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RESEARCH ARTICLE

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Developing a Soccer Player's Performance Index Model for Chinese Professional Football: Integrating Physical Condition, Match Performance and Team Circumstance

Hefeng Song[1], Xue Wang[1], Junhui Zhao[1,*]
[1]Nanning College of Technology, China

Abstract: The study aims to develop a soccer player's performance index (SPPI) model for Chinese professional football players by integrating their physical condition, match performance, and team circumstances. The model is intended to identify potential talents and address the challenge of evaluating unknown players in player selection. Moreover, the study found a non-linear relationship between age and SPPI, which suggests that future research on Chinese professional soccer players' aging curves could benefit from using non-linear models. Overall, the findings of this study provide valuable insights for talent identification and player performance evaluation in Chinese professional soccer.

Keywords: soccer players' performance index; physical condition; match performance; team circumstance

1. Introduction

Football players are the essence and core of football (Zeng & Hu, 2013). The football industry has introduced the "Moneyball" philosophy aimed at finding relatively cheap, latent talent. Many football sites have hired analysts or commissioned data analysis companies to collect and analyze match data. Through the results obtained by the teams, the training plans of the teams are supplemented, and the game win rate is increased by selecting better players. The development of networking technology and processing technology due to the fourth industrial revolution has led to the commercialization of wearable devices (such as ProZone, Sportscode, AMISCO, etc.) and match analysis programs (Carling et al., 2014). In this way, advanced technology and equipment are mainly used for sports teams or players who are in charge of major sports axes, and are used as means to achieve individual goals and improve performance (Groom & Cushion, 2004).

Even with the development of advanced equipment, measuring and evaluating performance in sports is not easy. This is because while the soccer industry uses objective data to evaluate players, some media outlets and experts evaluate players based on subjective opinions. Soccer world rankings have been established, but they have been challenged in academic research. McHale & Morton (2011) pointed out that these rankings have shown poor prediction power in actual game results as a prediction tool. For this reason, academia has begun to pay more attention to analysis and prediction data for the performance of professional soccer players. Research in academia about the performance of professional soccer players is actively underway.

This study aims to develop a Soccer Players' Performance Index Model (SPPI) by integrating a player's physical condition, match performance, and team circumstance, and to discover potential talents.

2. Literature Review

The definition of performance in sports refers to an individual's performance to achieve their goals while participating in athletic activities. According to Nevill et al. (2008), performance in sports is defined as the ability of a player to attain their desired goals during a sporting event. The

Corresponding Author: Junhui Zhao
Nanning College of Technology, China
Email: zhaojunhui@nnct.edu.cn

performance level in soccer is explained as a composite function of physical, technical, mental, and cognitive factors (Hiddink, 2001). However, in academic research, the majority of studies understand the components of performance as a combination of physical, technical, tactical, and mental factors (Kim, 2018). Therefore, there are both areas of agreement and disagreement between the practical field and academic research regarding soccer performance.

Evaluating athletic performance in sports usually involves both qualitative and quantitative analysis (Sin, 2015). Qualitative analysis deals with non-numeric factors while quantitative analysis deals with numeric factors that can be recorded and expressed in numbers. In soccer, factors such as goals assists, and shots are quantitative, while tactics and psychology are qualitative as they are difficult to quantify and have subjective interpretations (Pappalard et al., 2019).

Quantitative variables that make up the performance of a soccer player include technical factors such as the number of goals, assists, shots, opportunities recognized, yellow cards, red cards, pass attempts, and passing success rates. The physiological factors include age, weight, height, dominant foot, etc. These quantitative factors can be quantified and converted into a typical data format for statistical processing.

When examining the composition of qualitative factors, there are tactical-related factors such as judgment, spatial creation ability, role performance ability, and ability to transfer skills. There are also psychological factors such as individual behavior and attitude of the athlete, concentration, motivation, competitive drive, and teamwork. Quantifying these qualitative factors is difficult, so detailed observation and interpretation of each factor are required (Yoon & Kim, 2004).

This study aims to present a framework of prior concepts and then develop factors within that framework. This is because the possibility of underlying structures that cannot be discovered through literature review cannot be excluded, so we adopt a compromise approach by presenting a theoretical framework and following a flow of exploratory factor analysis.

3. Research Subject

The subject of this study is a total of 2,006 data of 842 players who participated in 23 teams in the Chinese Super League during the 2016-2020 seasons. The players who played less than 1 game or less than 10 minutes were excluded from the analysis. The basic data required for the analysis, such as team and player performance records and market value data, were collected from various sources, including the football websites whoscored.com, wikipedia.org, baike.baidu.com, transfermarkt.com, and the official websites of each team.

Table 1 Variables

Variable		Sub-factors	Total
Independent Variables	Personal Physical	Debut time, Age, Weight, Height, Preferred foot, National team, Nationality, Injury history et.al	8
	Match Performance	Appearances, Playing time, Goals scored, Assists, Yellow cards, Red cards, Shots, Passing success rate, MOM, Key passes, Offsides, Mistakes, Headers, Interceptions, Own goals, Passes et.al	28
	Team Circumstance	Year of club founding, Stadium Capacity (seats), Coach win rate, City GDP of the club, Number of club staff et.al	9
Dependent Variable	Performance	Rating	1

The study conducted a literature review and previous research to extract the sub-factors affecting the performance of Chinese professional soccer players, as seen in **Table 1**. Over 30 explanatory variables for performance were found in existing domestic and international papers. Based on this, three factors affecting the performance of Chinese soccer players were derived: “personal physical condition”, “match performance”, and “team circumstance”. The dependent variable, rating, is the

player rating used by Dendir (2016) from WhoScored.com. WhoScored.com assigns 10 points per game based on recorded events using computer algorithms.

4. Empirical Study

Based on the results of the technical statistics of Chinese professional soccer players, there were a total of 842 players and 2,006 data sets during the five seasons from 2016 to 2020 in the Chinese Super League.

4.1. Analysis of data reliability, validity, and factor analysis

In this section, the personal physical condition, match performance, and team circumstances of Chinese professional soccer players will be examined to determine the factors that constitute the soccer player performance index model. The aim is to analyze the reliability and validity of each factor.

Table 2 Factor Analysis

	Component		
	Match Performance	Team Circumstance	Physical Condition
Goals scored	.884	-.076	-.005
Headers	.856	-.103	-.042
Shots	.851	-.028	-.107
Chances Created	.828	-.157	.051
MOM	.810	.088	.259
Assists	.741	-.155	.104
key passes	.739	-.059	-.120
Passes	.658	.115	-.126
Offsides	.614	.350	.269
Playing time	.520	.113	.119
Appearances	.483	.089	.096
Coach win percentage	.278	.876	.381
Club value	.014	.807	.133
Club rating	.126	.729	.131
Club rank	-.085	-.799	-.124
Stadium capacity	-.018	.579	-.134
Player average age	-.198	-.535	-.103
Club soccer	.087	.496	.277
Club city GDP	-.036	.431	.117
Weight	.277	.248	.595
Height	-.002	.014	.591
Age	.291	.152	.726
Debut	.191	.149	.722
National team	-.005	-.138	.521
Cumulative Variance (%)	29.486	49.047	65.460

KMO=.806, Bartlett's=40,215.79, x2=276(p<.0001)

In this paper, we use these theoretical measurement bases to analyze the reliability and validity of each factor. As shown in **Table 2**, we conducted a factor analysis to understand how the three variables that make up the Chinese professional football player performance index are classified by conducting a factor analysis using principal component analysis as the factor extraction method and a varimax rotation. A total of 45 variables were analyzed. As a result, 24 out of the 45 factors showed loadings of 0.4 or higher. The remaining 21 factors need to be excluded as they reduce the validity. Meanwhile, the accumulated variance was 65.460%, indicating that the three variables that make up the performance index have high explanatory power.

Table 3 Reliability analysis

Variable		Cronbach's alpha	Sub-factors(N)
Variables composing Game Performance Index	Match Performance	.844	11
	Team Circumstance	.757	8
	Physical Condition	.781	5
Performance (Rating)		.882	1

As can be seen in **Table 3**, a reliability analysis was performed to examine the internal consistency of the sub-factors of match performance, team circumstance, physical condition, and the scores for performance (rating). The results of the Cronbach's alpha showed high values of over 0.7 specifically for performance (11 items), team conditions (8 items), and physical conditions (5 items). In other words, it was concluded that the reliability of the main variables in this study is acceptable.

4.2. Development of soccer player performance index model

The study finds the relative importance of each variable and its factors in affecting the performance index and uses the individual physical condition, match performance, and team circumstance and their relative importance to develop the Soccer Players' Individual Performance Index Model for Chinese professional soccer players. Additionally, the study will determine the extent of individual performance and index it.

To achieve the research objectives, a regression analysis will be conducted with individual physical condition, match performance, and team circumstance as independent variables and performance (rating) as the dependent variable. The results are shown in **Table 4**.

As a result, a total of twelve variables, which were either insignificant or had a multicollinearity problem, were removed. The remaining factors were deemed significant.

Table 4 Regression Analysis Results

IVs	DVs	UC		SC	t	p	CS	
		B	Std. Error	Beta			TOL	VIF
Performance (Rating)	Constant	2.236	.322		6.945***	.000		
	Shots	.121	.007	.289	18.122***	.000	.442	12.260
	Assists	-.007	.004	-.036	-2.051***	.040	.374	2.675
	MOM	.058	.005	.192	12.041***	.000	.445	2.247
	Key passes	.199	.012	.292	16.012***	.000	.340	2.942
	Playing time	.000	.000	.292	22.279***	.000	.658	10.520
	Appearances	-.014	.001	-.075	-9.829	.000	.093	10.747
	Goals scored	.005	.005	.011	1.159	.246	.059	16.832
	Headers	.003	.003	.004	.927	.354	.351	2.853
	Club rating	.389	.041	.144	9.536***	.000	.498	2.006
	Club rank	-.006	.001	-.073	-4.798***	.000	.490	2.042
	Club soccer	.003	.001	.045	3.919***	.000	.867	1.154
	Coach win percentage	.001	.001	.007	1.176	.240	.160	6.234
	Club value	-1.223E-010	.000	-.002	-.508	.611	.410	2.437
	Age	.006	.001	.061	5.135***	.000	.797	1.255
	Height	.543	.102	.080	5.335***	.000	.498	2.008
	Weight	.002	.001	.031	2.168**	.030	.537	1.861
	National team	.001	.000	.044	3.582***	.000	.749	1.334

	Debut	-.001	.003	-.001	-.191	.849	.104	9.577
R^2=.775, F=572.218								

* p< 0.1, ** p< 0.05, *** p< 0.01

To develop the individual performance index of Chinese professional football players, first, the values of match performance, team circumstance, and physical conditions are calculated using the standardized beta coefficients shown in Table 4. Equations 1-1, 1-2, and 1-3 are as follows:

Physical Condition:
= 0.061 × 'Agei'
+ 0.031 × 'Weighti'
+ 0.080 × 'Heighti'
+ 0.044 × 'National Teami'
Equation 1-1

Match Performance:
= 0.289 × 'Shotsi'
- 0.036 × 'Assistsi'
+ 0.192 × 'MOMi'
+ 0.292 × 'Key passesi'
+ 0.292 × 'Playing timei'
Equation 1-2

Team Circumstance:
= 0.144 × 'Club ratingi'
- 0.073 × 'Club rankingi'
+ 0.045 × 'Club socceri'
Equation 1-3

Thus, the individual performance index model for Chinese professional soccer players has been completed, which is presented as Equation 2.

Yi = Physical Conditioni + Match Performancei + Team Circumstancei
(i : i-th soccer player)
Equation 2

Table 5 Performance Index and Converted Values

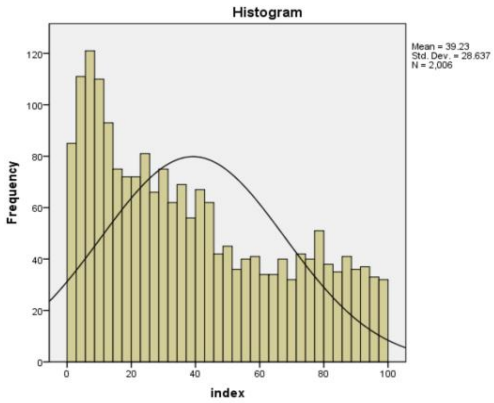
Statistic			
		SPPI	SPPI Converted to 100-Point Scale
N	Valid	2,006	
	Missing	0	
Mean		314.36	39.24
Standard Deviation		229.44	28.63
Variance		52,641.20	819.93
Skewness		.50	.50
Std. Error of Skewness		.06	.06
Kurtosis		-.97	-.97
Std. Error of Kurtosis		.11	.11
Min.		8.20	1.02
Max.		801.26	100.00

According to the results of the SPPI and converted values in **Table 5**, the minimum and maximum values of individual player performance Yi were 8.2 and 801.26, respectively. After converting the maximum performance score of 801.26 to 100 points, the remaining individual performance scores (Yi) were converted to relative values out of 100 points. Thus, the percentage of players who showed the highest performance score could be calculated. This was considered the performance index for Chinese soccer players.

$$\text{SPPIi} = \frac{\text{i}}{801.26} \times 100 \qquad (\text{i : i-th soccer player})$$

Equation 3

Fig. 1
Normal Distribution of Chinese Soccer Players' Performance Index



The index scores a maximum of 100 with a minimum of 1.02, using 100 as the full score. The mean of the index was 39.24, and the standard deviation was 28.63. Equation (3) represents the final form of the Soccer Player Performance Index (SPPI) of Chinese professional soccer players, which was calculated in this study.

5. Conclusion

This study developed an individual performance index (SPPI) that integrates personal physical condition, match performance, and team circumstance to quantify the factors that influence the performance of Chinese professional soccer players. We confirmed whether the SPPI followed a normal distribution by examining its mean, variance, and standard deviation, and demonstrated that the performance of soccer players varied individually. The proposed model in this study has the potential to identify talented young players at the beginning of their careers, whose value may not yet be widely recognized. In this context, this study provides evidence for the application of the "Moneyball" ideology in soccer associations.

Conflict of Interest

The authors declare that they have no conflicts of interest to this work.

References

Zeng, Z., & Hu, T. (2013). The pricing model constructions of professional football players club transfer market, Beijing Sport University Journal, 36(2), 38-42.

Carling, C., Wright, C., Nelson., L. J., & Bradley, P. S. (2014). comment on performance analysis in football: A critical review and implications for future research, Journal of Sports Sciences, 31(1), 2–7.

Groom, R., & Cushion, C. (2004). Coaches perceptions of the use of video analysis: A case study, Insight, 7(3), 56-58.

McHale, I., & Morton, A. (2011). A Bradley-Terry type model for forecasting tennis match results, International Journal of Forecasting, 27(2), 619-630.

Nevill, A., Atkinson, G., & Hughes, M. (2008). Twenty-five years of sport performance research in the journal of sports sciences, Journal of Sports Sciences, 26(4), 413–426.

Hiddink, G. (2001). Korean team and European teams–Comparative view, Celebrating Seminar for NFC Completion, Korea. Football Association.

Kim, Y. (2018). A study on the conceptual structure for the estimation of annual salary of K-league players. The Korean Society of Sports Science, 27(6), 389-401.

Sin, J. (2015). Sin Jaemyeong's football match analysis, Miryang. Hans Media.

Pappalardo, L., Cintia, P., Ferragina, P., Massucco, E., Pedreschi, D., & Giannotti, F. (2019). Player Rank: Data-driven performance evaluation and player ranking in soccer via a machine learning approach, ACM Transactions on Intelligent Systems and Technology, 10(5), 1-27.

Yoon, Y., & Kim, W. (2004). Analytic hierarchy process to examine psychological factors influencing football performance, Korean Society of Sport Psychology, 15(2), 129-138.

Dendir, S. (2016). When do soccer players peak? A note, Journal of Sports Analytics, 2(2), 89-105.

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