
**ANALYSIS OF SELECTED PHYSICAL AND PHYSIOLOGICAL VARIABLES
HIGHLY CORRELATED WITH PLAYING ABILITY OF INTER-COLLEGIATE
LEVEL SOCCER PLAYERS****NS. Kirankumar**

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Corresponding mail: - directorkirankumar@gmail.com - pkuloth@gmail.com**Abstract**

The intension of the study was to investigate the selected physical and physiological variables highly correlated with playing ability of inter-collegiate level soccer players. To attain this aim, the investigator selected one hundred and sixty inter-collegiate level affiliated different colleges of Bangalore North University soccer players as subjects. Random group design was used for this investigation, as it is considered most suitable. The age of the selected subjects ranged from eighteen to twenty five years. In this study one criterion (soccer playing ability) and ten determinant variables are included. Pearson product moment correlation was utilized to verify the association between criterion (soccer playing ability) and determinant speed, agility, flexibility, explosive power, muscular endurance, leg strength, vital capacity, VO₂ max, anaerobic power and resting pulse rate variables respectively. The relationship between criterion and determinant variables as well as inter-correlations among determinant variables was calculated by using Pearson product-moment correlation formula. To test the hypothesis 0.05 level of confidence was fixed. The selected physical fitness and physiological variables such as agility, VO₂ max, speed, anaerobic power and muscular endurance were highly significantly correlated with soccer playing ability of Bangalore north university affiliated inter collegiate level soccer players.

Keywords: *Physical Fitness, Physiological and Soccer players*

INTRODUCTION

Modern soccer is the most popular sport worldwide and originated from United Kingdom, England. It played by both teams of eleven players within ninety minutes of 15 mints break time. [Taylor, 2016] Most elite African soccer players migrated to English premier league clubs and Spanish league. Football is governed by the worldwide federation international football association (FIFA). [Chatterjee Rudranath and Bandopadhyay Kanchan, 2018] Training youth football players important for developments of sport at national and international levels. [Manoj Kumar

and Manoj, 2017] Modern football games greatly demand physiological profiles Vo2Max, heart rate, blood, and physical fitness of the players.

In another similar study [**Bompa and Gregory, 2006]** found in an investigation that individual games athletes had significantly higher muscular strength, agility, power, speed and cardiovascular endurance ($p < 0.01$) than team games athletes. Further investigations are needed on the above studied variables along with physiological variables to assess relationships among them and with performances in team games and individual games athletes.

Physiological characteristics have a positive relationship with the playing ability of soccer players. [**Aychiluhim and Deyou, 2020]** Soccer requires agility, speed, tactical, technical, physical fitness, and physiological profile players, and studies are useful to identify the performance and talents of premier league soccer players. [**Sporis et al, 2009]** Soccer is the most spectacular team sport that needs systematic investigations on scientific training with different playing positions of players.

Mielke, (2015) Football helped in nation-building of different societal values and cultures. 270 million people were involved in soccer developments from Africa, Brazil, and Russia. [**Marcello et al, 2009]** Physiological evaluation of football training refers to the measurement of anatomical, physiological, biochemical, and functional changes of the target to effects of training. Also, physiological assessments are very important to researchers and coaches to identify talents, performance, and modify training intensities and durations.

Aerobic capacity of soccer players affected by Anthropometric conditions of participants. Similarly, physical and physiological parameters affected by the player's position and mental ability of players during competition season. [**Ozcan Bizati, (2016)**] As the researcher recommended that during planning, training program coaches, football players, and sport managers consider positional differences. Therefore, football coaches have to give appropriate specific training based on formation and player positions.

Study on physiological parameters of between American professional soccer players during a competition session, sedentary population, and long distance runners' results of the study concluded that [**Tomas Stolen et al, 2005]** American soccer players have high cardio-respiratory endurance (Vo2 max) as compared with that of the sedentary population but low compared with that of long distance runners. Also, there is a significant difference in body mass index (BMI) among professional soccer players and sedentary populations. The present study mainly focuses on selected physical fitness and physiological variables. As far as the performance of soccer team is concerned above said variables are vital. The researcher reviewed number of journals, books, e-resources, unpublished thesis, dissertations and coaching manuals in which it was observed that the standard skills of soccer players are based on these selected physical fitness and physiological variables. Based on these observations, the investigator selected this investigation.

METHODOLOGY

Selection of Subjects

The study under investigation was intended to identify the factors influencing the soccer playing ability of inter collegiate soccer players from selected physical and physiological variables.

To achieve the purpose of the study investigator selected one hundred and sixty intercollegiate level men soccer players from Bangalore North University affiliated different colleges in Karnataka state, India. The subjects were in the age group of 18 – 25 years and were selected from those teams that entered the quarter final in the inter zonal intercollegiate tournaments held at Lowry Adventist College, in the year 2021 -2022.

Selection of Variables

Criterion Variable: The subjective rating of the experts, who were designated to evaluate the soccer playing ability of the selected subjects.

Physical Fitness Variables: The following physical fitness variables namely speed, agility, flexibility, explosive power, muscular endurance and leg strength were selected.

Physiological Variables: The following physiological variables namely vital capacity, VO₂ max, anaerobic power and resting pulse rate were selected.

Collection of Data

The playing ability of the subjects was assessed by judges rating and the selected physical fitness and physiological variables were measured through standard test and measurements.

Statistical Techniques

In this study one criterion (soccer playing ability) and ten determinant variables are included. Pearson product moment correlation was utilized to verify the association between criterion (soccer playing ability) and determinant variables. The relationship between criterion and determinant variables as well as inter-correlations among determinant variables was calculated by using Pearson product-moment correlation formula. To test the hypothesis 0.05 level of confidence was fixed.

RESULT OF STUDY

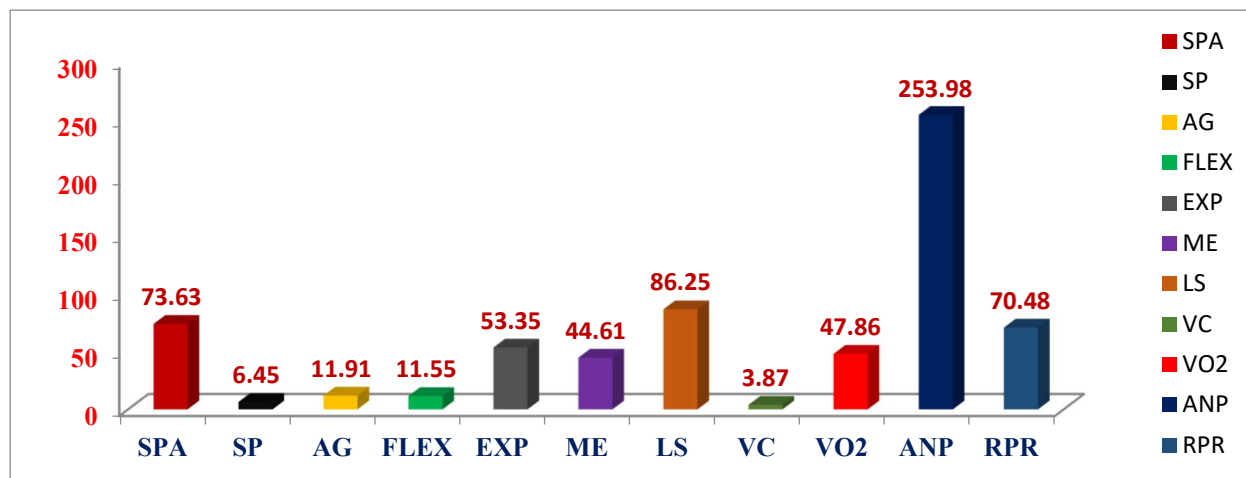
Table- 1

COMBINED MEAN STANDARD DEVIATION ON SELECTED VARIABLES FOR THE QUALIFIED TEAM PLAYERS OF INTER COLLEGIATE SOCCER TOURNAMENT

S. No	Variables	N	Min	Max	Range	Mean	SD
1	Playing Ability	160	70	79	09	73.63	2.10
2	Speed	160	6.11	6.85	0.74	6.45	0.16
3	Agility	160	11.03	13.63	2.60	11.91	0.62
4	Flexibility	160	8	15	07	11.55	1.80
5	Explosive Power	160	49	64	15	53.35	3.34
6	Muscular Endurance	160	32	55	23	44.61	5.91
7	Leg Strength	160	74	99	25	86.25	6.47
8	Vital Capacity	160	3.29	4.36	1.07	3.87	0.28
9	VO ₂ max	160	41.19	55.78	14.59	47.86	3.91
10	Anaerobic Power	160	242	265	23	253.98	5.45
11	Resting Pulse Rate	160	67	72	05	70.46	1.38

The obtained mean and standard deviation values on soccer playing ability and selected physical fitness and physiological variables of playing ability (73.63 ± 2.10), speed (6.45 ± 0.16), agility (11.91 ± 0.62), flexibility (11.55 ± 1.80), explosive power (53.35 ± 3.34), muscular endurance (44.61 ± 5.91), leg strength (86.25 ± 6.47), vital capacity (3.87 ± 0.28), VO_2 max (47.86 ± 3.91), anaerobic power (253.98 ± 5.45) and resting pulse rate (70.46 ± 1.38) of the inter-collegiate soccer players were calculated and it is graphically displayed in figure-I.

Figure – I: Diagram Showing the Mean Value on Soccer Playing Ability and Selected Physical Fitness and physiological Variables of Soccer Players



To determine the relationship between criterion and determinant variables and also to find out the interrelationship between the determinant variables Pearson product moment correlation was used and the obtained results are given in table-2.

**Table –2:
CO EFFICIENT CORRELATION AMONG THE SELECTED PREDICTOR
VARIABLES OF INTER COLLEGIATE SOCCER PLAYERS**

	VPA	SP	AG	FLX	EXP	ME	LS	VC	VO2	AP	RPR
VPA	1	-.526*	.726*	.306*	.116	.387*	.652*	.392*	.664*	.506*	-.595*
SP		1	.417*	.350*	-.186*	-.401*	-.463*	-.417*	-.392*	-.312*	.360*
AG			1	.336*	-.134	-.366*	.607*	.379*	.585*	.449*	.620*
FLX				1	.074	-.275*	.323*	.325*	.316*	.243*	.260*
EXP					1	.455*	.058	.439*	.041	.027	-.138
ME						1	.252*	.985*	.153*	.104	-.195*

LS							1	.276*	.676*	.559*	-.633*
VC								1	.181*	.112	-.211*
VO2									1	.452*	-.666*
ANP										1	-.523*
RPR											1

*The required table 'r' value is 0.15 at 0.05 level of confidence.

SPA	Soccer Playing Ability	LS	Leg Strength
SP	Speed	VC	Vital Capacity
AG	Agility	VO2	VO2 max
FLX	Flexibility	ANP	Anaerobic Power
EXP	Explosive Power	RPR	Resting Pulse Rate
ME	Muscular Endurance		

Table 2 revealed the correlations between soccer playing ability and physical fitness variables (speed, agility, flexibility, explosive power, muscular endurance and leg strength). Speed, agility and flexibility had a negative significant relationship with soccer playing ability are [(r= -0.526 p<0.05)], [(r= -0.726 p<0.05)] and [(r= -0.306 p<0.05)] respectively. For muscular endurance and leg strength table revealed a positive signification relationship with soccer playing ability are [(r= 0.387) p<0.05] and [(r= 0.652) p<0.05] respectively. However, there was explosive power no significant relationship with soccer playing ability (r= -0.116, p<0.05).

Diagram Showing the Correlation Coefficient Values between Soccer Playing Ability and Physical Fitness Variables

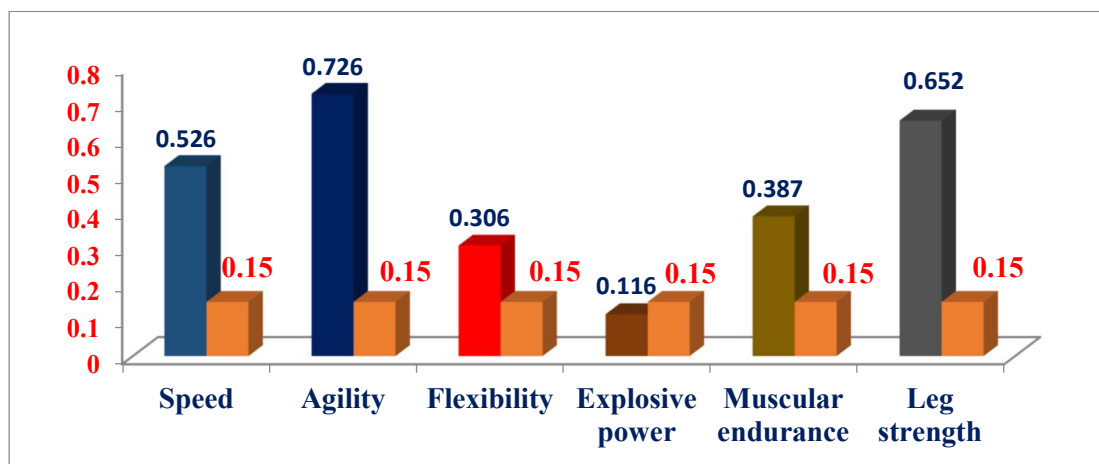


Table 2 revealed the correlations between soccer playing ability and physiological variables (vital capacity, VO₂ max, anaerobic power and resting pulse rate). Vital capacity, VO₂ max and anaerobic power had a positive significant relationship with soccer playing ability are [(r= 0.392 p<0.05)], [(r= 0.664 p<0.05)] and [(r= 0.506 p<0.05)] respectively. For resting pulse rate table revealed a negative signification relationship with soccer playing ability [(r= -0.595) p<0.05] respectively.

Diagram Showing the Correlation Coefficient Values between Soccer Playing Ability and Physiological Variables

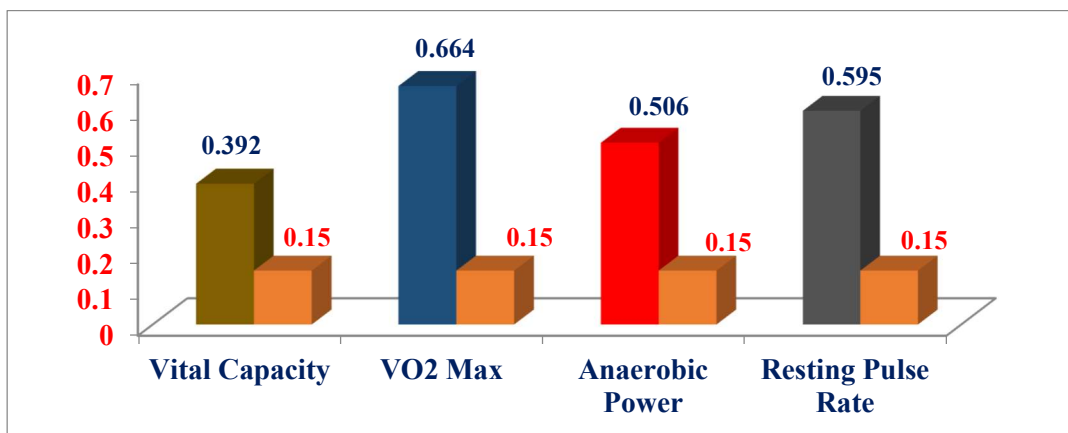


Table-3

ANALYSIS OF VARIANCE FOR THE INFLUENCE OF PREDICTOR VARIABLES ON SOCCER PLAYING ABILITY OF THE INTER COLLEGIATE SOCCER PLAYERS

Model		Sum of Squares	df	Mean Square	F
1	Regression	372.261	1	372.261	175.58
	Residual	334.982	158	2.120	
	Total	707.244	159		
2	Regression	434.219	2	217.109	124.84
	Residual	273.025	157	1.739	
	Total	707.244	159		
3	Regression	459.802	3	153.267	96.62
	Residual	247.442	156	1.586	
	Total	707.244	159		
4	Regression	468.300	4	117.075	75.94
	Residual	238.944	155	1.542	
	Total	707.244	159		
5	Regression	476.987	5	95.397	63.80
	Residual	230.257	154	1.495	
	Total	707.244	159		

The found 'F' values of 175.58, 124.84, 96.62, 75.94 and 63.80 are highly significant of (0.05 levels). It established that the all chosen determinant variables have collectively influenced the soccer playing ability.

Since the ANOVA 'F' values are very much significant, the computations of multiple regressions were performed. Multiple regression equation was calculated only because the multiple correlations were adequately high to warrant prediction from it. Then, the correlation identified the independent variables to be included and their order in the regression equation.

Multiple correlations were computed by step-wise argument method and the results are presented in table – 4.

Table - 4
STEPWISE MULTIPLE REGRESSION CO EFFICIENT BETWEEN PREDICTOR
VARIABLES ON SOCCER PLAYING ABILITY OF INTER COLLEGIATE
SOCCER PLAYERS

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.726 ^a	.526	.523	1.456
2	.784 ^b	.614	.609	1.318
3	.806 ^c	.650	.643	1.259
4	.814 ^d	.662	.653	1.241
5	.821 ^e	.674	.664	1.222
a. Predictors: (Constant), Agility				
b. Predictors: (Constant), Agility, VO ₂ max				
c. Predictors: (Constant), Agility, VO ₂ max, Speed				
d. Predictors: (Constant), Agility, VO ₂ max, Speed, Anaerobic Power				
e. Predictors: (Constant), Agility, VO ₂ max, Speed, Anaerobic Power, Muscular Endurance				

From Table – 4 it was found that the multiple correlations co-efficient for predictors, such as agility, VO₂ max, speed, anaerobic power and muscular endurance was 0.821 which produce highest multiple correlations with soccer playing ability. 'R' square values show that the percentage of contribution of predictors to the soccer playing ability (Dependent variables) is in the following order.

1. About 72.60 % of the variation in the soccer playing ability was explained by the regression model with one predictor such as agility.

2. About 78.40 % of the variation in the soccer playing ability was explained by the regression model with two predictors such as agility and VO₂ max. An additional 5.80 % of the variance in the soccer playing ability was contributed by VO₂ max.

3. About 80.60 % of the variation in the soccer playing ability was explained by the regression model with three predictors such as agility, VO₂ max and speed. An additional 2.20 % of the variance in the soccer playing ability was contributed by speed.

4. About 81.40 % of the variation in the soccer playing ability was explained by the regression model with four predictors such as agility, VO₂ max, speed and anaerobic power. An additional 0.80 % of the variance in the soccer playing ability was contributed by anaerobic power.

5. About 82.10 % of the variation in the soccer playing ability was explained by the regression model with five predictors such as agility, VO₂ max, speed, anaerobic power and muscular endurance. An additional 0.50 % of the variance in the soccer playing ability was contributed by muscular endurance.

Table – 5
VARIABLES IN THE EQUATION FOR INTER COLLEGIATE SOCCER PLAYERS

Model		Unstandardized Coefficients		Standardized Coefficients	t
		B	Std. Error	Beta	
1	(Constant)	76.051	2.223		34.210
	Agility	-2.470	.186	-.726	-13.251
2	(Constant)	84.988	3.635		23.381
	Agility	-1.743	.208	-.512	-8.378
	VO ₂ max	.197	.033	.365	5.969
3	(Constant)	101.517	5.384		18.854
	Agility	-1.536	.205	-.451	-7.480
	VO ₂ max	.171	.032	.317	5.315
	Speed	-2.753	.686	-.214	-4.016
4	(Constant)	87.433	8.010		10.916
	Agility	-1.427	.208	-.419	-6.869
	VO ₂ max	.152	.033	.283	4.677
	Speed	-2.582	.680	-.200	-3.799
	Anaerobic Power	.049	.021	.128	2.348
5	(Constant)	78.407	8.732		8.979
	Agility	-1.276	.214	-.375	-5.969
	VO ₂ max	.162	.032	.301	5.013
	Speed	-2.027	.708	-.157	-2.863
	Anaerobic Power	.054	.021	.140	2.595
	Muscular Endurance	.045	.019	.127	2.410

From the Table – 5, the following regression equations were derived for soccer playing ability of soccer players. Regression equation in obtained scores form = PA

$$Y^1 = C + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5$$

(Soccer Playing Ability (SPA) = 76.051 – 2.470 (Agility) + 0.197 (VO₂ max) – 2.753 (Speed) + 0.049 (Anaerobic Power) + 0.045 (Muscular Endurance).

The regression equation for the soccer playing ability includes agility, VO₂ max, speed, anaerobic power and muscular endurance. As the multiple correlations on soccer playing ability with the combined effect of these independent variables are highly significant, it is apparent that the obtained regression equation has a high predictive validity.

DISCUSSION ON THE FINDINGS

In this study, the soccer playing ability was predicted from 160 inter collegiate level soccer players with the help of selected predictor variables such as speed, agility, flexibility, explosive power, muscular endurance, leg strength, vital capacity, VO₂ max, anaerobic power and resting pulse rate. The soccer playing ability was determined by subjective rating by three experts and was used as the criterion variable. The step wise selection in multiple regression method was used to determine the prediction equation (**Thomas and Nelson, 1990**).

In step wise regression selection method begins with the squared multiple correlation of all the predictor variables with independent variables. The predictor variables are deleted from the regression equation one at a time, and the last two R square due to deletion of the variable is studied, that is, each variable is treated as if it were entered last in the equation. Thus, it is possible to find out which variables adds least when entered last in the equation, and the loss in R square is compared against a criterion of meaningfulness as well as significance. Thus, when a variable does not add meaningfully or significantly to prediction it is deleted, and when no variable is deleted, the analysis is terminated.

In this present study for a multiple correlation of 0.821 with the following ten variables were excluded from a total of variables, namely i) Agility ii) VO₂ max iii) Speed iv) Anaerobic power v) muscular endurance with the probability. Hence, agility, VO₂ max, speed, anaerobic power and muscular endurance were included in the equation with the multiple correlations (R) of 0.821, beyond which the size of the multiple correlation no longer increases to any extend (**Thomas and Nelson, 1990**).

Among the physical fitness variables studied agility, speed and muscular endurance were found as the best predictors of soccer playing ability with significant correlations. **Santhosh and Sivakumar., (2015)** have proved that significantly relationship between the selected football playing ability such as, dribbling ability and selected physical fitness components such as, speed, agility and muscular endurance. The result of the study shows that there was a significant relationship between the dribbling ability and selected motor fitness components such as, speed, agility and muscular endurance. **Joniton and Gopinath (2017)** have found that significantly relationship with football playing ability and the selected criterion variables muscular strength, muscular endurance, cardio respiratory endurance, flexibility, agility, elastic power, among Sri Lankan foot ball players. **Kanwar Mandeep et al., (2017)** have proved that speed and agility were significantly correlated with football skills performance. **Kanyarat Chalowrak et al., (2014)** have showed that the flexibility, balance,

muscle strength and endurance, muscle power speed and agility were significantly correlated to dribbling ability (P The study findings resulted in the positive impact of the physical fitness training program on improving the dribbling ability for soccer players. **Erick Burhain et al., (2020)** have found that the significantly relationship between leg strength, balance, coordination and shooting skill in soccer game. **Fredrik Alfrets Makadada (2022)** have found that the positive and significant relationship between of speed and agility with dribbling skills in soccer games for students of SMK Negeri 1 Modonding.

Among the physiological variables studied anaerobic power and VO₂ max were found as the best predictors of soccer playing ability with significant correlations. **Mahaprasad and Brajanath, (2014)** have found that significant relationship between cardio respiratory endurance, agility, and speed; higher VO₂ max and lower resting pulse rate; and average height and weight; higher BMI, arm length and leg length can predict one's kho-kho skills. **Alessandro Zagatto et al., (2015)** have found that significantly correlation with VO₂ max determined in treadmill running, and correlation with velocity relative to anaerobic threshold, body composition and RAST outcomes. **Amrial Subrata., (2019)** have found that significantly relationship between agility and endurance VO₂ Max with dribbling skills of students of Pekanbaru Forestry Vocational School. **Buket Akinc et al., (2019)** have found that the significantly correlated with Anterior (right) balance ($p=0.036$, $r=0.306$) and VO₂max ($p=0.011$, $r=-0.367$), and the T-test was correlated with postero-lateral (left) balance ($p=0.009$, $r=-0.377$) and VO₂max. **Ingebrigtsen et al., (2014)** have proved that the significantly relationship between yo-yo intermittent recovery 1 and 2 test performance, sprinting speed, repeated sprint ability, heart rate with skills performance soccer players. **Joniton and Gopinath (2017)** have found that significantly relationship with football playing ability and the selected criterion variables forced expiratory volume in one second and VO₂ max among Sri Lankan foot ball players. **Sanjay Kumar (2018)** have football performance were found significantly correlated with calf girth, resting heart rate, vital capacity, diastolic blood pressure at 0.05 level of significance and multiple correlations to anthropometric variables are 0.799 and physiological variables are 0.904. **Aggarwala et al, (2019)** have showed that significantly relationship between VO₂ Max, Anaerobic power and playing ability college level kabaddi players.

CONCLUSION

Among the selected determinant variables agility, VO₂ max, speed, anaerobic power and muscular endurance of the soccer players were highly correlated with soccer playing ability. The predictor variables namely agility, VO₂ max, speed, anaerobic power and muscular endurance can be used to predict the soccer playing ability of the Inter-collegiate level soccer players. The ability of a player in a team game like soccer depends largely in physical fitness and physiological parameters of the players. Present day science is very much interested in estimating the optimum physical fitness and physiological make-up of a player. So the scanning and selection of a particular soccer player may be achieved successfully to a great extent by measuring physical fitness and physiological variables.

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