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Chronological Age and Soccer Specific Fitness Parameters

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Abstract

The ultimate of the study was to unveil how chronological age or maturity of soccer players relate affect linear sprinting speed, repeated sprinting ability (RSA), and change-of-direction-speed (CODS) performance. Competitive soccer players at the national league level participated in the study. A total of 88 field players who were volunteer and free from any kind of injury completed the study protocol. Age was calculated using their birth certificate and fitness performance was measured using specific test protocols for each fitness element. For credibility fitness test was done for weekly for about five consecutive weeks and the average was taken. Bivariate zero-order correlation, partial correlation and GLM analysis method were used. The bivariate correlation showed that sprinting speed, CODS and RSA best significantly correlate with age. However, RSA total time, RSA average and RSA worst do not correlate with age. Sheer speed significantly correlated with maturity, but other qualities which rely on aerobic fitness do no relate with age. Training age however correlates only with CODS. The bottom line is that speed and speed related performance is dependent on maturity and genetic make and they are trainable qualities.

Keywords: *Age; Maturity; Speed; Repeated Sprinting Ability; Fitness*

Introduction

Performance improvement in soccer is the prime goal sought by coaches, players, and others around soccer clubs or teams [1,2]. The realization of a peak performance and the sacrifice for its maintenance is the ultimate underlying reason for coaches and players to work hard in today`s soccer [3]. This is most needed for winning or success, because now a day`s success and winning in soccer are a matter of big business. Though there is a greater emphasis placed on winning, soccer as a sport is too demanding [4,5]. Barnes., *et al.* [4] indicated that the game is becoming more demanding in terms of high-intensity running distance, number of high intensity actions, sprint distance and number of sprints. Also, it is demanding physically requiring not only simple sprinting speed, endurance or strength, but also speed in different distances from 5m to 60m of 40 - 60 sprints with a short recovery in between [6,7]. It is becoming more demanding in terms of technical proficiency [5] that requires the most difficult skills [8,9]. Most importantly soccer requires the execution of technical skills explosively or at high tempo [10].

It is showed that technical-tactical ability is the distinguishing factor of successful teams from unsuccessful teams [5,11], but without fitness it deteriorates [10,12,13]. This highlights the necessity of specific fitness development and maintenance in soccer. When fitness decays, technical-tactical proficiency and psychological vitality can be flooded away. This invaluable role of fitness for soccer success elicited teams to have a fitness coach, a nutritionist, strength and conditioning specialist, and a physiotherapist. Even those world class players pay a due regard to their soccer specific fitness. Therefore, competing at high level soccer demands players to have well developed physical qualities which can enable them to shine and utilize their technical-tactical qualities that the game demands. For example, strength, speed, and repeated sprinting ability (RSA) are important fitness components to combat and win the limited ball contacts encountered during match play [11,14]. All these signify the critical value of speed and speed related fitness in soccer.

Soccer is known to its specific fitness requirements. For example, agility, acceleration, deceleration, speed and RSA are considered as critical components of soccer. For this, soccer is an intermittent sport with numerous short, explosive, high intensity bouts as sprinting, change of direction and jumping interspersed with short recovery periods over 90 minutes [5,6]. This is because that during matches players are expected to accelerate, decelerate, sprint and change direction throughout the game [12,15,16]. Moreover, time-motion analysis indicated that short distance sprint occurs more frequently during soccer matches [5,7,12,17]. Players perform 150 - 250 intense anaerobic actions during a game [6,18]. The capacity of soccer players to produce varied high-speed actions can greatly impact match performance. Although high-speed actions (anaerobic activities) account only approximately 11% of the total distance covered in a match (Bangsbo and Krustrup, 2009), they constitute the most crucial moments of the game, that is, mainly the difference between losing or winning ball possession, scoring or missing, saving or clearing and conceding goal [12]. For example, linear or straight sprinting is the most common high-speed action before those crucial moments during games [12]. Therefore, it is too logical to invest a lot or to study this segment of soccer fitness (i.e. sprinting speed and RSA), from different perspective.

Generally, those fitness parameters as speed, change-of-direction-speed and repeated sprinting ability (RSA) are the most important fitness qualities that modern soccer players expected to have. A lot of training protocols to improve and maintain these qualities are devised. For example, short term protocols of both complex (OCD plus plyometric) training protocol and isolated COD protocol are important to have meaningful improvements in speed parameters of soccer players [19,20]. However, being in the same culture (football training and style) and being in the same squad players do not have the same level of performance in these specific qualities. Also, the response they show for the same training season or protocol is not affecting the same level. Therefore, the performances of soccer players in this regard need to be accounted for some other factors as maturity or age. This study, as a result came across with the relationship of age with these qualities and how maturity determines speed and speed related performance of soccer players.

Objective of the Study

The main objectives of the study were to:

- Identify how chronological age and training age relates linear sprinting speed performance in soccer,
- Reveal the relationship of maturity with change-of-direction speed (CODS),
- Unveil the relationship of age with RSA parameters.

Method

The study used a correlational design so as to disclose the relationship of age or maturity with speed, CODS, and RSA performance. A total of 88 outfield soccer players from five randomly selected teams participated in the study. 5 teams were selected randomly from 11 teams who were participating or competing in the national league. This league is the third league level in the nation next to the premier league and super league. The data regarding fitness performance was collected using valid and specific test protocols.

For measuring linear sprinting speed, 40-m linear sprinting was measured. Three trails for each player were given and the best score was taken for analysis (i.e. 7 - 9 minutes with standing passing as an active recovery between trials). For CODS, Concerning which agility tests are the most valid for the planned agility of soccer players, Sporis., *et al.* [21] found that, sprint 9-3-6-3-9 m with backward and forward running (SBF) is among the most valid and reliable tests (i.e. $\alpha = 0.949$). As a result, this test has been used in this research to measure planned agility performance of the players. The distance the player has to cover was 24m with forward sprinting and 6m with backward running. Most sprints in soccer game are linear but. The test that I have selected to use better goes in parallel with this fact that the actions do not involve 90- or 180-degree sharp turn.

RSA performance was measured using the 35m*6 test protocol. Cones have been set out at the end of a 35-meter running lane. Two testers were involved, as one person was required to time the 25 second recovery period. The player stands at one end of the 35m lane and starts a maximal sprint on the command "go". Players were encouraged verbally to enable them produce maximum sprint through the distance. Then, after 25 seconds of recovery the next sprint starts from the opposite end of the 35m lane. The sprint repeated the same way until 6 sprints were completed. Previous researches showed that, this test can be used as a valid and reliable method [22]. Furthermore, a recent study has also confirmed that running based anaerobic test (RAST) is a valid and reliable measure [23]. In relation with its validity, the nature of soccer is related to the test protocol and this alone can make the test relevant. This is because that a good sport specific test should be derived from logical reasoning, based on game analysis 24[].

These tests were conducted for about five consecutive weeks and the averaged value has been taken for analysis. This was done to insure a more reliable data about the players' performance. The analysis was done using bivariate correlation, partial correlation and general linear model (GLM).

Result and Discussion

Basic information regarding the age, training age and bodily measurements is provided here under (Table 1). They were 22.25 ± 2.27 years old with a training age of 9.30 ± 2.78 year's soccer training. They weighted 63.78 ± 5.33 kg with a height of 172.91cm tall.

	N	Minimum	Maximum	Mean	Std. Deviation
Age	88	18.00	30.00	22.2500	2.27050
Training Age	88	4.00	18.00	9.3864	2.78102
Weight	88	52.00	74.50	63.7830	5.33171
Height	88	150.00	185.00	172.9091	6.28744
Valid N (listwise)	88				

Table 1: *Basic demographic information of the participants*

Training age, which was measured in the number of years the players, participated in structured soccer training and physical fitness has been examined to reveal about how they relate. Fitness was assessed using those specific parameters as linear sprinting speed measured over 40-m dash, CODS (9-3-6-3-9) and RSA as measured with 35-m*6 test protocol.

		Speed	CODS	RSA Total Time	RSA Average	RSA Best	RSA Worst
Training Age	Pearson Correlation	-.188	-.230*	-.135	-.130	-.120	-.118
	Sig. (2-tailed)	.080	.031	.208	.228	.265	.274
	N	88	88	88	88	88	88

Table 2: *The relationship of training age with fitness.*

Training age does not have a significant relationship with linear sprinting speed or RSA performance of the players. What is basic physiological knowledge remind is that speed more rely on somatotype (muscle fiber). Those with a fast twitch muscle fiber are the one innate for speed. Thus, speed can be seen as a fitness quality which is training resistant. The effect of training may not be as significant as heredity. But CODS has showed a statistically significant positive relationship with training age/years r (88) = -.208, p = .031. Here the relationship tells us that a unit change in training year can result 0.208 second reduction in the 9-3-6-3-9 CODS test. Going in parallel, Nerga., *et al*. [20] showed that specific kind of training can result a significant improvement in CODS. The perception and decision element present here with CODS can be impacted by training, though the speed element may not be impacted. CODS do not involve sheer speed, instead it demands on perceiving the space and controlling ones movement to change direction.

The selected soccer specific fitness parameters were assessed about how they correlate with maturity level of the players. A zero-order correlation test was used to identify how significantly age or maturity is related with soccer specific fitness.

		Speed	CODS	RSA Total Time	RSA Average	RSA Best	RSA Worst
Age	Pearson Correlation	-.254*	-.216*	-.208	-.206	-.235*	-.176
	Sig. (2-tailed)	.017	.043	.052	.055	.028	.100
	N	88	88	88	88	88	88

Table 3: *The relationship between chronological age.*

Linear sprinting speed significantly correlated with chronological age of the players r (88) = -.254, p = .017. As players get matured improved sprinting speed is expected to increase. Basically, maturity is associated with quality differentiation. Most importantly, with men's maturity can result hypertrophy and more testosterone production which can impact strength. Still the significant correlation between age and RSA best (r (88) = -.235, p < .028), is an indicator that maturity related changes can heavily impact speed. Here the relationship of age with RSA average, RSA total and RSA worst time is an indicator that maturity impacts strength or speed mainly no other qualities which rely on aerobic fitness or slow twitch muscle fiber (RSA average, RSA total and RSA worst relies on aerobic quality or the ability to recover between consecutive runs. The same way, maturity is significantly related with CODS (r (88) = -.216, p = .043). Recent findings on the matter came across with similar findings. For example, speed and CODS were found to be better with more matured players [25]. Moreover, U23 players were found to be significantly faster than U16 players in 20-m linear sprinting speed (2.09 versus 2.98 seconds, p=0.02; ES=0.94) (Bishop, Brashil, Abbot, Read, Lake and Turner, 2019). Still other recent finding witnessed that repeated-sprint sets (RSS) improve with maturation in young soccer players [26,27].

Though, the zero-order correlation showed the relationship of age with neuromuscular fitness without considering the moderating effect the variables on the relationship nature, partial correlation was used to examine how each variable affects the relationship of age with specific fitness.

		Speed	CODS	RSA Total Time	RSA Average	RSA Best	RSA Worst
Age	Correlation	-.167	.033	.092	-.108	.060	.100
	Significance (2-tailed)	.132	.769	.408	.331	.591	.368
	df	81	81	81	81	81	81

Table 4: *The partial correlation between chronological age and fitness.*

The fitness elements as speed, CODS and RSA are highly related. Here the partial correlation result indicated that the nature of the relationship between maturity and each fitness qualities was highly affected or moderated by each other. For this reason, the significant relationship found in the zero order correlation (Table 3) is not found in the partial correlation test (Table 4).

Using GLM, the overall regression model was found significant F (1, 86) = 5.93, p=.017. From this analysis it was found that 6.5% of the variance in linear sprinting speed can be explained by maturity. 80-90% by heredity and the remaining by age and remaining may be due

Dependent Variable: Speed						
Source	**B**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model		1	.657	5.930	.017	.065
Intercept	6.529	1	38.221	344.854	.000	.800
Age	-.038	1	.657	5.930	.017	.065
Error		86	.111			
Total		88				
Corrected Total		87				
a. R Squared = .065 (Adjusted R Squared = .054)						

Table 5: *The GLM of speed from age.*

to training and nutrition. The coefficient revealed that a year increment in age can result a 0.038 seconds reduction in the time to taken to cover the 40-m dash. This amount of time change in 40-m sprinting is not negligible as a performance factor. Sprinting speed is mostly left to genetic make-up, meaning that it is not such a trainable attribute. As a result, the obtained capacity of age to explain speed is convincing and significant. The model can be summed up as follows:

Speed= 6.529-0.038 (Age) or Y= 6.529-0.038 (X1).

The prediction capacity of chronological age or maturity to CODS performance of soccer players has been tested using GLM.

Dependent Variable: CODS						
Source	**B**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model		1	4.336	4.227	.043	.047
Intercept	12.133	1	132.009	128.710	.000	.599
Age	-.098	1	4.336	4.227	.043	.047
Error		86	1.026			
Total		88				
Corrected Total		87				
a. R Squared = .047 (Adjusted R Squared = .036)						

Table 6: *GLM CODS from age.*

The overall regression model to predict CODS from age is significant $F(1, 86) = 4.227$, $p < .001$. Maturity level was found to account 4.7% of the variance in 9-3-6-3-9 CODS performance. This means that a unit change (increment) in age can cause a 0.098 seconds reduction in the time to cover the test. This magnitude effect of maturation on change-of-direction-speed performance is not negligible. This kind of fitness has such a positive relationship with linear sprinting speed, meaning that it is training resistant quality. On the other side, the effect maturation, which accompanies differentiation in muscle quality is expected to cause performance change CODS.

To examine how age of the players predict RSA performance, the best time of RSA scores (i.e., the best (minimum value among the 6 consecutive sprints) has been taken. GLM was used to test the prediction capacity. This is because that age does not have significant relationship RSA total time, RSA average time or RSA worst time. There was only a significant relationship between age and RSA best time.

Dependent Variable: RSA Best						
Source	**B**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model		1	.397	5.012	.028	.055
Intercept	5.679	1	28.922	365.416	.000	.809
Age	-.030	1	.397	5.012	.028	.055
Error		86	.079			
Total		88				
Corrected Total		87				
a. R Squared = .055 (Adjusted R Squared = .044)						

Table 7: *GLM of RSA best from chronological age.*

The overall regression model was significant F (1, 86) = 5.01, p = .028, R squared = .055. The coefficient of age is significant, meaning that a unit change in age can cause a 0.30 second change or reduction. The effect of age is higher with that of RSA best time as it is highly dependent on sprinting quality. As players get matured and strong because of indigenous hormone testosterone, they are likely to be good in sprinting and RSA best. The study was done with only male soccer players the effect of maturity or testosterone can immensely matter speed and speed or strength related performance. However, those measures as RSA total time, RSA average time and RSA worst time can rely on other training related qualities like aerobic fitness or lactate threshold. The ability to get rid of lactate which is inherent to anaerobic glycolysis during repeated sprinting, can greatly impact these performance parameters of RSA.

Conclusion

When maturation comes quality differentiation and performance or fitness increments are highly expected. What this study came across is that players with the higher age tend to perform better when fitness is examined. Linear sprinting speed, CODS and RSA best are physical qualities which are dependent on the age level of the players.

When we evaluate players performance in relation to speed we need to acknowledge and consider the effect of maturity on performance. Therefore, during talent identification, we ought to know that regardless of size less matured or even late matured players may be less advantageous.

Other researchers need to focus on the how specific effect of speed or speed related training regimens effect is affected by maturity level. How the effect of these training protocols is moderated by maturity level. For better elucidating the matter, the question of at which age or maturity level does speed and speed related trainings produce the best possible outcome is worthy of scientific investigation.

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