ORIGINAL ARTICLE

The different influence of speed, agility and aerobic capacity toward soccer skills of youth player

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Abstract

Background and Study Aim: The significant influence of speed, agility and aerobic fitness on youth soccer performance is described by current football literature. The sensitive phases of age development of students have been stated to have a different influence compared to professional players. The purpose of this study was to determine the contribution of speed, agility and aerobic fitness on soccer skills to the Student Activity Units (UKM) of Football.

Material and Methods: The method used in the correlation research study is a descriptive-quantitative with a cross-sectional approach. The population study was all 35 members of UKM football players and the sample was selected through purposive methods sampling. Furthermore, the instruments to be applied are (1) speed with 30 meters sprint test; (2) agility through a 5-meters shuttle run; (3) aerobic endurance by using the 20m Beep-test protocol; (4) soccer skill using David Lee's test. The SPSS 28 program was used for the statistical operations in the analytical data technique, followed by prerequisite analysis tests, namely the normality test and homogeneity test, as well as a hypothesis test to confirm the hypothesis.

Results: The result shows that there is a correlation in positive values between both the independent and dependent variables. Statistical analysis confirms that there is a correlation and positive impact of speed, agility and aerobic capacity of football skills. Significant differences in correlations were found in the speed, agility and aerobic capacity of the participants ($p < 0.05$).

Conclusions: Physical activity based on the anaerobic system has a positive effect on individual skills. In contrast, aerobic capacity plays a role more in the complex skills of football games in real situations.

Keywords: football skills, speed, agility, aerobic fitness

Introduction

Sports achievement can be achieved optimally if fulfills several supporting component requirements such as athletes talent, coaches, training programs that are managed with well-structured training management [1]. Other influenced technical factors such as training infrastructure and the welfare needs of coaches and athletes must also be considered by sports management. The current study also strengthens the psychological condition [2], the condition of the athlete's physiology, regeneration, body constitution [3], and the ability in skill, tactic, and strategy [4] as defining components are also needed to consider. An athlete's performance on the soccer field is commonly influenced by physical, technical, tactical, and psychological factors [5]. However, current strength and conditioning journals reported that bio-motoric ability plays a more significant role in support to perform as individuals and in teams [6, 7].

Bio-motor ability is an ability coming from the acclamation of exercise results, an exercise arranged based on the program made by coaches and a sports club [8]. Every athletes have a different characteristic level of bio-motor ability, therefore, a trainer should arrange an appropriate exercise program thoroughly to reach the exercise program itself [9]. It is required a program designed with individualism responses since everyone has an own level of bio-motor ability and different impact to the sport ability [8, 9, 10].

Different types of sports games have a dominant bio-motor difference applied including football [11]. Football is the most popular game sport by the community, played by 2 teams with a duration of 2x45 minutes and 2x15 minutes of extra time, carried out with high intensity with an intermittent stop and go nature so that it requires speed, skill, and endurance to play for 90 minutes [12, 13].

The recently applied journal has stated that the bio-motor abilities in soccer were dominated by speed, agility and aerobic capacity [14]. Football players are required to have good physical fitness to move from attacking to defending positions, shooting, dribbling, passing, heading and running

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around the field with a total distance of 10-12 km in each match [15]. The speed ability is required since an athlete needs to be active moving for dribbling, passing, attacking, and running around the field in a short time speed [16]. In the interrelation principles, speed in movement is also required to be able to produce power for kicking, jumping, and heading in combination with other bio-motoric components [14, 16, 17]. Another statement shows that agility has close interrelation between speed, coordination and flexibility [18]. Football, which is played on a large field, requires complex movement. In a sport where the direction of the coming and going ball is irregular, the movement ability in controlling, running to get a ball, jumping, making a sudden stop, or avoiding the opponent is required [19].

Agility is known as a body's movement ability to accelerate position into a one-way direction [20], accelerate a movement into opposite various positions at high velocity [21], and change a movement into multi-direction promptly in the good body mechanical position [22]. It shows that a football player needs the elements of agility as well as it can give some benefits for teams to make them able to perform an optimal pattern of attack and defense. Seems agility is an essential bio-motor aspect in football since the movements of football are performed in a fast way and in a short time execution [23], therefore agility is required to keep and maintain the ball possession from an opponent [24].

Aerobic endurance is a dominant aspect needed in every sport that requires a long time both in a match and competition including football [25]. Aerobic capacity is most crucial for sports games that need require high physical activities to be able to perform at a good level in long time duration and recover faster without any issues in physical fatigue [26]. The importance of aerobics capacity in soccer is also confirmed in a study that discusses the method to maintain good aerobic capacities in soccer and to provide proper recovery management to deal with the regeneration issues in soccer recently [3].

Football is a very popular sport among various levels of people starting from kids, and teenagers, to adult communities [27]. It was a common sports game played in every urban and rural area since it is friendly to play, has an understandable rule, and could be played in every ordinary facility for recreational purposes, or in good infrastructure for professional aims [28]. The pattern of coaching Indonesian football starts from the scope of youth clubs through *PPLP-D* or clubs handled by professional management [29]. This coaching is carried out on an ongoing basis with the aim of monitoring reliable young footballers in Indonesia who are able to carve football achievements in the international arena. However, the success ratio of senior athletes who have reliable football achievements compared to the population of Indonesia is still far below the standard. Indonesia has a very minimal number of elite athletes, despite having a large number of clubs with a huge population of more than 267 million. Sports management studies explain that in order to achieve maximum performance, good cooperation between coaches and management needs to be implemented in the planning and preparation of short, medium and long term training instruments [30]. The average PPLPD athlete already has a chronological age phase and an optimal training age so that they can be given training that is oriented towards increasing the volume and intensity of exercise progressively to see the adaptability and response to training of each athlete [31].

However, the lack of monitoring of the exercise schedule, rest time, becomes an obstacle to determine the progress of the exercise, so that the results of the exercise have not been well informed. As a result, the determination of the expected peak performance at the time of the competition has not been achieved, due to the lack of regular reports regarding the effect of given training on improving the performance of each training cycles [32]. Several general parameter tests have been carried out but have not provided a clear description of the relationship between parameter tests and soccer performance. In this case, measurements related to aspects of the dominant bio-motor components in soccer including speed, agility, and endurance on soccer performance need to be carried out [33]. Although several studies have shown that biomotor speed, agility and endurance can affect the level of soccer performance at the elite level, other strength and conditioning studies explain that in adolescence the elements of basic skills and techniques are prioritized. In addition, it is very important to know the choice of exercise priority between physical or technique that must be prioritized for PPLPD athletes to be able to provide an overview to the coach about how the relationship between speed, agility, and aerobic endurance affects the development of soccer skills. Thus, the purpose of this study is to determine the biomotor profile of speed, agility, endurance and soccer skills, it will also measure the relationship between each of these variables to the soccer skills of each athlete to be used as material for evaluating training programs, either individually or team

Materials and Methods

Participants

This research was conducted at Yogyakarta State University (UNY) which is located at Jalan Colombo No. 1 Yogyakarta. The study was carried out on August 27th to October 23rd, 2021. The population taken in this study were all students who were members of the University Soccer Club

(USC) at UNY, while the sampling technique used purposive sampling which was carried out by taking subjects based on age aspect screening, weight, gender, physical condition, health profile and soccer skills. The use of purposive sampling is used by considering reliable sampling based on information obtained quantitatively, to strengthen the required data. This experimental study used a correlation method with the descriptive-quantitative with cross-sectional approach [34] involving 35 male athletes (aged 18.33±1.31, BMI 21.34±1.49, RHR 71.4±6.7bpm, Lactate 2.34±0.52mmol/l), selected through inclusion and exclusion criteria and were prepared for national student competition [35]. The study begins with signing an informed consent in accordance with university policy and approved by the University Research Ethics (Approval Number KE/FK/1012/EC/2021).

Research Design

The variable of this research consists of two independent variables and one dependent variable. The independent variables are the speed (X_1), agility (X_2), and aerobic capacity (X_3). The dependent variable in this research is the result of football skill testing. The design of the study is to examine the relationship strength among two or more events or traits or to describe the relation between the independent variable such as speed (X_1), agility (X_2), and aerobic capacity (X_3) to and the dependent variable of soccer skills (Y). The test begins with examination of samples by doctors and physical trainers to check health status, physiological including the absence of cardiovascular complaints, followed by measurement of height and weight. The speed ability was carried out using a 30m straight sprint test on a running track with a standing start [36] using a sensor-based digital measuring instrument, and the agility tests were carried out using the 10m shuttle test protocol [37]. The aerobic endurance test was carried out using the 20m beep-test [38], and the soccer skill test was carried out using the David Lee Soccer skills protocol with a validity of 0.73 and a reliability of 0.8 [39].

Statistical Analysis.

The data analysis technique used prerequisite test, normality test, linearity test, correlation test, and homogeneity test, and hypothesis testing was used with SPSS 28.

Results

The initial data collecting was started with several aspects including Ages, Body mass index (BMI), Resting Heart Rate (RHR) and Basal Lactate Level to confirm whether samples are in normal status. The description of mentioned data will be displayed as follows.

The result (table 1) shows that mostly participants have a productive age group (18.33±1.31 yr.), having a normal level of Health Status as shown in BMI (21.34±1.49kg/m^2), without having issues with fatigue condition as described in Resting Heart Rate (71.4±6.7 bpm) and Lactate Profile (2.34±0.52 mmol/l). This explanation can be interpreted that the sample is assumed to have relatively the same condition in terms of age, health and fitness so that it is believed not to have a high bias value. Another simultaneous quantitative measurement to show the characteristics of speed, agility, aerobic and soccer skills experienced conducted after pre-requisite check and describes as below (table 2).

Table 1. The characteristic of Ages, BMI, Pulse rate and Lactate

Variables	N	Mean+Std. Deviation	Std. Error
Ages (years)	35	18.33±1.31	19.5
BMI (kg/m^2)	35	21.34±1.49	59.4
Resting Heart Rate (pulse/minute)	35	71.4±6.7	21.2
Lactate (mmol/l)	35	2.34±0.52	33.8

Table 2. Descriptive Statistics

Variables (n=35)	N	Percentage (%)	Mean+Std. Error
High Speed (<3.8)	6	17.1	
Moderate Speed (4.1–5.4)	22	62.9	4.75 ± 1.32
Low Speed (>5.4)	7	20.0	
High Agility (>5.1)	19	54.3	
Moderate Agility (6.5–7.5)	13	37.1	6.12 ± 1.96
Low Agility (> 7.5)	3	8.6	
High Aerobic (>11)	7	20.0	
Moderate Aerobic (7 – 9)	24	68.6	8.27 ± 2.76
Low Aerobic (<5)	4	11.4	

From the conclusion above (table 2), it can be seen that in the speed category, more than half of the samples showed in moderate level, which was shown at 62% with an average running speed of 4.75 seconds in 30 meters, another 17% had a high level of speed with an average time below 3.8 seconds, and the remaining 20% are only able to run with a time above 5.4 seconds so that it is included in the low category. For the speed ability, it can be concluded that the average sample has a moderate level of speed, indicated by 4.75 ± 1.32. at the agility aspect, the data above shows that the majority of the sample has high agility as much as 54.3%, while 37.1% of the sample has sufficient agility and 8.6% is found to have poor agility. It can be concluded that the average sample has good agility with an average value of 6.12 ± 1.96. On the aspect of aerobic endurance, only 20% of the samples showed high aerobic endurance abilities, while the majority of samples were only at a moderate level with 68.6% and the remaining 11.4% were shown to have low aerobic endurance abilities. Overall, it can be concluded that the sample has moderate aerobic endurance with an average score of 8.27 ± 2.76.

The further step taken after descriptive is conducting the analysis prerequisite testing of which the data is examined through 3 stages, namely normality, homogeneity, and hypothesis testing. The following is the explanation of the testing in detail.

The Normality Test

The normality test is used to determine whether the dependent variable, independent variable, or both variables are normally distributed or close to normal [40]. According to Samantha [41], the implementation of the normality test can use the Kolmogorov-Smirnov test, with applicable criteria where a significant result > 0.05 means that the residuals are normally distributed. The following are the results of the normality test on the research variables carried out.

Based on these results (table 3), it can be seen that the significance value shows the number 0.998 which can be concluded that the variables in this study are normally distributed both as independent variables and dependent variables.

The Homogeneity Test

The homogeneity test is a test to find out whether the distribution of two or more variances has similarities. The homogeneity test that will be used in this study is the homogeneity test of variance and the Bartlett test. A homogeneity test was conducted to find out whether the data on variable X and variable Y was homogeneous. The homogeneity test can be stated that the research population has homogeneity or is similar if the significance value obtained is <0.05. The results of the homogeneity test can be seen in the several table (table 4, 5, 6) below.

The results of the homogeneity test can be seen (table 4) that the significance value of the speed variable is 0.033, while the agility variable indicates 0.002 (table 5) and the homogeneity value of aerobic endurance variable shows a significance value of 0.002 at table 6. Based on these results, it can be concluded that all research variables have a homogeneity as evidenced by a significance value below p<0.05

The Linearity Test

The linearity test can be used to determine

Table 3. Normality Test's Result

Variables	Speed test	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Football skill	42.00	.260	2	.			
	399.00	.260	2	.			
	405.00	.260	2	.			
	419.00	.260	2	.			
	428.00	.260	2	.			
	446.00	.217	3	.	.988	3	.791
	462.00	.260	2	.			
	467.00	.260	2	.			

Table 4. The Speed towards the Football Skills

Variables		Levene Statistic	df1	df2	Sig.
Football skills	Based on Mean	3.825	7	9	.033
	Based on Median	2.563	7	9	.095
	Based on Median and with adjusted df	2.563	7	2.000	.309
	Based on trimmed mean	3.743	7	9	.035

Table 5. The Agility towards the Football Skills

Variables		Levene Statistic	df1	df2	Sig.
Football skills	Based on Mean	8.128	7	10	.002
	Based on Median	1.591	7	10	.244
	Based on Median and with adjusted df	1.591	7	3.187	.372
	Based on trimmed mean	7.135	7	10	.003

Table 6. The Endurance towards the Football Skills

Variables		Levene Statistic	df1	df2	Sig.
Football skills	Based on Mean	8.128	7	10	.002
	Based on Median	1.591	7	10	.244
	Based on Median and with adjusted df	1.591	7	3.187	.372
	Based on trimmed mean	7.135	7	10	.003

Table 7. The Linearity Test's Result

ANOVA[a]					
Model	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Regression	2947561.512	3	982520.504	.427	.735[b]
Residual	71320260.374	31	2300653.560		
Total	74267821.886	34			

a = Dependent Variable: football skill; b = Predictors: (Constant), aerobic endurance test, agility test, speed test.

whether the independent variable has a significant linear relationship with the dependent variable [41]. The linearity criteria can be conducted through the test of linearity. Linearity criteria can be done through linearity test. The criterion that applies is that only if the significance value is > 0.05, it means that there is a linear relationship between the independent variable and the dependent variable. The following are the results of the linearity test.

Based on the linearity value above (Table 7), it can be seen that the significant value shown is 0.427. Thus, it can be concluded that both the independent variable and the dependent variable in this study have a significant relationship where the three independent variables affect the dependent variable.

The Correlation Test

The Correlation test is a test used to determine the level of closeness of the relationship between the three independent variables with one dependent variable with a value of 0 (zero) to 1 (one) [42] . If the significance value (r) is close to the number 1 (one), it can be stated that the variable has a close relationship and vice versa. The results of the correlation test can be seen in the table below.

Based on the results above (table 8), it can be seen that the correlation value between speed and soccer skills shows a significant number of -0.143, which implies that the speed variable has a small degree of relationship in the opposite direction. This means that every increase in the ability of soccer skills will affect a decrease in speed with small relationship strength. The correlation value between agility and soccer skills shows a significant number of 0.034, which means that the speed variable has a small relationship with a positive direction. This means that every increase in agility ability will also affect the improvement of soccer skills with small relationship strength. Meanwhile, the correlation value between aerobic endurance and soccer skills shows a significant value of 0.130, which means that speed has a small relationship with a positive direction. This means that every increase in aerobic endurance will have an effect on improving soccer skills on a small scale of relationship strength. It can be concluded that speed, agility and aerobic endurance are shown to have a low correlation with soccer skills.

Discussion

The quality of speed in soccer is influenced by the quality of exercise, rest, healthy lifestyle, and environmental and genetic factors that affect the type of muscle fibers possessed [43]. Several studies explain that fast-twitch muscle types are able to provide greater and stronger force quickly, however, have a shorter duration of contraction, and are exhausted quickly because they have less blood supply, so they are classified as anaerobic contractions [44]. On the other hand, slow-twitch muscle types have more mitochondria and myoglobin and are aerobic than fast-twitch fibers, hence more resistant to fatigue, on the smaller sustained contractions [45]. In soccer, the basic need for speed is needed in

Table 8. The Correlation Test's Result

Variables	The Correlation Test	Speed	Agility	Aerobic Endurance	Football Skill
Speed test	Pearson Correlation	1	-.139	.062	-.143
	Sig. (2-tailed)		.426	.722	.413
	N	35	35	35	35
Agility test	Pearson Correlation	-.139	1	.051	.034
	Sig. (2-tailed)	.426		.769	.848
	N	35	35	35	35
Aerobic	Pearson Correlation	.062	.051	1	.130
	Sig. (2-tailed)	.722	.769		.458
	N	35	35	35	35
Soccer skill	Pearson Correlation	-.143	.034	.130	1
	Sig. (2-tailed)	.413	.848	.458	
	N	35	35	35	35

almost all aspects of basic soccer movements such as running for the ball, dribbling, receiving the ball, kicking the ball, and other explosive movements [46]. Speed is an adaptation of strength training, so strength is an important aspect that supports speed in performing some basic soccer techniques [47]. This is explained by studies that explain the determination of anaerobic speed in addition to being determined by the type of muscle fiber, nerve-muscle coordination, and biomechanical aspects, the contribution of muscle contraction strength has a significant influence on the speed produced [48]. Another study also added that regular muscle strength training with the method of concentric and eccentric contraction types had the effect of increasing optimal sprint speed [49]. It can be concluded that the element of strength is a crucial aspect in the development of speed aspect, so the element of weight training related to increasing speed must be given in an orderly, planned, and measurable manner to soccer players.

Another physical demand in soccer is the ability to move quickly, and change movements in various directions accompanied by good ball control coordination, which is also the main demand to be able to play ball optimally [50]. This statement is strengthened by another study of games analysis, which explains that having good speed skills will have a high correlation with the demands of agility in playing soccer [51]. Agility is a combination of some physical elements such as the element of strength, speed, and flexibility. The element of strength is required in the early process of body movement when supporting or rejecting legs. The element of speed is required to move fast from one point to another. Meanwhile, the element of flexibility is needed to bend or move body parts leading to the next movement [52]. Motor agility must be possessed to be able to move from one place to another in a very short time. This statement was confirming that agility is related to speed and flexibility, which is also confirmed another study also confirmed that the factors that affect agility are reaction speed, motor coordination, balance control, and joint flexibility [53]. In this case, it can be concluded that strength can be transformed into an element of speed, where speed will produce agility if it is equipped with motor coordination and flexibility in basic sports movements. On the other hand, the quality of speed-running is explained to be influenced by leg length and stride length, which is the product of the multiplication of stride length and frequency per the second step [54]. In this case, students who have heredity aspects related to long leg length are assumed to have the main modality of factors that can produce optimal stride length. However, the results of the biomechanics study explain that the relationship of leg length is not always positively correlated with running speed. It is associated that the resulting stride length, proved to be significantly affected by the propulsion force of the foot in the contact phase with the ground, which was carried out with a time of less than 200ms/step [55]. The conclusion obtained is that the anthropometric profile of students related to leg length contributes positively to speed-running, as long as accompanied by aspects of strength to produce optimal foot propulsion in a short time. The correlation of agility to basic skills in football in the technique of passing, dribbling, and shooting in a team, is explained to have a significant influence so the inter-relationship of agility training with skills packaged through the defense and attack patterns needs to be given comprehensively [56]. The results of the study that explain the correlation value of agility to soccer skills on a small scale in this study are believed to be because it only involves the agility aspect. So, in its development, it is necessary to do

calculations involving more variables to see the correlation more significantly. In addition, another conclusion obtained is that to improve soccer skills, agility training needs to be given through a comprehensive form of motor coordination training involving other bio-motor aspects, which are packaged with specific game methods.

However, previous study provides another controversial opinion that explains since winger attack, full-backs and playmakers position have to repeatedly run across the field for a long time, and perform rapid sprints to control the ball, which requires sufficient endurance ability, hence the dominance of the slow-twitch fiber type has also been shown to have a significant effect [43, 44, 45, 57]. This is explained in previous studies that excellent physical endurance will have a positive effect on increasing blood circulation and the ability of the heart to work, increasing strength, flexibility, endurance, coordination, balance, speed, and body agility [58]. In addition, it will also have an effect on increasing the ability to move efficiently and increasing the ability of the body's organs after exercise as well as increasing the body's response ability [7].

Sports physiology studies explain that anaerobic endurance is needed in soccer to meet energy needs through converting glycogen into an energy source without the help of oxygen which is correlated with maximum contraction speed using anaerobic energy sources [23].

However, aerobic endurance in soccer is also needed to be able to supply oxygen optimally in its need to break down fatigue and get a good speed of fatigue regeneration with the availability of an optimal oxygen supply [59]. This study examines the correlation between aerobic endurance and soccer skill, which shows a correlation on a small scale. It is believed that because soccer skills are strongly influenced by bio-motor aspects and high technical mastery, the involvement of aerobic endurance elements alone is believed to be insufficient to describe the level of correlation and its influence on soccer skills [17]. Therefore, the involvement of various bio-motor aspects, mastery of basic techniques is expected to be involved in further studies to be able to comprehensively describe the level of correlation with soccer skills.

Conclusions

Based on the results of the data analysis and discussion above, it can be concluded that there is a contribution between speed, agility, and aerobic endurance to the skills of university soccer players at Yogyakarta State University. Through this research, it is hoped that it can become useful basic data for coaches at Yogyakarta State University to evaluate the ongoing coaching program.

Conflict of interest

There is no conflict interest declared by the authors.

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