Speed running is determined by strength and power in young football players

Szybkość biegu młodych piłkarzy jest determinowana ich siłą i mocą

Piotr Kuczek[A,B,D,F], Beata Nowak[B,C,E]

Państwowa Wyższa Szkoła Zawodowa w Tarnowie, Wydział Ochrony Zdrowia
University of Applied Sciences in Tarnów, Faculty of Health Sciences, Poland

A – przygotowanie projektu badawczego
B – zestawienie danych
C – przeprowadzenie analizy statystycznej
D – interpretacja wyników
E – przygotowanie manuskryptu
F – przegląd literatury

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Abstract

Introduction: For years researchers and trainers have been looking for determinants of sports talent in the youngest and also in the relationship between individual motor features relevant in given sport disciplines. There is a fundamental consensus in the opinion that the strength and power of the lower limbs are correlated with the speed of running. However, this relationship also among the youngest is not so clear. The purpose of the work was to show the relationship between strength and power generated during vertical jump and achieved height jump and the speed of flat running in the youngest footballers.

Material and methods: The research covered 75 children training football at the age of 6–14 years divided into two age groups. The subjects made a countermovement jump on a dynamometric platform measuring strength, power, speed of rebound and the height obtained, after which they performed a flying run over a distance of 20 m.

Results: A strong, positive correlation was demonstrated between all dynamic and kinetic parameters of the jump and running speed. This correlation turned out to be clearly stronger in the older group of football players than in the younger group.

Conclusions: The obtained results suggest that strength and power are good predictors, such an important feature in football as the player's motion speed, already at the basic level of training.

Keywords: running speed, strength, power, young player

Introduction

Recently, there has been a significant shift in the initial phase of the training process towards an increasingly young age. Various types of schools and football academies involves children as young as 7 years old are becoming commonplace. Such an early start of sports training makes it important to ask whether the rules and relationships in the training of older players also apply to beginners and very young athletes. Particular interest was directed towards seeking parameters that would identify talented children in the earliest possible period of their lives.

It has been shown that among the many features a football player traits running speed is a good indicator of his later sports skills [1, 2]. Therefore, for a long time, indicators that may be predictors of achieving high running speed have been sought. There is agreement between researchers and practitioners that improving the strength and power of the player translates into improved speed (sprint) and the ability to quickly change direction (team games) [2–6]. Many practitioners use special strength and jumping programs to improve running speed. Most researchers agree, and empirical evidence confirms that strength and power are important for the development of running speed in mature competitors [7, 8]. However, in the case of young and youngest subject, the case is not so obvious and it is worth investigating.

* Adres do korespondencji/Address for correspondence: piotrkuczek@interia.pl

Materials and methods

Assumptions and research plan

The main purpose of the work was to demonstrate the existence of a correlation between running speed and selected vertical jump strength parameters in children undertaking football training.

All study participants underwent the same testing procedure that began with somatic measurements for all groups. After somatic examinations, each participant took part in the study of muscle power on the platform. Then, after at least an hour, the participants took part in a speed test. Before each test, participants warmed up according to their age and needs.

Participants

Participants are a group of boys participating in the initial sports training at a football club. They were divided into two groups. The younger group (8.1±1.36 years) consisted of 35 people and the older group (12.0±1.49 years) consisted of 28 people. Both groups performed the task on the same day and in the same conditions. The younger group attended training twice a week and the older group three times a week.

Somatic measurements

All participants were subjected to measurements including body weight, body height, and body fat content. Body weight and body fat content were tested with TANITA. BMI was calculated based on the measurements. The characteristics of research groups are below.

Motor measurements

To check the relationship of selected strength parameters and running speed, the distance jump test was carried out on a strain gauge platform (MVJ4v0). During the jump the following parameters were measured: maximum force during the jump, maximum power during the jump, maximum jump speed and jump height. The test was repeated three times and the best result was used for the analysis. Then a flying run was made over a distance of 20 m on artificial surfaces in neutral and windless weather conditions. During the run test, the time was measured with an accuracy of 0.01 s with the Microgate Witty Wireless Training Timer and the running speed in m/s was determined.

Statistical methods

Descriptive analyses, Shapiro-Wilk test, t-Student test for independent variables by group, U Mann-Whitney test, effect size and Spearman correlation analysis were performed using the Statistica 13.3 program.

Results

The results of motor tests showed that in each measurement the older group obtained higher results than the younger group. In all cases, the differences between the groups were statistically significant. This is not in doubt because the groups differed in age which had to translate into the results of the tests. The results are presented in the table below.

Table 1. Characteristics of the research group

Variable	Younger group n=35				Older group n=28				p	Effect size
	Śr	Min	Maks	SD	Śr	Min	Maks	SD		
Age [years]	8.07	6.01	9.94	1.36	12.03	10.15	14.89	1.49	>0,001*	-1,63
Body mass [kg]	30.85	19.00	70.90	10.39	47.93	28.30	90.20	13.71	>0,001*	-1,16
Body height [cm]	127.11	113.00	143.80	9.64	151.53	134.00	177.60	11.81	>0,001*	-1,51
BMI [kg/m^2]	18.25	14.10	33.76	3.78	20.31	15.33	32.30	3.63	0,004*	-0,53
Fat tissue [%]	22.10	12.70	49.30	7.83	20.34	10.60	48.30	8.31	0,290	0,21

*statistically significant differences

Table 2. Results of selected strength and speed tests

Variable	Younger group n=35				Older group n=28				p	Effect size
	Śr	Min	Maks	SD	Śr	Min	Maks	SD		
Speed [m/s]	5.18	3.96	6.08	0.56	6.01	4.62	7.97	0.80	>0,001*	-1,05
Fw_max [N]	692.20	391.00	1337.00	217.96	1056.39	720.00	1884.00	277.02	>0,001*	-1,19
Vw_max [m/s]	1.79	1.31	2.58	0.28	2.17	1.64	2.89	0.28	>0,001*	-1,15
Pw_max [W]	960.14	409.00	1753.00	366.21	1853.11	1120.00	3646.00	615.57	>0,001*	-1,34
Hw(v) [cm]	0.17	0.09	0.34	0.05	0.24	0.14	0.43	0.06	>0,001*	-1,16

*statistically significant differences

Correlation analysis showed a significant correlation between run speed and jump height and maximum rebound speed in the younger group. No significant correlation was found between running speed and strength and power generated during rebound. In this group, the speed significantly correlated with the percentage of body fat. The correlation in all these cases is moderate.

In the older group, the running speed significantly correlated with body fat, body height, maximum rebound speed, power and jump height. A particularly strong correlation occurred between the running speed and the speed obtained during the rebound, and between the running speed and the height obtained during the rebound.

Table 3. Correlation between speed and selected jump force parameters

Variable	Younger group		Older group	
	R	p	R	p
Body mass [kg]	0.12	0.502	0.21	0.284
Body height [cm]	0.32	0.060	0.40	0.037*
BMI [kg/m^2]	-0.24	0.155	-0.09	0.647
Fat tissue [%]	-0.35	0.037*	-0.43	0.021*
Fw_max [N]	0.27	0.116	0.30	0.120
Vw_max [m/s]	0.42	0.012*	0.82	>0.001*
Pw_max [W]	0.32	0.059	0.57	0.002*
Hw(v) [cm]	0.42	0.011*	0.82	>0.001*

*statistically significant correlations

The obtained results showed that there is a significant difference in the correlation of running speed and jump-force parameters depending on the age of the subjects. The older group showed a greater relationship of the examined features than the younger group.

Discussion

The main achievement of the work was to indicate that there is a relationship between the speed of the flat run and the dynamic parameters obtained during the vertical jump of the both feet in the youngest footballers. It turned out that this dependence largely depends on the age of the children studied. The largest occurs between the speed of the run and the height and final speed of the jump, but in older children this correlation is much stronger. However, the correlation between jump power and speed of running among older children is moderate and in younger children it is not statistically significant.

These results are important for sports practice. Researchers have long been looking for a proven and reliable source of information about the symptoms occurring in children and announcing success in adulthood. It is a common phenomenon to base the assessment of children's sports capabilities on the basis of anthropometric rather than physical and fitness features [9]. However, as Malina showed, this strategy does not work for a long period of time. The use of anthropometric traits as an indicator of sporting talent can especially prefer pubertal children to pre-pubertal children [10]. For example, Gil [11] showed that among young players from the same year of birth, players born in the first six months of a given year achieved better results. Therefore, according to Reilly's suggestion, parameters other than anthropometric should be used to select young players who can reach the championship level in the future [12, 13]. The best confirmation of the insignificant significance of using physical conditions as a predictor of later successes is the fact that although in this study speed correlated positively with the body height of the subjects, in the study of the elite of young footballers it correlates negatively with quite great strength p = 0.64 [9].

It would also be difficult to attach importance to the fairly significant negative correlation obtained in this work between the percentage of body fat and the speed of running. Although it does not raise any doubts, it is a small diagnostic value due to the large variability in body composition during ontogenetic development. In addition, children with a higher body fat content can run slower but not because they are slower but simply heavier and have to do more work [14].

So what, if not anthropometric conditions, can give the most reliable information on the problem of talent hidden in the body of a young person. A comparative analysis of the best players with average goals is helpful to show which features differ-

entiate these two groups in a special way. It turns out that the particularly important element is the players' aerobic capacity, which is completely neglected in the recruitment process. Top-class players have a higher VO2max, cover a greater distance during the match and perform more sprints [1]. Unfortunately, the application of measurements of aerobic fitness among the youngest is quite difficult. Children often get bored of long distance running, get tired and recover faster [15], and the use of advanced measuring technique at this stage would be expensive, laborious and unprofitable.

Therefore, it is right in practice to focus more on speed, strength and power as predictors of subsequent successes [16]. Many studies show a high or moderate correlation between these variables but among older subjects [17, 18]. The results presented in this work does not confirm this relationship among the youngest footballers. Strength did not significantly correlate with speed in any of the groups studied. It should be emphasized, however, that the maximum force was used in the research of Wisløff and Penalillo [17], and in this study the force generated during the jump was used. It is likely that such young subjects (10–12 years old) were not yet able to use their strength during the jump. Therefore, the question arises why the height of the jump positively correlated with the speed of the run. It seems that the young subjects achieved their jump power more of speed than of strength, and this is the only way to explain why the jump height correlated with running speed, but the force generated during the jump did not.

Conclusions

This result is of great importance for sports recruitment. Strength and power, especially the rebound speed obtained during the vertical rebound strongly correlate with the speed of the flat run, also for the youngest players. This means that during the recruitment and selection process for sport, coaches should include tests measuring the strength and power of the jump in their tests diagnosing the fitness of athlete candidates. Coaches should use both strength and speed parameters obtained during the jump because they are a good prognostic of later successes in the athlete's adult life. However, it should be remembered that the speed parameters have a higher diagnostic value than strength ones.

References

[1] Castagna C, Chamari K, Stolen T, Wisloff U. Physiology of soccer, An Update. *Sports med*. 2005;*35*(6):501–536.

[2] Triplett NT, Erickson TM, McBride JM. Power associations with running speed. *Strength & Conditioning Journal*. 2012;34(6):29–33.

[3] Cunningham DJ, West DJ, Owen NJ, et al. Strength and power predictors of sprinting performance in professional rugby players. *J Sports Med Phys Fitness*. 2013;53(2):105–11.

[4] Cronin JB, Hansen KT. Strength and power predictors of sports speed. *J Strength Cond Res*. 2005;19(2):349–357.

[5] Young WB, James R, Montgomery I. Is muscle power related to running speed with changes of direction? *J Sports Med Phys Fitness*. 2002;42(3):282–288.

[6] Brughelli M, Cronin J, Levin G, Chaouachi A. Understanding change of direction ability in sport. A Review of Resistance Training Studies. *Sports med*. 2008;8(12):1045–1063.

[7] Parchmann CJ, McBride JM. Relationship between functional movement screen and athletic performance. *J Strength Conditioning Res*. 2011;25(12):3378–3384.

[8] Dodd KD, Newans TJ. Talent identification for soccer: Physiological aspects. *JSAMS*. 2018;21(10):1073–1078.

[9] Wong PL, Chamari K, Dellal,A, Wisløff U. Relationship between anthropometric and physiological characteristics in youth soccer players. *J Strength Cond Res*. 2009;3(4):1204–1210.

[10] Malina RM, Eisenmann JC, Cumming SP, Ribeiro B, Aroso J. Maturity-associated variation in the growth and functional capacities of youth football (soccer) players 13–15 years. *Eur J Applied Physiology*. 2004;91(5–6):555–562.

[11] Gil SM, Gil J, Ruiz F, Irazusta A, Irazusta J. Physiological and anthropometric characteristics of young soccer players according to their playing position: relevance for the selection process. *J Strength Cond Res*. 2007;1(2):438–445.

[12] Reilly T, Williams AM, Nevill A, Franks A. A multidisciplinary approach to talent identification in soccer. *J sports sci*. 2000;18(9):695–702.

[13] Unnithan V, White J, Georgiou A, Iga J, Drust B. Talent identification in youth soccer. *J sports sci*. 2012;30(15):1719–1726.

[14] Brunet M, Chaput JP, Tremblay A. The association between low physical fitness and high body mass index or waist circumference is increasing with age in children: the 'Quebec en Forme'Project. *Int J Obes*. 2007;31(4):637–643.

[15] Ratel S, Duché P, Williams CA. Muscle fatigue during high-intensity exercise in children. *Sports Med*. 2006;36(12):1031–1065.

[16] Arnason A, Sigurdsson SB, Gudmundsson A, Holme I, Engebretsen L, Bahr R. Physical fitness, injuries, and team performance in soccer. *Medicine & Science in Sports & Exercise*. 2004;36(2):278–285.

[17] Wisløff U, Castagna C, Helgerud J, Jones R, Hoff J. Strong correlation of maximal squat strength with sprint performance and vertical jump height in elite soccer players. *BJSM*. 2004;38(3):285–288.

[18] Peñailillo L, Espíldora F, Jannas-Vela S, Mujika I, Zbinden-Foncea H. Muscle strength and speed performance in youth soccer players. *Journal of human kinetics*. 2016;0(1):203–210.

Streszczenie

Wprowadzenie: Od lat badacze i trenerzy szukają determinantów talentu sportowego u najmłodszych a także związku między poszczególnymi cechami motorycznymi, istotnymi w danych dyscyplinach sportowych. Istnieje fundamentalna zgoda w opinii, że siła i moc kończyn dolnych są skorelowane z prędkością biegu. Czy jednak korelacja ta występuje również u najmłodszych nie jest już tak jasne. Celem pracy jest wykazanie zależności pomiędzy siłą, mocą generowaną podczas wyskoku pionowego i osiągniętej wysokości a szybkością biegu płaskiego u najmłodszych piłkarzy nożnych.

Materiał i metody: Badaniami objęto 75 dzieci trenujących piłkę nożną w wieku 6–14 lat, podzielonych na dwie grupy wiekowe. Badani wykonali skok dosiężny na platformie dynamometrycznej, z pomiarem siły, mocy, prędkości odbicia i uzyskanej wysokości, po czym wykonali bieg lotny na dystansie 20 m.

Wyniki: Wykazano silną, dodatnią korelację między wszystkimi parametrami dynamicznymi i kinetycznymi skoku i prędkości biegu. Korelacja ta okazała się wyraźnie silniejsza w starszej grupie piłkarzy niż w młodszej grupie.

Wnioski: Uzyskane wyniki sugerują, że siła i moc są dobrymi predyktorami ważnej w piłce nożnej cechy, jaką jest prędkość ruchu zawodnika, już na podstawowym poziomie treningu.

Słowa kluczowe: szybkość biegu, siła moc, młodzi piłkarze