

A multilateral modelling of Youth Soccer Performance Index (YSPI)

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Abstract. This study aims to identify the most dominant factors that influencing performance of soccer player and to predict group performance for soccer players. A total of 184 of youth soccer players from Malaysia sport school and six soccer academy encompasses as response of the study. Exploratory factor analysis (EFA) and Confirmatory factor analysis (CFA) were computed to identify the most dominant factors whereas reducing the initial 26 parameters with recommended >0.5 of factor loading. Meanwhile, prediction of the soccer performance was predicted by regression model. CFA revealed that sit and reach, vertical jump, VO_{2max} , age, weight, height, sitting height, calf circumference (cc), medial upper arm circumference (muac), maturation, bicep, triceps, subscapular, suprailiac, 5M, 10M, and 20M speed were the most dominant factors. Further index analysis forming Youth Soccer Performance Index (YSPI) resulting by categorizing three groups namely, high, moderate, and low. The regression model for this study was significant set as $p < 0.001$ and R^2 is 0.8222 which explained that the model contributed a total of 82% prediction ability to predict the whole set of the variables. The significant parameters in contributing prediction of YSPI are discussed. As a conclusion, the precision of the prediction models by integrating a multilateral factor reflecting for predicting potential soccer player and hopefully can create a competitive soccer games.

1. Introduction

Structured talent detection, identification and development programs have been established for several sports, where success has been associated to anthropometric, physiological and skill characteristics [1-3]. Even though equivalent programs for soccer are less clear, many clubs selectively enrol promising players at a relatively early age and offered specialized programs with the aims of developing and perfecting playing ability [4,5]. The selection, development and professional supervision of young players is thus a priority for many top soccer clubs in order to maintain their game competitiveness. In the world of soccer, physical fitness, anthropometric, technical and physiological is the most important element to improve soccer player performance. Furthermore, this sport can increase the strength and



stamina and ensures the health of the players. Therefore, the coach plays a big role in building an active player at the maximum fitness. Based on previous studies, the model that has been used is to find out the most vital variable aims to improve an impact of training [6-8].

Coaches and instructors are often faced with the problem of choosing the appropriate dimensionality of a soccer performance model that will fit a given set of multilateral factors. Construction of soccer performance in adolescents, requires that trainers, teachers or soccer instructors observe carefully and thoroughly in providing guidance to their players. Therefore, football trainers, teachers or trainers must understand and identify the appropriate players' skills and personality at their age [6]. This view is shared by a specialist in youth soccer, who suggest that advanced players in maturity are associated with the advantages of size, fat-free mass, muscle mass, strength, power and speed [7]. In the football team, fulfill players with a very specific role is necessary. Therefore, it is important to measure specific performance by identifying the most important attributes for each player [8]. Thus, this study aims to identifying the most dominants factors affected the performance of soccer players and prediction predictive performance relative to the category of soccer player performance.

2. Materials and Method

The procedures of the soccer battery test and psychometric related to soccer was undertaken the following procedure:

2.1 Participants

A random sampling approaches were applied to this study encompasses of all players in Malaysia soccer academies. Inclusion and exclusion of the players condition were applying whereas only players suit with the ex post facto design. Overall of 184 youth soccer players (mean age = 15.2 ± 1.6 years) were joined to participate in this study which is drawn from two Malaysian youth soccer academies and six from state school centre of soccer. All the process of the research including procedure, protocol and equipment were approved by the university Human Research Ethics Committee (UniSZA/02/1/2016/Jil. 207). Consent forms and objective of the study were informed to the managers of the academies, parents, and guardians of the players with voluntary signed by the players.

2.2 Anthropometrics, growth and maturation

Anthropometric tests were carried out to measured weight, height, sitting height, and four sites of body fat. Weight is assessed using a standard electronic digital scale to the nearest of 0.1 kg, meanwhile height was measure to the nearest 0.5cm. Chronological age is measured in the month starting from the date of each player being born until the date of test. Furthermore, sitting height were measured from the top of the head to the bottom of the sitting and recorded to the nearest 0.5 cm. Percentage of body fat is assessed through skinfold calliper using four measuring sites namely, tricep, biceps, subscapular and suprailiac to the nearest 0.1 mm according to the recommendation from previous studies [9-12]. Additionally, the girth of the body size or circumference is measured on two parts of the body namely, calf circumcission (cc) and medial upper arm circumference (muac) by adhesive and non-elastic tape. All procedures and protocol testing body fat and circumference were obtained twice and the mean score for the final score is recorded for further analysis. On the other hand, the most visible changes during puberty are growth in stature and development of secondary sexual characteristics. Equally profound the achievement of fertility and changes in most body systems especially in soccer. Maturation were measured by applying tanner scale stages of maturity as recommended by previous researchers and adopting the protocol and procedure into current study [10].

2.3 Soccer battery test

Muscle strength tests are measured in the recommended way for physical fitness assessment. There are seven variables to be measured in physical fitness test performance are vertical jump, variability of sit up, agility, sit and reach, 5 m, 10 m and 20 m speed. The tape measurement is used to scale the size of the flexibility and the long reach of sit and reach and measure long jump for vertical jump. A sit and reach test are performed to measure the flexibility of the lower back of the body and the hamstring

muscles. The player must start in a ready state with both straight legs. The range is calculated to the extent that the hand reaches the maximum measuring line. Vertical jump tests are performed to measure heights while jumping. While calculating the height of the jump, the time is also taken when the jump is done. The purpose of this test is to measure the strength of the leg muscles [13]. Stopwatch and timing gate were used to record and coordinated the time to test the routine variability of sit-ups and 505 agility tests. Variability of sit up test is performed to measure the strength and durability of abdominals and hip muscles. The sit up maximum routine of set undertaken for recorded. Meanwhile, agility is the ability to quickly change the body position in the minimum requirement time. The timing gate is required to record the fastest time from the start line to the finish line [14].

2.4 Soccer technical skills

Soccer specific battery tests were implemented to acquire technical skill attributes by applying method from the prior studies namely F-MARC test conducting to measured dribbling with and without ball, ball control using three different part of body consecutively, short pass, long pass, shooting with foot and score using head. Time and speed are taken and evaluated during the test process [8].

2.5 Psychometric (Motivation)

Task and Ego Orientation in Sports (TEOSQ) have been employed in this study. It contains 13 items that measure the ability of athletes to task or ego oriented towards the sports. The questionnaire was translated into Bahasa Melayu using the back-translation method and it was confirmed and added extraordinary reliability in sports. Scale for task and ego orientation shows sufficient internal consistency with alpha 0.82 and 0.71 reliability coefficients respectively [15]. This instrument contains six items that assess the ego components (such as "I can do better than my friends") and seven items assess the task components (such as "I work hard"). Feedback is shown on 5 points of the Likert type scale where 1 strongly disagrees and 5 strongly agree.

2.6 Data Analysis

A total 4784 of matrices data that comprised 184 observations of players and 26 parameters was calculated to be analyzed. In this case, box plots and Kolmogorov-Smirnov were used to check the missing data and normality of the data. Based on this result, its described the data do not have any missing although some of the variables are not normal, further analysis were computed as recommendation by the prior researches stated that it is normal to have unnormal data to be distributed in human performance because of the individuality variation [6,8,10,11].

To achieve the objective of this study, the researcher was conducted a factor analysis (FA) method to analyze the data collected. Through the analysis, it can help the researcher to determine the main factors related to the soccer performance. Factor analysis have been used to reduce a large variable into a fewer variable. Hereby, the dominant of factors will be displayed. From this study, 26 of factors were categorized as an independent variable. However, the dominant factors extracted by applying principal components analysis method will only be interpreted when applying varimax rotation [12]. Moreover, all the assumptions of the FA were computed prior of the analysis such as sampling adequacy and sphericity test of the parameters need to be achieve [6,8,10,11]. Furthermore, researcher also applying regression aims to predict the soccer performance by sets of soccer players dominants factors acquire from FA. In specific, regression is used primarily to state the cause and effect. In the simplest form, this formula shows correlation between one independent variable (x) and dependent variable (y), $Y = B_0 + B_1 X_1 + B_2 X_2 + B_3 X_3$.

3. Results and Discussion

The output of this study will project in two-fold, 1) identifying the most dominants factors related to the performance of soccer player and 2) predict relative group performance for soccer players based on the most dominants factors related to the performance of soccer player. Initial analysis of FA, exploratory factor analysis (EFA) were computed to determine the latent factors by selecting the appropriate factors with the condition of eigenvalue greater than 1 (>1.0). Based on the Figure 1, scree plot projected the factors that meet the eigenvalue rule which is only four latent factors have the value greater than 1.

Further analysis by applying four new latent factors will further analyzed computing using confirmatory factor analysis (CFA).

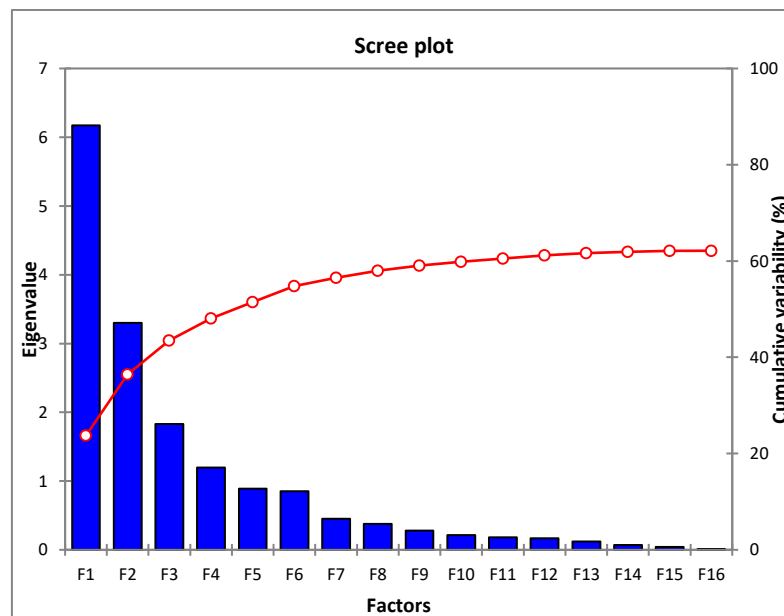


Figure 1: Scree Plot of Descriptive Eigenvalue value.

Factor pattern after varimax rotation was disclosed in Table 1. There are ten components that can be seen from first factor (D1) that are fulfilled the 0.50 factor loading threshold (Sit & Reach, Vertical jump, VO₂max, age, weight, height, sitting height, muac, cc, and maturation). Likewise, second dominant factor (D2) identifies four components with a positive higher factor loading such as bicep, tricep, subscapular and suprailiac. The rest is components from D3 as the third most important factor, had identified three parameters of speed component (5 m, 10 m and 20 m). Meanwhile, there is no dominant factor for D4 that meet the rule of the factor loading setting. Furthermore, it disclosed the most significant component of factor loading after varimax and it can be seen the contribution of the variance for D1 (23.746 %), D2 (12.693 %), D3 (7.045 %) and D4 (4.598 %) with a total of the variance is 48.081 % respectively.

FA by applying a combination of EFA and CFA revealed only seven variables have been dropped out from 26 variables initially. Therefore, 17 variables have been categorized as the dominant factors. From this analysis it has been described from the most dominant factors until the less important factor. In this case, it has proved the most dominant factor were sit & reach, vertical jump, VO₂max, age, weight, height, sitting height, muac, cc, and maturity. It is explaining the important of the coordination, agility, power, and body balance attributes are important component that influencing soccer players performance [16]. The vertical jump influencing of athlete soccer performance due to player's strength in half squat. Hereby, the coach should focus on strength training especially in terms of player movements, and indirectly improve the power of the jump [17].

Table 1. Descriptive of Factor pattern after Varimax rotation.

Variables	D1	D2	D3	D4
Sit & Reach (cm)	0.514	-0.067	-0.051	0.072
Vertical jump (cm)	0.506	-0.146	-0.155	0.139
Variability Sit Up (reps)	0.218	-0.035	-0.061	-0.175
Agility (s)	0.098	0.089	-0.091	0.213
5 m speed	0.046	0.077	0.798	0.150
10 m speed	-0.269	0.053	0.857	-0.138
20 m speed	-0.375	0.116	0.817	-0.057
VO ₂ max (ml/kg/min)	0.516	-0.322	-0.145	0.179
Chronological age (month)	0.657	-0.108	-0.295	0.387
Weight (kg)	0.847	0.274	-0.163	-0.117
Height (cm)	0.807	-0.057	-0.090	0.026
Sitting Height (cm)	0.740	0.026	-0.055	-0.021
Bicep (mm)	0.009	0.821	0.244	-0.057
Tricep (mm)	-0.021	0.844	0.108	-0.027
Subscapular (mm)	0.397	0.696	-0.016	0.094
Suprailiac (mm)	0.124	0.857	-0.056	0.025
MUAC (mm)	0.660	0.348	-0.117	-0.122
CC(mm)	0.792	0.291	-0.169	-0.136
Maturation	0.719	-0.064	-0.136	0.272
Task	0.115	-0.053	0.002	-0.121
Ego	0.014	0.040	-0.091	-0.119
Ball Control (point)	0.120	-0.060	0.247	0.281
Long Pass (point)	0.438	-0.044	-0.124	0.384
Short Pass (point)	0.254	-0.085	0.287	0.373
Shooting Right top corner (point)	-0.228	0.103	-0.127	0.463
Shooting Left top corner (point)	-0.216	0.040	-0.117	0.483
Eigenvalue	6.174	3.300	1.8316	1.1953
Variability (%)	23.746	12.693	7.045	4.598
Cumulative %	23.746	36.439	43.483	48.081

*Note: MUAC = middle upper arm circumference; CC = calf circumference; factor loading set at >0.50.

Additionally, further analysis was computed by developing an index of the youth soccer performance by applying output of the CFA. Index of the youth soccer performance are based on the most dominant parameters resulting to produce three different categorical groups of soccer performance namely low, moderate and high soccer performer as shown in Table 2. Categorical groups of performance are define based on the calculated standardization range of all variables and it is tabulate ranked in the index as shown in the group ranged on the Table 2. It also presenting the frequency and cumulative frequency of the players in each group. Based on the result of index, each group were coded as low =1, moderate =2 and high =3 for the analysis of regression. Based on an index described 49 players for high performance, moderate 117 players and low 18 players.

Table 2. Index Status of youth soccer performance.

Status YSP	Freq	Cum. Freq.	%	Cum. %	Group range	Group
-82.86	18	18	9.78%	9.78%	$-82.86 \leq \text{low} < -34.39$	Low
-34.39	117	135	63.59%	73.37%	$-34.39 \leq \text{Moderate} < 14.08$	Moderate
14.08	49	184	26.63%	100.00%	$\text{High} \geq 14.08$	High

Table 3 shows the goodness of fit statistics for observation of the 184 soccer players in this study. It shows prediction ability of the contributions of the regression model. It is also show that R² value is 0.822 which explained that the model used in this study has contributed for the total of 82% prediction ability to predict the whole data set of the variables. This result shows that this model is strong enough to measure the set of variables studied and can continue for the further analysis.

Table 3. Goodness of Multiple linear regression fit statistics.

Observations	184
Sum of weights	184
DF	157
R ²	0.8228
Adjusted R ²	0.7934
MSE	0.0697
RMSE	0.2641
DW	1.6996

Further analysis of variance as shown in Table 4, revealed that there is a significant effect on the model ($p < 0.001$) explain by the most dominants parameters and it is worth to identify the parameters that contribute to the model.

Table 4. Analysis of Variance.

Source	DF	Sum of Squares	Mean Squares	F	Sig
Model	26	50.8277	1.9549	28.0307	< 0.0001
Error	157	10.9495	0.0697		
Corrected Total	183	61.7772			

Backward stepwise method was applied to indicate the contribution of the most dominant parameters explaining the youth soccer performance. As disclosed on the Table 4, it is described the most significant parameters statistically contributes to the prediction of the player performance. By applying backward stepwise method, it is show the most significant parameters that explaining the prediction ability of the youth soccer performance namely 5 m speed, age, weight, height, sitting height, bicep, cc, maturity, task, ball control, short pass, and shooting right top corner ($p < 0.05$). Meanwhile, 14 parameters were excluded from the prediction model.

The variables included in the prediction model contributes and affects the relative performance of soccer players. This finding is in concordance with the previous studies indicated that to win a game in the soccer match, players must perform an attacking or counter attack to score goals. An attacker must

be active in looking for any weakness on the opponent to exploit the opponent properly. Possession of the game is related to the ball control and passing which can dominate the game and producing goal. Both components are related to the performance of the players and it is related in increasing chances of win the game [13].

Table 5. Significant variable resulting from backward regression method.

Source	Value	Standard error	t	Pr > t	Lower bound (95%)	Upper bound (95%)
Intercept	7.565	0.763	9.914	< 0.0001**	6.059	9.071
Sit & Reach	0	0				
Vertical jump	0	0				
Var Sit Up	0	0				
AGILITY	0	0				
5m Speed	-0.781	0.142	-5.504	< 0.0001**	-1.061	-0.501
10m Speed	0	0				
20m Speed	0	0				
VO2MAX	0	0				
Age	-0.062	0.017	-3.724	0.0003**	-0.095	-0.029
Weight	-0.032	0.006	-4.929	< 0.0001**	-0.044	-0.019
Height	0.013	0.006	2.368	0.019**	0.002	0.025
Sitting height	-0.021	0.006	-3.410	0.0008**	-0.033	-0.009
BICEP	-0.085	0.024	-3.498	0.0006**	-0.133	-0.037
TRICEP	0	0				
SUBSCAPULAR	0	0				
SUPRAILIAC	0	0				
MUAC	0	0				
CC	-0.038	0.018	-2.121	0.0354**	-0.072	-0.003
Maturity	-0.085	0.038	-2.228	0.0272**	-0.160	-0.010
TASK	-0.005	0.003	-2.058	0.0411**	-0.010	0.000
EGO	0	0				
Ball Control	-0.039	0.010	-3.915	0.0001**	-0.058	-0.019
LONG PASS	0	0				
SHORT PASS	-0.017	0.006	-2.824	0.0053**	-0.028	-0.005
SHOOTING RTC	-0.014	0.007	-1.984	0.0488**	-0.028	0.000
SHOOTING LTC	0	0				

**Note: Significant at $p < 0.05$

In contrast to soccer specific attributes, only the ball control, short pass and shooting at the right top corner test significantly associated among players by level of youth soccer performance as shown in Figure 2. It is interesting that the long pass test showed poor contribute and also cannot predict the performance. Low and moderate performance of the group performed well on this test as did high players. The result suggest that the long pass test may not be a priority attribute in youth soccer performance models. Further information by the figure of the contribution of the parameters suggesting that 5 m speed are more related to the soccer players and also affecting by the physical characteristics as projected in the Figure 2. Meanwhile, maturation and task oriented players were significantly contributing to the youth soccer performance.

Generally, finding of the study are generally consistent with previous researches in light of the fact that the low performance players corresponded to the high performance players in the present design [18]. Consistent with the previous multidimensional investigations of youth soccer and field hockey model, finding of the current study revealed the better prediction models of youth soccer performance by the multilateral set of the most dominant factors in soccer [19-20].

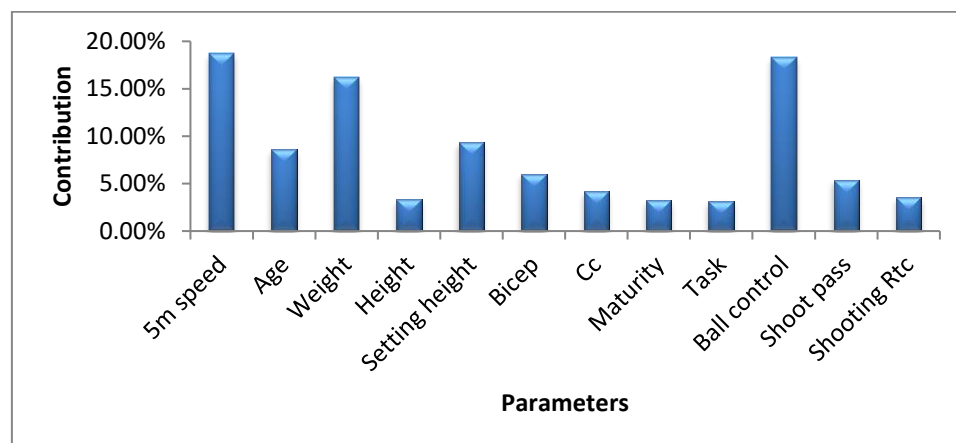


Figure 2. Interface for Camera Live View and Sensors.

4. Conclusion

As noted, the prediction model is limited by its cross-national nature (Malaysia). The consideration of the variables did not include perceptual cognitive, tactical, and biomechanical, all these data were not encompassed because it is generally laboratory-based and not suitable for current studies design. In instant, the present study specifies that prediction model of youth soccer performance was significantly associated with the selected parameters in the current studies and players with different level of performance were statistically influence by the physical characteristics, physiological elements, maturation, soccer specific attributes and task orientation. The finding also highlights the relevance of the contribution on each significant parameter specific on soccer performance. Specifically, contribution of the parameters locus values for the total sample of youth soccer players may be useful for coaches and instructors in both the talent evaluation and development processes.

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