the gymnasium. Percentages of body fat was calculated by using the formulas of Lohman (1981) and Brozek et al.(1963).

Physical fitness test:

Participants were instructed to refrain from vigorous activities for at least 48 hours before the day of testing. On the day of testing, participants completed a 10-minute warmup specifically designed for the tests.

Speed test:

Speed was measured after a 10, 20 and 40 meter (m) sprint with an infrared photo electronic cell (Speed trap II Wireless Timing System; Brower Timing Systems, Draper, UT, USA). This test was done twice with a three-minute interval and recovery time between each test. The fastest 10, 20- and 40m sprint time was selected from both tests (Masocha 2013).

Vertical Jump tests:

Participants performed vertical jump tests using a jump mat (Ergo jump, Bosco-Systems, Rome, Italy). The vertical jump was performed from a squat position, that is, knees flexed to 90^0 and hands-on-hips. From that position, the participants made a maximal vertical jump landing with straight knees on the mat. The highest of three trials were considered for analysis and had a reliability of .93 for this test (Johnson and Nelson 1974) .

Agility test:

Agility was evaluated by the Illinois test: The subject began with both feet behind the starting point. When instructed to start, the participants ran around the course as quickly as possible in the direction indicated, without knocking the cones over, to the finish line. The time taken to complete the course was recorded on one pair of photoelectric cells which was placed at the starting and finishing points. Participants were instructed to run as fast as possible and the fastest time from two trials was considered for analysis (Davis et al 2000).

Yo-Yo Intermittent Recovery Test Level 1 (YYIRTL1):

Given that soccer includes intermittent bouts of high-intensity exercise, the 20-m progressive run test is similar to the running that occurs in the game of soccer (Bangsbo et al. 2008). In this test, participants had to perform a series of 20-m shuttle runs at a pace set by an audio metronome with a standard 10-second rest interval between each shuttle. Distance covered by participants was measured to estimate relative maximal oxygen consumption (VO_{2max}) using the formula provided by (Bangsbo et al., 2008).

Statistical analysis

SPSS version 25.0 (SPSS, Inc. Chicago, IL, 2005) was used for the statistical analyses. Mean scores and SDs were calculated for each variable for both groups (non-selected (residential) vs. selected (sports camp) players). One-way ANOVA was used to test the calibre of players based on their position (goalkeeper, defender, midfielder, forward) their body mass, height, BMI, %BF, speed, agility, lower body power, and aerobic capacity. Follow-up analyses were undertaken using post hoc Bonferonni-corrected pairwise comparisons, where appropriate. Comparisons were made between selected and non-selected players by playing position using an independent sample t-test, at a $p \leq 0.05$ significance level. Cohen's effect sizes (d) were used for interpretation of small (0.20), medium (0.50) and large (0.80) effects (Cohen 1988). Finally, linear discriminant function analysis (stepwise criteria) was used to predict player status and position using anthropometric and physical fitness attributes as explanatory variables. The attributes that significantly differed according to playing status and position were then used as the predictive variables, percentages of correct classifications were noted.

The reliability of each measurement and test was assessed by technical error of measurements (TEM), intraclass correlations (ICCs) and coefficients of variance (CV). The results showed that these measurements and tests were highly repeatable: Body mass (ICC = 0.99; TEM%=0.08%; n = 400), height (ICC = 0.98; TEM%=0.08%; n = 400), triceps skinfold (ICC = 0.86; TEM%=1.56%; n = 400), subscapular skinfold (ICC = 0.89; TEM%=1.90%; n = 400), abdominal skinfold (ICC = 0.78; TEM%=1.97%; n = 400), vertical jump test (ICC = 0.89; CV=3.14%; n = 400), Illinois test (ICC = 0.81; CV=3.90%; n = 400), 10m sprint (ICC = 0.83; CV=3.74%; n = 400), 20m sprint (ICC = 0.80; CV=3.99%; n = 400), 40m sprint (ICC = 0.80; CV=4.10%; n = 400). Although the repeatability of Yo-Yo Intermittent Recovery Test Level 1 (YYIRTL1) test cannot be calculated from the present study as they were performed only once, previous studies have shown that the CV of incremental Yo-Yo intermittent exercises ranged from 4.9 to 9.6% (Krustrup et al. 2006), with no significant difference between test retest distance coverage ($p \leq 0.05$) (Castagna et al. 2006).

Results

The mean scores of the anthropometric and physical fitness characteristics for players are summarized in table 1.

Table 1. Anthropometry and physical fitness characteristics (mean ± SD) of selected and non-selected football players (N=400) and the effect sizes between the two groups.

	Selected	N	Non-selected	N	Effect size (d)
Age (years)	16.73±0.58	120	16.46±0.79	280	0.02
Mass (kg)	54.48±6.45*	120	48.02±8.92*	280	0.31
Height (m)	1.65±0.06*	120	1.60±0.09*	280	0.29
BMI (kg m^{-2})	20.03±1.82*	120	18.72±2.09*	280	0.27
Percentage of body fat (%)	6.87±0.78*	120	6.70±0.72*	280	0.16
Speed 10m (sec)	2.30±0.30*	120	2.49±0.20*	280	0.28
Speed 20m (sec)	3.38±0.33*	120	3.59±0.29*	280	0.27
Speed 40m (sec)	5.93±0.55*	120	6.33±0.40*	280	0.29
Illinois (sec)	18.73±0.99*	120	19.25±1.11*	280	0.23
Vertical jump (cm)	41.71±11.87*	120	30.73±10.78*	280	0.33
VO_2max (ml $kg^{-1}min^{-1}$)	50.07±5.10	120	49.97±5.16	280	0.05

*p≤0.05.

Players differed significantly by player status in all anthropometric attributes as well as physical fitness except for VO_2 max. Selected players were found to be heavier (M = 54.48, SD = 6.45, p≤0.0001, d = 0.31), taller (M = 1.65, SD = 0.06, p≤0.0001, d = 0.29) and had higher BMI values (M = 20.03, SD = 1.82, p≤0.0001, d = 0.27). They also showed faster, sprinting capacity over 10m (M = 2.30, SD = 0.30, p≤0.0001, d = 0.28), 20m (M = 3.38, SD = 0.33, p≤0.0001, d = 0.27) and 40m (M = 5.93, SD = 0.55, p≤0.0001, d = 0.29), greater agility (M = 18.73, SD = 0.99, p≤0.0001, d = 0.23), and better vertical jump scores (M = 41.71, SD = 11.87, p≤0.0001, d = 0.33).

The results in table 2 indicate significant differences among the player's in anthropometric measurement based on their playing position and fitness. The greatest difference, however, was among the goalkeepers, as they were found to be the tallest (mean=1.69, SD=0.09) and heaviest (mean=55.31, SD=9.74), presenting the highest percentage of muscle (mean=48.84, SD=9.17) and the lowest amount of body fat (mean=3.66, SD=0.89). They were the best performers in agility (mean=17.47, SD=0.86) and vertical jump (mean=46.69, SD=9.04), but their VO2max capacity (mean=46.03, SD=4.01) and the sprinting test were the lowest among the players (mean=6.50, SD=0.57).

In each position, selected players had better, sprinting capacity over 10m [goalkeeper: $p < 0.001$; d = 0.71,defenders: $p < 0.0001$; d = 0.39; midfielders: $p < 0.001$; d = 0.34, forwards: $p < 0.0001$; d = 0.42], 20m [goalkeeper: $p < 0.05$; d = 0.52, defenders: $p < 0.001$; d = 0.34, midfielders: $p < 0.0001$; d = 0.38, forwards: $p < 0.001$; d = 0.41], 40m [goalkeeper: $p < 0.05$; d = 0.57, defenders: $p < 0.0001$; d = 0.43, midfielders: $p < 0.0001$; d = 0.41, forwards: $p < 0.005$; d = 0.38], and vertical jump [goalkeeper: $p < 0.001$; d = 0.70, defenders: $p < 0.0001$; d = 0.58, midfielders: $p < 0.0001$; d = 0.58, forwards: $p < 0.0001$; d = 0.56] than non-selected players (Table 3). In contrast, players in non-selected players at each position did not differ in percentage of body fat values, (except midfielders: $p < 0.05$; d = 0.26) and aerobic endurance (except goalkeeper: $p < 0.05$; d = 0.55).

Results of the discriminant function analysis (Table 4) indicates a linear function of four variables: vertical jump, a speed assessed at 40 meters, a height and speed assessed at 10 meters, which selected out 74% of the players based on their playing status [Wilks' Lambda = 0.697, $\chi_{(4)}^2 = 142.74$, $p \leq 0.0001$, $r_c = 0.55$, Eigenvalue = 0.434]. The analyses by position in the game also differentiated selected and non-selected players, with a speed assessed at10 meters as well as their vertical jump and agility which is a requirement for goalkeepers: [Wilks' Lambda = 0.551, $\chi_{(2)}^2 = 18.72$, $p \leq 0.0001$, $r_c = 0.694$, Eigenvalue = 0.929]; vertical jump and speed at 10 meters for defenders: [Wilks' Lambda = 0.648, $\chi_{(1)}^2 = 57.31$, $p \leq 0.0001$, $r_c = 0.593$, Eigenvalue = 0.544]; speed at 40 meters, vertical jump and VO_2max for midfielders: [Wilks' Lambda = 0.4, $\chi_{(4)}^2 = 87.38$, $p \leq 0.0001$, $r_c = 0.707$, Eigenvalue = 1.00]; vertical jump and speed at 40 meters for forwards: [Wilks' Lambda = 0.759, $\chi_{(1)}^2 = 27.60$, $p \leq 0.0001$, $r_c = 0.49$, Eigenvalue = 0.318]. The remaining variables were not selected as they were not found to have sufficient discriminating power. When the analysis was repeated by position, the model correctly classified 81.3%, 84.4%, 87.7% and 84.5% of goalkeeper, defenders, midfielders and forwards, respectively.

Discussion

The result of the study showed that there was a significant difference observed between non-selected and selected players in all anthropometric attributes. Furthermore, except for VO_2max results, significant differences were observed in all physical fitness attributes. These results are consistent with Reilly et al. (2000), who used a multivariate analysis of anthropometric and physiological characteristics and observed that elite footballers (aged 16) compared to their non-elite (aged 15) counterparts, were leaner, faster and had more aerobic power. Furthermore, it was observed that there were significant differences between the selected and non-selected football players in their anthropometric and physiological characters. They found that selected players were taller, leaner, and faster, had better endurance and fat percentages between 10–12%. This is considered appropriate for this level of football. Whereas in the non-selected group, many had well above 12% fat percentage (Gil et al. 2007b). Gissis et al. (2006) reported that speed and strength were the discriminating factors among the elite, sub-elite, and recreational football players.

The findings were also similar to Young et al. (2005), who reported that in the Australian Football League, starters had better sprint times than non-starters. In contrast, the current study did not find statistically significant differences in VO_2 max between non-selected and selected players. This result does not mean that aerobic capacity is not an important factor for good football performance, because other studies by Reilly et al. (2000) have demonstrated that both young and adult elite players have an above-average VO_2 max. However, the present study results emphasise the premise that an outstanding aerobic capacity is not necessary to be outstanding in football (Hoff 2005, Reilly et al. 2000). The current results contradicted earlier findings by le Gall et al. (2010), who did not find any anthropometric or physiological differences between international players (aged 14–16 years) who became professionals and those who did not.

Table 2 Positional comparisons of anthropometric and physical fitness variables (N=400)

	Goal Keepers (n=32) M (SD)	Defenders (n=135) M (SD)	Mid Fielders (n=130) M (SD)	Forwards (n=105) M (SD)	Statistical significance (p-Values)						
					$F_{(3, 396)}$ p-value	Goalkeeper/ Defenders	Goalkeepers/ Midfielders	Goalkeepers/ Forwards	Defenders/ Midfielders	Defenders/ Forwards	Midfielders/ Forwards
Mass (kg)	55.31(9.74)	50.96 (8.22)	49.01 (8.10)	48.18 (9.26)	F=6.75 p=.0001	0.05*	0.001*	0.000*	0.253	0.067	0.886
Height (cm)	1.69 (0.09)	1.62 (0.07)	1.59 (0.08)	1.60 (0.10)	F=13.91 p=0.0001	0.005*	0.000*	0.000*	0.001*	0.061	0.961
BMI (kgm^{-2})	19.36 (2.25)	19.21 (2.15)	19.25 (1.94)	18.73 (2.15)	F=1.55 p=.202	0.983	0.993	0.454	0.998	0.310	0.245
% BF	6.94 (0.93)	6.73 (0.71)	6.79 (0.78)	6.67 (0.68)	F=1.29 p=.277	0.465	0.705	0.254	0.931	0.910	0.614
FM (kg)	3.66 (0.89)	3.37 (0.67)	3.34 (0.76)	3.16 (0.77)	F=4.00 p=.008	0.183	0.129	0.005*	0.992	0.152	0.260
FFM (kg)	48.84 (9.17)	46.61 (7.68)	45.68 (7.45)	44.02 (8.57)	F=3.73 p=.01	0.487	0.188	0.016*	0.779	0.064	0.39
10m sprint (sec)	2.53 (0.27)	2.43 (0.24)	2.41 (0.23)	2.44 (0.27)	F=2.05 p=..106	0.135	0.071	0.253	0.968	0.978	0.845
20m sprint (sec)	3.72 (0.30)	3.52 (0.30)	3.54 (0.32)	3.47 (0.32)	F=5.46 p=.001	0.006*	0.014*	0.000*	0.981	0.566	0.355
40m sprint (sec)	6.50 (0.57)	6.19 (0.48)	6.19 (0.47)	6.15 (0.44)	F=4.77 p=.003	0.005*	0.005*	0.001*	1.000	0.886	0.911
Agility (sec)	17.47 (0.86)	19.09 (1.03)	19.26 (0.93)	19.39 (1.04)	F=33.11 p=.0001	0.000*	0.000*	0.000*	0.525	0.093	0.724
Vertical jump (cm)	46.69 (9.04)	32.24 (9.42)	24.95 (7.99)	43.88 (10.09)	F=104.98 p=.0001	0.000*	0.000*	0.428	0.000*	0.000*	0.000*
Vo_2max ($mlkg^{-1}min^{-1}$)	46.03 (4.01)	50.02 (4.92)	51.17 (5.57)	49.73 (4.52)	F=9.25 p=.0001	0.000*	0.000*	0.000*	0.291	0.963	0.132

* The mean difference is significant at the 0.05 level.
BMI= Body mass index, FM= Fat mass, FFM= Fat free mass, %BF= Percentage of body fat

Table 3. Independent samples t-test analysis by playing position within the player's status: non-selected and selected.

	Players Status	GK (N=32) N=20 non-selected N=12 selected	p	d	DF (N=135) N=89 non-selected N=46 selected	p	d	MF(n=130) N=86 non-selected N=44 selected	p	d	FW(n=103) N=73 non-selected N=30 selected	p	d
Age (years)	Non-selected	16.57±0.66	0.18	0.43	16.49±0.79	0.05	0.26	16.48±0.79	0.07	0.52	16.36±0.86	0.12	0.27
	Selected	16.89±0.33			16.76±0.54			16.73±0.59			16.65±0.69		
Mass (kg)	Non-selected	53.48±9.53	0.09	0.48	49.27±8.63	0.000*	0.35	46.52±8.19	0.000*	0.43	46.53±9.18	0.002*	0.39
	Selected	60.00±9.12			54.83±5.55			53.86±5.29			53.08±7.76		
Height (m)	Non-selected	1.68±0.10	0.34	0.36	1.61±0.07	0.003*	0.32	1.57±0.08	0.000*	0.41	1.58±0.10	0.002*	0.38
	Selected	1.71±0.07			1.65±0.04			1.63±0.05			1.65±0.07		
BMI (kg m^{-2})	Non-selected	18.91±2.04	0.07	0.50	18.80±2.22	0.001*	0.34	18.80±2.00	0.000*	0.37	18.46±2.04	0.03*	0.32
	Selected	20.49±2.47			20.13±1.64			20.13±1.48			19.53±2.32		
Percentage of body fat (%)	Non-selected	6.95±0.95	0.93	0.10	6.73±0.74	0.90	0.06	6.69±0.73	0.04*	0.26	6.59±0.60	0.06	0.30
	Selected	6.92±0.91			6.74±0.63			6.98±0.85			6.88±0.85		
Speed 10m (sec)	Non-selected	2.62±0.19	0.001*	0.71	2.48±0.17	0.000*	0.39	2.46±0.21	0.001*	0.34	2.49±0.20	0.000*	0.42
	Selected	2.30±0.30			2.29±0.32			2.32±0.25			2.28±0.37		
Speed 20m	Non-	3.79±0.25		0.52	3.58±0.27		0.34	3.62±0.29		0.38	3.53±0.29		0.41

(sec)	selected		0.05*			0.001*			0.000*			0.001*	
	Selected	3.56±0.36			3.39±0.33			3.38±0.31			3.29±0.33		
Speed 40m (sec)	Non-selected	6.64±0.43	0.02*	0.57	6.33±0.38	0.000*	0.43	6.33±0.40	0.000*	0.41	6.22±0.36	0.003*	0.38
	Selected	6.14±0.74			5.88±0.53			5.92±0.49			5.93±0.59		
Illions (sec)	Non-selected	17.41±0.82	0.59	0.27	19.30±1.01	0.000*	0.35	19.42±0.91	0.004*	0.32	19.55±1.02	0.008*	0.36
	Selected	17.60±1.01			18.62±0.93			18.93±0.90			18.93±0.97		
Vertical jump (cm)	Non-selected	43.57±6.34	0.001*	0.70	28.15±6.72	0.000*	0.58	21.24±6.28	0.000*	0.58	40.65±7.50	0.000*	0.56
	Selected	54.67±10.32			41.63±7.91			32.18±5.69			53.46±10.82		
VO_2max (ml $kg^{-1}min^{-1}$)	Non-selected	45.08±2.89	0.03*	0.55	49.91±4.89	0.70	0.11	51.73±5.59	0.11	0.24	49.53±4.49	0.45	0.19
	Selected	48.46±5.48			50.27±5.05			50.06±5.43			50.31±4.66		

GK= Goalkeeper, **DF= Defender,** **MF= Midfielder,** **FW=Forward**

*The mean difference is significant at the 0.05 level.

Table 4. Summary of stepwise discriminant analyses of players by player status (selected and non-selected) and their position.

	Summary of canonical discriminant functions.						Step	Entered	Unstandardized discriminant function coefficients	Wilks' Lambda	Sig
	Wilks' Lambda	df	Chi-square	Canonical correlation	Eigenvalue	Sig					
All players (N=400)	0.697	4	142.74	0.55	0.434^a	0.000	1	Speed 10m	1.944	0.843	0.000
							2	Vertical jump	-0.035	0.755	0.000
							3	Speed 40m	0.944	0.724	0.000
							4	Height	-4.599	0.697	0.000

								Constant	-1.981		
Goalkeeper							1	Speed 10m	-2.879	0.682	0.001
(n=32)	0.518	3	18.723	0.694	0.929[a]	0.000	2	Vertical jump	0.091	0.597	0.001
							3	Agility	0.663	0.518	0.000
								Constant	-8.519		
Defender							1	Speed 10m	-1.642	0.676	0.000
(n=135)	0.648	2	57.31	0.593	0.544	0.000	2	Vertical Jump	0.106	0.648	0.000
								Constant	0.553		
Midfielders							1	Vertical jump	0.162	0.577	0.000
(n=130)	0.500	4	87.377	.707	1.001[a]	0.000	2	VO_2 max	-0.060	0.544	0.000
							3	Speed 40m	-0.711	0.522	0.000
								Constant	4.328		
Forward							1	Speed 40m	-1.144	0.799	0.000
(n=105)	0.759	2	27.597	.491	0.318[a]	0.000	2	Vertical jump	0.084	0.759	0.000
								Constant	3.358		

[a.] First 1 canonical discriminant functions were used in the analysis

Good football players are often selected at a very young age. However, the studies that have been conducted to explore which factors influence the progression of young into elite football players is still unknown (Gil et al. 2007b, Malina et al. 2000). In order to identify the factors that may have influenced the selection of a football player, this study compared the anthropometric and physical fitness characteristics of selected sports camp residence elite players with those who are non-selected. The linear combination of predictors of the current study could correctly predict approximately 81.3% of goalkeepers, 84.4% of defenders, 87.7% of midfielders and 84.5% of forwards. Vertical jump, 20m sprint ability and five of the six anthropometric tests did not discriminate players by selection status. The parameters highlighted by the discriminant analyses correspond well with the characteristics suggested as being essential in football-specific test batteries and with the changing physiological demands of senior football (Bangsbo 1994, Hoff 2005, Reilly et al. 2000). Among young football players, the variation in discriminating factors may be associated with differential timing of the adolescent growth spurt and sexual maturation (Malina et al. 2004, Malina et al. 2000). Position-specific predictive analyses were also used in the Getxo Arenas Club (Bizkaia, Spain) by (Gil et al. 2007a) to predict players selected based on their playing positions. As for the selection process, they reported that agility and lower extremities power was the predictive variables for the forwards. This result is consistent with the role of forwards, who must be agile, fast and higher jumpers, and must cover the longest distances in high-intensity running (Mohr et al. 2003).

The results of this study, with regards to forwards, showed slight consistency with those findings where it was found that the power of the lower extremities was a discriminating factor among them. The best predictor for the selection of midfielders in this study was the vertical jump, speed (40m sprint), VO_2max and flexibility, which differs with the research by Gil et al. (2007a). They reported that in selecting midfielders, agility was the best predictor together with height. Regardless of the above, they also stated that endurance performance was a significant variable to discriminate the selected players from non-selected.

In football matches, midfielders usually connect the back with the centre and front field and are therefore the ones who run the longest distances and need the highest endurance capacity (Gil et al. 2007a, 2007b). In the defender's group, the current result confirmed the power of the lower legs as being a discriminating variable. This is supported by previous findings in the literature by Gil et al. (2007a), who stated that the power of the lower legs was one of the discriminating variables along with the leaner body. In this position, players must be able to jump high to defend the ball going into the goal. The result of this study further indicated that speed (10m and 40m sprint), vertical jump, and fat mass were a discriminate factors in goalkeepers. These findings are in contradiction with Gil et al. (2007a), who reported that they found none of the statistically significant differences among goalkeepers. Consistent with previous investigations of youth football and field hockey, the results of this study highlight the better discriminating power of physical fitness over anthropometric attributes (Elferink-Gemser et al. 2004; Reilly et al. 2000).

Conclusion

Results from this study indicate that speed assessed over 10m and 40m, vertical jump, and height among Ethiopian junior football players were the discriminate attributes of players by selected vs non-selected status and thus placement in an elite residential unit or domestic residence. The result also confirms that speed over 10m, vertical jump, and agility were the significant discriminate variables of selected and non-selected players in the goalkeeper position. Vertical jump and speed over 10m were the significant discriminate variables of selected and non-selected defenders. The speed at 40m, vertical jump, and VO_2max were the significant discriminate variables of selected and non-selected midfielder players. Vertical jump and speed at 40m were the significant discriminate variables of selected and non-selected forwards players. The discriminative model presented here may be further improved through the inclusion of other attributes related to a high -level of performance specifically, those of relating to technical and tactical skill as well as physiological testing. Nonetheless, anthropometrical and physical fitness attributes are important in the assessment and selection of young Ethiopian football players with the potentials for higher-level performance selection.

Practical implications of the results of the study. The practical implication of this study is twofold.

- First, an analysis of anthropometrical and physical fitness testing data can offer greater insight into the multiple profiles that exist in Ethiopian young footballer, whilst also predicting a player's likelihood of selection for professional football.
- Secondly, assessment relating to decision making and technical proficiency should be added to existing testing batteries undertaken in junior Ethiopian football players. This may facilitate improved prediction of a player's success through further refinement of the discriminate attributes presented in this study.

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Conflict of interest

The Authors do not have any conflicts of interest to declare.

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