Теорія та методика фізичного виховання
Physical Education Theory and Methodology
Teorìâ ta Metodika Fìzičnogo Vihovannâ

ISSN 1993-7989 (print)
ISSN 1993-7997 (online)
ISSN-L 1993-7989

ORIGINAL SCIENTIFIC ARTICLE

ANTHROPOMETRIC AND PHYSIOLOGICAL PREDICTORS OF SOCCER SKILLS IN YOUTH SOCCER PLAYERS

Chanawat Sanpasitt[1ABCD], Atcharat Yongtawee[2ABCDE], Thitiwat Noikhammueang[2ABCD], Daranee Likhitworasak[2ABCD] and Minjung Woo[3ACD]

[1]Chulalongkorn University
[2]Ministry of Tourism and Sports (Thailand)
[3]University of Ulsan

Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Corresponding Author: Chanawat Sanpasitt, E-mail: Chanawat_l@yahoo.com
Accepted for Publication: September 13, 2023
Published: October 30, 2023

DOI: 10.17309/tmfv.2023.5.04

Abstract

Study purpose. This study aimed at investigating the anthropometric and physiological characteristics that affect soccer skills in advanced-level youth soccer players.

Materials and methods. Ninety advanced youth male soccer players from the U-18 division 1 soccer club were enrolled to participate in this study. The participants were classified into three different positions: defenders, midfielders, and forwards. The anthropometric profiles (height, weight, and body fat) and physiological variables (Y-balance test, Yo-Yo Intermittent Recovery Test Level 1, running-based anaerobic sprint test, sit-up test, countermovement jump test, drop jump test, arrowhead agility test, and 40-m sprint test) were assessed. Soccer-specific skills were measured using the Loughborough soccer passing and shooting protocol.

Results. The multiple regression analysis revealed a statistically significant relationship between physical factors and the Loughborough soccer passing ability ($R^2 = 0.291$, $F_{(15, 74)} = 2.200$, $p = 0.015$). The results indicated that the relative maximum power displayed the strongest association with passing ability, followed by sit-up, countermovement jump without and with arm swing, and fatigue index. Concerning the shooting performance, the predictors accounted for 21.8% of the variance, with sit-up being the sole significant predictor among other factors.

Conclusions. Our findings underscore the significance of relative maximum power, fatigue tolerance, muscular power, and core strength as valuable predictors for enhancing passing ability. In addition, abdominal strength emerged as a crucial indicator of shooting performance. Soccer coaches could use the essential information described in this study for talent identification purposes.

Keywords: physical fitness, muscular power, soccer passing, talent identification, youth soccer.

Introduction

Soccer is a highly unpredictable opened-skill sport that requires exceptional physiological abilities on the professional level, as well as proficiency in movement, motor control, decision-making, and cognitive function (Reilly et al.,2000; Fernandez-Rio & Méndez-Giménez, 2014; Romeas et al., 2016). Renowned, world-class-level soccer players such as Lionel Messi, Christiano Ronaldo, Neymar da Silva Santos Júnior, and Kylian Mbappé have demonstrated exceptional talent from a young age. Therefore, national soccer associations and youth academies of professional clubs worldwide have made significant financial investments in systematically implementing talent identification and development (TID) programs. The primary objective of these initiatives is to identify the most promising young athletes who possess the potential to advance to and excel at the adult professional level (Bergkamp et al., 2019; Mourao, 2016; Till & Baker, 2020). Obviously, numerous soccer clubs and academies prioritize early enrollment as a crucial aspect of long-term player development in the pursuit of training elite players. Performance success in team sports such as soccer could be reportedly influenced by several critical factors, including anthropometry, physiological fitness, cognitive/psychological characteristics, sport-specific skills, and sociological profiles (Murr, Raabe, & Höner, 2018; Yongtawee et al., 2022). Certain of these parameters have been identified as talent predictors in systematic review studies (Williams & Reilly, 2020). For instance, top professional-level players reportedly exhibit significant differences in traits such as leanness, height, weight, physical fitness, speed, agility, and skill level during adolescence compared to their peers (Carling et al., 2012; Williams, Ford, & Drust, 2020). In the context of TID programs across various countries, specific indicators have been identified that predict future success in adulthood during the early adolescence phase in Germany. These indicators include sprinting ability, agility, dribbling skills, ball control, and shooting proficiency (Höner, Leyhr, & Kelava, 2017). In England, the Elite Player Performance Plan has been implemented since 2012 to optimize home-grown player performance across multiple domains, including physical, technical, tactical, and psychological aspects, through a comprehensive multidisciplinary approach (Premier League, 2012). Likewise, in the Netherlands, several professional soccer clubs have implemented the TID process that primarily involves evaluating a comprehensive test battery assessing multidimensional performance characteristics encompassing physiological, technical, tactical, and psychological aspects (Huijgen, Elferink-Gemser, Lemmink, & Visscher, 2014). Therefore, holistic performance diagnostics appear to be crucial for the long-term international success of national football associations and professional clubs.

In order to reach the pinnacle of professional soccer, young soccer players need to enhance their performance in multiple domains, including physiological, technical, tactical, and cognitive/psychological characteristics (Meylan, et al., 2010; Reilly et al., 2000; Vaeyens et al., 2006). Moreover, when selecting elite athletes, factors such as body composition, aerobic endurance, speed, agility, and balance are crucial. Wong et al. (2009) suggest that anthropometric data can serve as reliable indicators of soccer performance. In the contemporary soccer system, teams often adopt a compact playing style, making it challenging for opponents to create space. Possessing excellent passing skills is thus vital for the players of a soccer team to maintain possession and control the game (Gonçalves et al., 2017; Rein et al., 2017). Developing shooting skills is crucial for soccer players as it is essential for winning games and overall success (Lago-Ballesteros & Lago- Peñas, 2010). Therefore, coaches should consider significantly these specific skills. However, our knowledge concerning the influence of anthropometric and physical fitness profiles on specific skills, such as passing and shooting ability, remains limited. Hence, understanding these physical demands would be essential for recruiting top-level players, particularly considering the positional differences among youth soccer players. Consequently, this study aimed at investigating how anthropometric and physiological characteristics affect soccer skills in advanced-level youth soccer players.

Materials and methods

Participants

We recruited 90 advanced youth male soccer players from the U-18 division 1 soccer club to participate in this study. Each cohort comprised a diverse group of players from different positions including defender, midfield, and forward. All participants had at least 2 years of experience in the national youth competition. None of the participants had musculoskeletal injuries or used anabolic drugs. We informed all the participants about the purpose of the testing procedures and possible risks and gave their informed consent prior to the study. The study protocol was approved by the Ethics Review Committee for Research Involving Human Research Subjects and it was conducted according to the Declaration of Helsinki.

Testing procedures

To evaluate anthropometric and physiological characteristics, we applied nine physical fitness tests as follows: 40-m sprint, Arrowhead Agility Test (AAT), sit-up, muscular power test (i.e., Countermovement Jump (CMJ) and Drop Jump (DJ) tests), Y-Balance test, Running-based Anaerobic Sprint Test (RAST), and Yo-Yo Intermittent Recovery Test level 1 (Yo-Yo IR1). Prior to testing, the participants were instructed to engage in a 15-min individual warm-up involving low aerobic activity and dynamic stretching. Each testing session was divided into two occasions separated by a 24-h recovery period. On the first visit, the demographic data, anthropometrical aspects, and two soccer skill tests (passing and shooting) were measured on the soccer pitch. On the second visit, the physiological profiles were assessed in the following sequence: YBT, sit-up, AAT, CMJ, DJ, 40-m sprint, RAST, and Yo-Yo IR1.

Anthropometry

Standing height was measured to the nearest 0.1 cm (Seca 220e, Hamburg, Germany). Body composition analysis was performed using Inbody 720 (Biospace Co., Seoul, Korea). Fat percentage was recorded using multifrequency bioelectrical impedance analysis.

Aerobic capacity

Aerobic performance was evaluated using Yo-Yo IR1. The participants performed repeated 20-m shuttle runs interspersed with a short active recovery. The time allowed for a shuttle, which progressively decreased, dictated by audio beeps. The objective of the tests was to complete as many shuttles as possible. To calculate maximal oxygen consumption, we used the following equation, as described previously (Bangsbo, 1994):

VO_2max (ml/min/kg) = running distance covered (m) × 0.0084 + 36.4

Anaerobic capacity

The RAST included 6 × 35 m sprints, interspersed by 10 s of active recovery (Draper and Whyte, 1997). The participants were requested to perform the sprints to the best of their abilities in each lap. Two photocells were used to record sprint time intervals. We assessed relative maximum power (Power = Weight × Distance^2 ÷ Time^3) and fatigue index ((Maximum power – Minimum power) ÷ Total time for the six sprints)/body mass based on the RAST results.

Muscular power

Muscular power values were measured using SmartSpeed Pro timing lights and force plate (Fusion Sport, Coopers Plains, Australia) during CMJ with and without arm swing and DJ. The participants completed the power test consisting of three jumps of one maximal CMJ on a force plate. The maximum value was selected as the final measurement. A 15-sec resting period was established to enable sufficient recovery between the jumps. Jump heights were recorded for each trial. DJ was performed from a 30-cm box while the participants were holding their hands on their hips. The participants were instructed to stand on the top of the box facing toward the force platform then step off of the box and rebound as fast as possible.

Muscular endurance

The sit-up test was set up as a protocol to evaluate muscular endurance. The participants were instructed to lay on the floor with 90°-knee joint flexion in a supine position. They were then asked to keep their hands at the side of their head with their elbows pointing straight forward to touch their knees, then lean back so that their shoulders would touch the floor. We counted sit-up repetitions in 40 seconds for each participant (Hohmann et al., 2018).

Agility

AAT was applied to assess the ability to change direction over a range of angles and directions. The AAT time was measured using timing gates (Fusion Sport, Coopers Plains, Australia) positioned at the start line. A total of four trials (2-2 attempts to start from left and right, respectively) were completed.

Speed

The 40-m sprint times were recorded using timing gates (SmartSpeed Pro timing lights; Fusion Sport, Coopers Plains, Australia). The photocells were placed at the start and 40 m. Participants were instructed to perform two maximal-effort 40-m sprints using a standing start position and the fastest time was used for analysis.

Balance

The YBT was applied to evaluate dynamic balance. The participants reached out in the anterior, posteromedial, and posterolateral directions with one foot while standing on the other foot on a centralized stance platform. The test was performed barefoot with both the left and right limbs.

Soccer-specific skills

The Loughborough soccer passing test (LSPT) was set to assess the passing performance. Figure 1 presents the LSPT layout. Four wood boards (2.5 × 0.3 m) were placed in the centermost within the 12 × 9.5 m layout. Four differently colored (green, blue, red, and white), 0.6 × 0.3 m sticker pads were attached to the middle of the boards. A 0.1 × 0.15 m thick black line was also taped to the center of the target areas. The participants were requested to respond quickly and accurately by 16 verbal randomized passing orders (Ali et al., 2007). The test sequence consisted of 8 passes including 3.5 meter (4 red and 4 white targets) and 4 meter (4 green and 4 blue targets) passes.

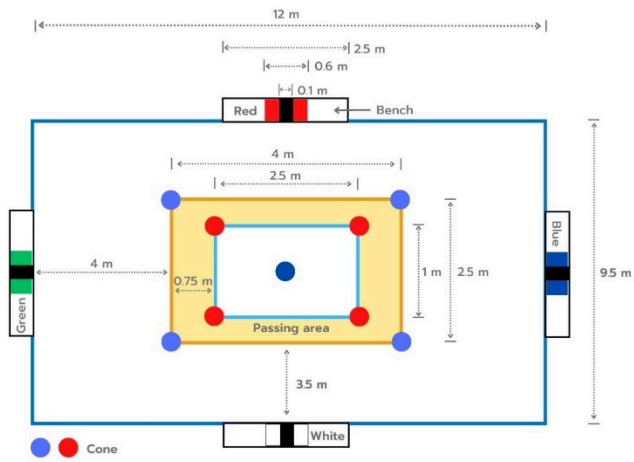

Fig. 1. Loughborough Soccer Passing Test (LSPT) layout

We used the Loughborough soccer shooting test (LSST) to measure the shooting ability. The participants were asked to sprint between two cones of 5.5 meters length from and directly in front of the goal to follow the shot sequence. The shooting zone was an 8.5 × 8.5 m square with a 16.5 m length from the goal line (Figure 2). Each participant completed a single trial of ten shots (5-5 to the right and the left sides, respectively), with a 30-second recovery between each shot order (Stone & Oliver, 2009).

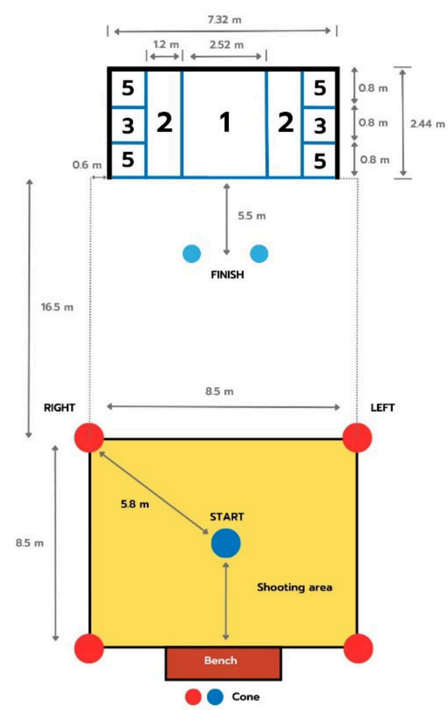

Fig. 2. Loughborough soccer shooting test (LSST) overview

Statistical Analysis

The obtained data were analyzed in terms of means, standard deviation, and multiple linear regression analysis was used to estimate the relative contributions of aerobic capacity, anaerobic performance, power, muscular endurance, balance, speed, and change of direction to specific soccer skills. One-way analysis of variance was used to examine the differences between three positions. The statistical significance was set at a P-value of $p < 0.05$. All statistical analyses were performed using SPSS version 23.0 for Windows (SPSS Inc Chicago, IL, USA).

Results

We performed multiple regression analyses to assess the relationship between anthropometric and physical fitness factor variables (Tables 1 and 2). Multiple linear regression analysis was applied to develop a model for predicting soccer performance including passing and shooting skills. Moreover, we aimed at determining if various physical factors could influence Loughborough soccer passing values (Table 1). The overall regression was statistically significant ($R^2 = 0.291$, $F_{(15, 74)} = 2.200$, $p = 0.015$) with the maximum power being the best predictor of passing abilities

Table 1. Multiple regression analysis of anthropometric and physical fitness factors affecting Loughborough soccer passing

Variable	B	SE	β	t	p
Constant	82.560	31.318		2.636	0.010
Height (cm)	−0.090	0.138	−0.118	−0.653	0.515
Weight (kg)	0.067	0.141	0.100	0.474	0.637
Body fat (%)	0.031	0.175	0.026	0.177	0.860
YBT-right leg composite	0.010	0.072	0.024	0.139	0.890
YBT-left leg composite	−0.054	0.072	−0.124	−0.744	0.459
Sit-up (reps)	0.171	0.072	0.271	2.383	0.020*
Arrowhead agility (s)	−0.604	0.699	−0.093	−0.864	0.390
40-m sprint (s)	−1.055	2.258	−0.058	−0.467	0.642
CMJ(cm) without arm swing	−0.517	0.213	0.496	−2.428	0.018*
CMJ (cm) with arm swing	0.449	0.189	0.516	2.376	0.020*
Drop jump (cm)	0.016	0.097	0.021	0.165	0.870
Relative maximum power (watt/kg)	−1.615	0.602	−0.545	−2.685	0.009*
Fatigue index (%)	1.044	0.446	0.446	2.341	0.022*
VO_2max (ml/min/kg)	0.015	0.132	0.012	0.114	0.910

*p < 0.05; YBT = Y-Balance test, CMJ = countermovement jump, VO_2max = maximal oxygen uptake

Table 2. Multiple regression analysis of anthropometric and physical fitness factors affecting shooting performance

Variable	B	SE	β	t	p
Constant	−4.060	4.876		−0.833	0.408
Height (cm)	0.019	0.022	0.168	0.833	0.380
Weight (kg)	−0.005	0.022	−0.049	−0.220	0.827
Body fat (%)	−0.007	0.027	−0.039	−0.253	0.801
YBT-right leg composite	−0.008	0.011	−0.132	−0.720	0.473
YBT-left leg composite	0.013	0.011	0.204	1.167	0.247
Sit-up (reps)	0.028	0.011	0.298	2.494	0.015*
Arrowhead agility (s)	−0.050	0.109	−0.052	−0.457	0.649
40-m sprint (s)	0.048	0.352	0.018	0.135	0.893
CMJ(cm) without arm swing	0.058	0.033	0.375	1.749	0.084
CMJ (cm) with arm swing	−0.025	0.029	−0.198	−0.865	0.390
Drop jump (cm)	0.001	0.015	0.009	0.067	0.947
Relative maximum power (watt/kg)	−0.001	0.094	−0.002	−0.007	0.994
Fatigue index (%)	−0.026	0.069	−0.074	−0.371	0.712
VO_2max (ml/min/kg)	0.023	0.021	0.126	1.139	0.258

*p < 0.05; YBT = Y-Balance test, CMJ = countermovement jump, VO_2max = maximal oxygen uptake

Table 3. Descriptive anthropometric and performance characteristics of soccer players (n = 90) by positions roles

Variable	Defender (n = 30)		Midfielder (n = 30)		Forward (n = 30)		F	p
	X	SD	X	SD	X	SD		
Age (years)	17.13	0.68	17.13	0.77	17.16	0.83	0.019	0.981
Weight (kg)	63.78	6.65	64.83	6.22	63.84	6.57	0.249	0.780
Height (cm)	173.32	5.98	172.63	5.69	172.22	5.35	0.287	0.752
Body fat (%)	10.74	3.71	12.13	3.83	12.17	3.29	1.510	0.227
YBT-Right Leg composite	115.16	11.56	110.96	10.15	112.55	9.61	1.229	0.298
YBT-Left Leg composite	114.65	11.43	110.99	10.08	110.39	7.8	1.631	0.202
Sit-up (reps)	31.73	7.00	33.53	6.91	33.10	6.61	0.565	0.570
Arrowhead agility (s)	18.93	0.64	19.00	0.65	18.95	0.80	0.101	0.904
40-m sprint (s)	5.49	0.19	5.51	0.25	5.46	0.26	0.400	0.672
CMJ without arm swing (cm)	38.56	3.92	36.17	4.41	36.92	3.96	1.606	0.206
CMJ with arm swing (cm)	44.48	4.72	42.30	4.83	43.56	5.20	1.529	0.223
Drop jump (cm)	35.27	4.71	33.10	5.50	31.74	6.44	3.040	0.053
Relative maximum power (watt/kg)	9.15	1.20	8.91	1.03	9.40	1.96	0.833	0.438
Fatigue index (%)	3.80	1.47	3.46	1.12	4.10	2.60	0.912	0.405
VO_2max (ml/min/kg)	47.15	3.01	47.29	3.57	47.89	3.73	0.391	0.678
Loughborough soccer passing	46.20	4.44	45.67	4.46	45.45	4.12	0.220	0.803
Loughborough soccer shooting	1.68	0.72	1.80	0.55	1.68	0.65	0.329	0.720

YBT = Y-Balance test, CMJ = countermovement jump, VO_2max = maximal oxygen uptake

(p = 0.009), followed by core strength endurance (p = 0.020), countermovement jump with arm swing (p = 0.020), and fatigue index (p = 0.022). These four variables were significantly crucial indicators to improve passing abilities in young soccer players. Furthermore, the multiple regression analysis indicates the factors affecting shooting performance (Table 2). Sit-up was the only statistically significant predictor of shooting capacity (p = 0.020). These factors constituted 21.8% of the explanatory power (R^2 = 0.218). Moreover, we identified no significant positional difference among any of the anthropometric- and physiological performance-related variables (Table 3).

Discussion

This study aimed at investigating the anthropometric and physiological characteristics affecting soccer-specific skills in advanced-level youth soccer players. Numerous studies described talent recruitment models to select young soccer players based on anthropometric and physical fitness (Vaeyens et al., 2006; Simon et al., 2019; Bergkamp et al., 2019). The findings of the current study provide a scientific rationale behind the physical capacities influencing soccer passing and shooting. The results showed that sit-ups, CMJ without arm swing, CMJ with arm swing, relative maximum power, and fatigue index were the five major factors influencing passing performance (Table 1). The relative maximum power was the main factor that negatively affected soccer passing, representing the ability of an individual to perform maximum anaerobic power achieved during the short interval sprint. The results of our study were in good agreement with a previous study (Eniseler et al., 2017) stating that the improvement of repeated sprint ability could be used as an effective predictor to enhance short-passing ability. Therefore, RAST is a useful tool to evaluate anaerobic capacity and predict short-distance performance in intermittent sports (Zagatto et al., 2009; Andrade et al., 2015). Moreover, the physical exhaustion also influences the passing ability. The fatigue index refers to the rate at which power declines for the athlete. These current study results suggest that good players should tolerate the fatigue threshold better and maintain anaerobic performance. Rampinini et al. (2008) discovered that exhaustion caused by short-term high-intensity intermittent actions negatively influenced the short-passing skills of the players. In addition, Mulazimoglu (2016) reported that the fatigue level of the players is an important indicator of their technical competencies. Among these, the degree of individual fitness of the players reportedly correlates with the decline in technical proficiency among players brought on by fatigue. Furthermore, CMJ values were positively linked with passing performance, implying that increasing them all indicates an improvement in the ability to perform an explosive vertical jump. This result was similar to that of a study by Benounis et al. (2013) revealing that the LSPT score performance negatively correlated with squat jump and CMJ performances. Our results facilitate using the CMJ test for talent identification and it could be a protocol to predict young soccer players. In agreement with this, Vanttinen et al. (2010) reported that passing accuracy is related to speed, countermovement jump performance, and coordination in adolescent soccer players. Among these listed characteristics, our study indicates that lower limb explosive strength has been anecdotally linked to passing success. Sit-ups also factor if for influencing passing performance, representing abdominal muscle strength. Core strength is pivotal for stability and movement. The lumbopelvic hip complex is crucial for movement control. Core muscles were confirmed to be essential for soccer players as they provide the basis for endurance, posture, strength, power, and coordination, lowering the risk of injury (Chat, 2011). Our results (Table 2) revealed that sit-up significantly affects shooting performance ($p < 0.05$). However, we observed no significant influence exerted by the other independent variables. A critical finding of our results of anthropometric and physical fitness on shooting ability was that the highest significant abdominal strength would be the best predictor of soccer shooting. In contrast, the previous study found that there were no significant correlation between sit-ups with shooting in college soccer players (Poornabodha et al., 2018). Nevertheless, Sun & Shin (2018) reported that pelvic stability could improve shooting speed and accuracy in junior soccer players. Therefore, during the shooting action, core strengthening could support better soccer shooting efficacy. In addition, the comparison between position roles resulted in no significant difference in any parameter, which was in line with the study of Malina et al. (2004) presenting no positional differences among young defender, midfield, and forward players in vertical jump, sprint time, and intermittent aerobic endurance. Our results also align with a previous study that revealed no significant positional differences in physiological performances including maximal vertical jump height, ball shooting speed, 10- and 30-m sprint times, Yo-Yo IR1, running cost and submaximal running cost, and VO_2max (Wong et al., 2009). In the present study, muscular power performance of defenders were higher than midfielders and strikers. The power seems to be a contributor to support defender characteristics as these players require stamina and strength to tackle and jump to prevent the opponents from scoring during their play in a defensive situation. This discovery was in good agreement with the performance characteristics where defenders showed the strongest jump ability. However, these differences were not significant ($p > 0.05$) versus those observed in goalkeepers and strikers (Wik et al., 2018). According to the rationale that no positional difference could be observed in physiological performances, coaches should modify the strength and conditioning regimens appropriately for youth soccer players. In summary, these results can later be used to evaluate the player's potential and to identify talents in youth soccer players.

Practical Applications

Our results established relationships between specific anthropometric as well as physiological characteristics and specific soccer skills which they impact. Although our discoveries underscore the significance of anaerobic performance and core strength endurance indicators, soccer coaches could use the results of this study for identifying young talents for recruiting and developing future top-level players.

Conclusions

In our study, we clarified that one of the most important factors in various facets of soccer performance is physical fitness. In particular, players with superior muscular endurance, power, and anaerobic capacity would stand comparatively better chances of being selected for a more advanced or higher-development program in the future, according to talent identification purposes.

Acknowledgment

The current study was supported by the Fundamental Fund from the Thailand Science Research and Innovation (TSRI) of Ministry of Higher Education, Science, Research and Innovation, Thailand (Grant number: FFB650053/0040). The authors would like to thank all participants from U-18 division 1 soccer club for their involvement in the present study.

Conflict of interest

The authors declare no potential conflict of interest.

References

Reilly, T., Williams, A. M., Nevill, A., & Franks, A. (2000). A multidisciplinary approach to talent identification in soccer. *Journal of Sports Sciences, 18*(9), 695-702. https://doi.org/10.1080/02640410050120078

Fernandez-Rio, J. & Méndez-Giménez, A. (2014). Talent detection and development in soccer: A review. *Journal of Sport and Health Research,* 6. 7-18.

Romeas, T., Guldner, A., & Faubert, J. (2016). 3D-multiple object tracking training task improves passing decision-making accuracy in soccer players. *Psychology of Sport and Exercise,* 22, 1-9. https://doi.org/10.1016/j.psychsport.2015.06.002

Bergkamp, T. L. G., Niessen, A. S. M., den Hartigh, R. J. R., Frencken, W. G. P., & Meijer, R. R. (2019). Methodological Issues in Soccer Talent Identification Research. *Sports Medicine, 49*(9), 1317-1335. https://doi.org/10.1007/s40279-019-01113-w

Mourao, P. R. (2016). Soccer transfers, team efficiency and the sports cycle in the most valued European soccer leagues–have European soccer teams been efficient in trading players? *Applied Economics, 48*(56), 5513-5524. https://doi.org/10.1080/00036846.2016.1178851

Till, K., & Baker, J. (2020). Challenges and [possible] solutions to optimizing talent identification and development in sport. *Frontiers in Psychology,* 11, 664. https://doi.org/10.3389/fpsyg.2020.00664

Murr, D., Raabe, J., & Höner, O. (2018). The prognostic value of physiological and physical characteristics in youth soccer: A systematic review. *European Journal of Sport Science, 18*(1), 62-74. https://doi.org/10.1080/17461391.2017.1386719

Yongtawee, A., Park, J., Kim, Y. & Woo, M.. (2022). Athletes have different dominant cognitive functions depending on type of sport. *International Journal of Sport and Exercise Psychology*, 20. 1-15. https://doi.org/10.1080/1612197X.2021.1956570

Williams, A. M., & Reilly, T. (2000). Talent identification and development in soccer. *Journal of Sports Sciences, 18*(9), 657-667. https://doi.org/10.1080/02640410050120041

Carling, C., Le Gall, F., & Dupont, G. (2012). Analysis of repeated high-intensity running performance in professional soccer. *Journal of Sports Sciences, 30*(4), 325-336. https://doi.org/10.1080/02640414.2011.652655

Williams, A. M., Ford, P. R., & Drust, B. (2020). Talent identification and development in soccer since the millennium. *Journal of Sports Sciences, 38*(11-12), 1199-1210. https://doi.org/10.1080/02640414.2020.1766647

Höner, O., Leyhr, D., & Kelava, A. (2017). The influence of speed abilities and technical skills in early adolescence on adult success in soccer: A long-term prospective analysis using ANOVA and SEM approaches. *PloS One, 12*(8), e0182211. https://doi.org/10.1371/journal.pone.0182211

Premier League. (2012). *Youth: Elite Performance.* https://www.premierleague.com/news/58934.

Huijgen, B. C., Elferink-Gemser, M. T., Lemmink, K. A., & Visscher, C. (2014). Multidimensional performance characteristics in selected and deselected talented soccer players. *European Journal of Sport Science, 14*(1), 2-10. https://doi.org/10.1080/17461391.2012.725102

Meylan, C., Cronin, J., Oliver, J., and Hughes, M. (2010). Talent identification in soccer: the role of maturity status on physical, physiological and technical characteristics. *International Journal of Sports Science and Coaching,* 5, 571-592. https://doi.org/10.1260/1747-9541.5.4.571

Reilly, T., Bangsbo, J., & Franks, A. (2000). Anthropometric and physiological predispositions for elite soccer. *Journal of Sports Sciences, 18*(9), 669-683. https://doi.org/10.1080/02640410050120050

Vaeyens, R., Malina, R. M., Janssens, M., Van Renterghem, B., Bourgois, J., Vrijens, J., & Philippaerts, R. M. (2006). A multidisciplinary selection model for youth soccer: the Ghent Youth Soccer Project. *British Journal of Sports Medicine, 40*(11), 928-934. https://doi.org/10.1136/bjsm.2006.029652

Wong, P. L., Chamari, K., Dellal, A., & Wisløff, U. (2009). Relationship between anthropometric and physiological characteristics in youth soccer players. *Journal of Strength and Conditioning Research, 23*(4), 1204-1210. https://doi.org/10.1519/JSC.0b013e31819f1e52

Gonçalves, B., Coutinho, D., Santos, S., Lago-Penas, C., Jiménez, S., & Sampaio, J. (2017). Exploring Team Passing Networks and Player Movement Dynamics in Youth Association Football. *PloS One, 12*(1), e0171156. https://doi.org/10.1371/journal.pone.0171156

Rein R., Raabe D., & Memmert D. (2017). "Which pass is better?" Novel approaches to asses passing effectiveness in elite soccer. *Human Movement Science,* 55,172-181. https://doi.org/10.1016/j.humov.2017.07.010

Lago-Ballesteros, J., & Lago-Peñas, C. (2010). Performance in Team Sports: Identifying the Keys to Success in Soccer. *Journal of Human Kinetics,* 25, 85-91. https://doi.org/10.2478/v10078-010-0035-0

Bangsbo, J. (1994). *Fitness Training in Football -A Scientific Approach.* Bagsvaerd: HO + Storm.

Draper, N., & Whyte, G. (1997). Here's a new running based test of anaerobic performance for which you need only a stopwatch and a calculator. *Peak Performance,* 96, 3-5.

Hohmann, A., Siener, M., & He, R. (2018). Prognostic validity of talent orientation in soccer. *German Journal of Exercise and Sport Research, 48*(4), 478-488. https://doi.org/10.1007/s12662-018-0549-5

Ali, A., Williams, C., Hulse, M., Strudwick, A., Reddin, J., Howarth, L., Eldred, J., Hirst, M., & McGregor, S. (2007). Reliability and validity of two tests of soccer skill. *Journal of Sports Sciences, 25*(13), 1461-1470. https://doi.org/10.1080/02640410601150470

Stone, K. J., & Oliver, J. L. (2009). The effect of 45 minutes of soccer-specific exercise on the performance of soccer skills. *International Journal of Sports Physiology and Performance, 4*(2), 163-175. https://doi.org/10.1123/ijspp.4.2.163

Simon J. Roberts, Allistair P. McRobert, Colin J. Lewis & Matthew J. Reeves (2019) Establishing consensus of position-specific predictors for elite youth soccer in England. *Science and Medicine in Football, 3*(3), 205-213. https://doi.org/10.1080/24733938.2019.1581369

Eniseler, N., Şahan, Ç., Özcan, I., & Dinler, K. (2017). High-Intensity Small-Sided Games versus Repeated Sprint Training in Junior Soccer Players. *Journal of Human Kinetics,* 60, 101-111. https://doi.org/10.1515/hukin-2017-0104

Zagatto, A. M., Beck, W. R., & Gobatto, C. A. (2009). Validity of the running anaerobic sprint test for assessing anaerobic power and predicting short-distance performances. *Journal of Strength and Conditioning Research, 23*(6), 1820-1827. https://doi.org/10.1519/JSC.0b013e3181b3df32

Andrade, V. L., Zagatto, A. M., Kalva-Filho, C. A., Mendes, O. C., Gobatto, C. A., Campos, E. Z., & Papoti, M. (2015). Running-based Anaerobic Sprint Test as a Procedure to Evaluate Anaerobic Power. *International Journal of Sports Medicine, 36*(14), 1156-1162. https://doi.org/10.1055/s-0035-1555935

Rampinini, E., Impellizzeri, F. M., Castagna, C., Azzalin, A., Ferrari Bravo, D., & Wisløff, U. (2008). Effect of match-related fatigue on short-passing ability in young soccer players. *Medicine and Science in Sports and Exercise, 40*(5), 934-942. https://doi.org/10.1249/MSS.0b013e3181666eb8

Mulazimoglu, O. (2016). The Effect of Fatigue Levels on Passing Accuracy in Young Soccer Players. *International Journal of Academic Research,* 8, 12-20.

Benounis, O., Benabderrahman, A., Chamari, K., Ajmol, A., Benbrahim, M., Hammouda, A., Hammami, M. A., & Zouhal, H. (2013). Association of short-passing ability with athletic performances in youth soccer players. *Asian Journal of Sports Medicine, 4*(1), 41-48. https://doi.org/10.5812/asjsm.34529

Vänttinen, T., Blomqvist, M., & Häkkinen, K. (2010). Development of body composition, hormone profile, physical fitness, general perceptual motor skills, soccer skills and on-the-ball performance in soccer-specific laboratory test among adolescent soccer players. *Journal of Sports Science and Medicine, 9*(4), 547-556.

Chat Williams, M. J. (2011). Core Training. *NSCA's Performance Training Journal, 10*(5), 1-29.

Poornabodha V Kadagadakai, Balaram Pradhan.(2018). Association of physical fitness and soccer skills in diploma college soccer players. *International Journal of Physiology, Nutrition and Physical Education, 3*(1), 20-22.

Sung, Ha-Rim & Shin, won-Seob. (2018). Effects of pelvic stability on instep shooting speed and accuracy in junior soccer players. *Physical Therapy Rehabilitation Science,* 7. 78-82. https://doi.org/10.14474/ptrs.2018.7.2.78

Malina, R. M., Eisenmann, J. C., Cumming, S. P., Ribeiro, B., & Aroso, J. (2004). Maturity-associated variation in the growth and functional capacities of youth football (soccer) players 13-15 years. *European Journal of Applied Physiology, 91*(5-6), 555-562. https://doi.org/10.1007/s00421-003-0995-z

Wik, E. H., Auliffe, S. M., & Read, P. J. (2018). Examination of Physical Characteristics and Positional Differences in Professional Soccer Players in Qatar. *Sports, 7*(1), 9.

АНТРОПОМЕТРИЧНІ ТА ФІЗІОЛОГІЧНІ ПРЕДИКТОРИ ФУТБОЛЬНИХ НАВИЧОК У ЮНИХ ФУТБОЛІСТІВ

Чанават Санпасіт[1ABCD], Атчарат Йонгтаві[2ABCDE], Тітіват Нойхаммуеан[2ABCD], Дарані Ліківорасак[2ABCD], Мінжан Воо[3ACD]

[1]Університет Чулалонгкорна
[2]Міністерство туризму та спорту (Таїланд)
[3]Ульсанський університет

Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 8 с., 3 табл., 2 рис., 40 джерел.

Мета дослідження. Метою цього дослідження було вивчення антропометричних і фізіологічних характеристик, які впливають на футбольні навички у юних футболістів високого рівня.

Матеріали та методи. До участі в цьому дослідженні було залучено дев'яносто юнаків-футболістів високого рівня з футбольного клубу 1-го дивізіону гравців віком до 18 років. Учасників розділили на три різні позиції: захисники, півзахисники та нападники. Оцінювали антропометричні профілі (зріст, вага та відсоток жиру в організмі) та фізіологічні змінні (Y-тест на збереження динамічної рівноваги (з виконанням на Y-подібній підставці на підлозі), тест Йо-йо з переміжним відпочинком (рівень 1), анаеробний спринт-тест на основі бігу, тест на підйом верхньої частини тулубу з положення лежачи, тест на вертикальний стрибок із зустрічним рухом, тест на зістрибування з платформи вниз на підлогу з негайним підстрибуванням, тест на спритність під час бігу зі зміною напрямків за стрілоподібною траєкторією та тест на 40-метровий спринт). Специфічні футбольні навички вимірювали за допомогою протоколу футбольних передач та ударів Лафборо.

Результати. Аналіз множинної регресії виявив статистично значущий зв'язок між фізичними факторами та здатністю до футбольних передач за протоколом Лафборо ($R2 = 0{,}291$, $F(15, 74) = 2{,}200$, $p = 0{,}015$). Результати показали, що відносна максимальна потужність продемонструвала найсильніший зв'язок зі здатністю до передач, за якою слідували показники в тестах на підйом верхньої частини тулуба з положення лежачи, вертикальний стрибок із зустрічним рухом без помаху і з помахом руками та індекс утоми. Щодо результативності ударів, предиктори становили 21,8% дисперсії, при цьому показник у тесті на підйом верхньої частини тулубу з положення лежачи був єдиним значущим предиктором серед інших факторів.

Висновки. Наші висновки підкреслюють важливість відносної максимальної потужності, стійкості до втоми, м'язової потужності та сили м'язів торсу як цінних предикторів для покращення здатності до виконання передач. Крім того, сила м'язів черевного преса виявилася ключовим показником результативності ударів. Футбольні тренери можуть використовувати істотну інформацію, описану в цьому дослідженні, для визначення талантів.

Ключові слова: фізична підготовленість, м'язова потужність, футбольні передачі, визначення талантів, юнацький футбол.

Information about the authors:

Sanpasitt, Chanawat: Chanawat_l@yahoo.com; https://orcid.org/0000-0001-8534-0618; Faculty of Sports Science, Chulalongkorn University, Phayathai Road, Pathumwan, Bangkok 10330, Thailand.

Yongtawee, Atcharat: atcharat.y@dpe.go.th; https://orcid.org/0000-0001-9854-9605; Department of Physical Education, Ministry of Tourism and Sports (Thailand), 4 Ratchadamnoen nok Road, Watsomanas, Pom Prap Sattru Phai, Bangkok 10100, Thailand.

Noikhammueang, Thitiwat: natthaphon.n@dpe.go.th; https://orcid.org/0000-0002-3839-504X; Department of Sports Science, Ministry of Tourism and Sports (Thailand), 4 Ratchadamnoen nok Road, Watsomanas, Pom Prap Sattru Phai, Bangkok 10100, Thailand.

Likhitworasak, Daranee: lee_buay@hotmail.com; https://orcid.org/0009-0007-7259-7482; Office of the Permanent Secretary, Ministry of Tourism and Sports (Thailand), 4 Ratchadamnoen nok Road, Watsomanas, Pom Prap Sattru Phai, Bangkok 10100, Thailand.

Woo, Minjung: mjwoo@ulsan.ac.kr; https://orcid.org/0000-0003-4242-9115; School of Exercise and Sport Science, University of Ulsan, 93 Daehak-ro, Nam-gu, Ulsan, South Korea

Cite this article as: Sanpasitt, C., Yongtawee, A., Noikhammueang, T., Likhitworasak, D., & Woo, M. (2023). Anthropometric and Physiological Predictors of Soccer Skills in Youth Soccer Players. *Physical Education Theory and Methodology, 23*(5), 678-685. https://doi.org/10.17309/tmfv.2023.5.04

Received: 17.07.2023. Accepted: 13.09.2023. Published: 30.10.2023