OPEN ACCESS JOURNALS
Indiana Journal of Agriculture and Life Sciences
Abbreviate Tittle- Ind J Agri Life Sci
ISSN *(Online)*- 2583-1623
Journal Homepage Link- https://indianapublications.com/journal/IJALS
DOI- https://doi.org/10.5281/zenodo.17226623

INDIANA PUBLICATIONS
PRODUCTIVE AND QUALITY RESEARCH

Research Article

ICFFL Goa Conference|2025

An Estimation of Badminton Performance Based on Selected Physical Fitness Components

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Article History
Received: 01.07.2025
Accepted: 20.08.2025
Published: 25.09.2025

Citation
Menon, S. Kumari, M. (2025). An Estimation of Badminton Performance Based on Selected Physical Fitness Components. Goa Conference 2025 Fit for Life: Empowering Youth Through Physical Education, Sports and Traditional Sports. *Indiana Journal of Agriculture and Life Sciences,* 126-131. Indiana Publications.

Abstract: This study aimed to determine the correlation between independent variables (physical fitness components) and dependent variables in badminton performance. To study the joint contribution of independent variables in predicting dependent variables and establish regression equations for predicting dependent variables based on independent variables. Selected variables were physical fitness components - cardiovascular endurance, explosive strength, flexibility, speed, and coordinative ability. Methodology: - For this study, forty All-Indian University Female Badminton players who came to participate at All India Inter University tournament were selected. The age ranged between 18 and 25 years for the subjects. Badminton match performance was considered as the dependent variable. The selected physical fitness Variables were measured by different tests. To find out the correlation between Independent Variables (physical fitness components - cardiovascular endurance, explosive strength, flexibility, speed, coordinative ability) and Dependent variables (Badminton performance), the Product Moment Method of correlation was used. To study the joint contribution of Independent Variables in estimating Dependent Variables, the Multiple correlation method was used. A regression equation was established for predicting Dependent Variables based on Independent Variables. Findings: - There exists a significant relationship between badminton match performance and flexibility. There exists an insignificant relationship between badminton match performance and cardiovascular endurance, explosive strength, Speed, and coordination ability. The regression equation for badminton match performance, four-corner agility test, Speed, sideway agility test, Cardiovascular Endurance, Flexibility, and Explosive strength was found beneficial in estimating Badminton match performance based on selected independent variables (cardiovascular endurance, explosive strength, flexibility, speed, coordinative ability).

Keywords: Badminton performance, physical fitness, Cardiovascular Endurance, Flexibility, Explosive strength, Speed, Coordinative Ability.

INTRODUCTION

Badminton has gained fame all over the world. Badminton is an attacking and defensive game. Especially of the attack is an individual effort while defence is a combined effort. Physical fitness is an inseparable part of sports performance and achievements. In practically all the world's nations and civilizations, many people have participated in or watched the field of human endeavour known as sports. The world's perception of competitive sports drastically changed during the past few decades. Sports competitions are now a highly thrilling and challenging endeavour as society becomes increasingly interested in the performance of its athletes and players at the national and international levels (Brar, et al., 2010). An ever-expanding aspect of human life is sports. From extremely primitive beginnings, human society's activities have developed into one that is highly organized. An athlete's ability to combine physical prowess, conditioning, training, mental toughness, and the capacity to perform well under pressure determines whether they succeed or fail. A high level of physical skill and a keen mental focus are both necessary for competitive sports. In a sport where many athletes are becoming more physically, technically, and strategically similar, the mind may provide the greatest opportunity for a competitive advantage (Kathuria, & Nanda, 2013).

Sports, a vital component of society, have a significant and positive impact on a variety of social sectors. According to this, a society's entire socioeconomic structure may be reflected in its sports. In contrast to other activities, sports do not have an end goal. Essentially, it is done for its own sake. When asked why they play, most people will respond that they do so for enjoyment, fun, or full fulfilment. The sport is a career that promotes teaching different sports and games with rules and regulations and gets students ready to participate actively in competitive sports. It develops from man's effort to survive on a dangerous planet.

Sports have evolved into a highly competitive and organized social phenomenon in the modern world due to their quick expansion and development. It is clearly divided into three categories based on the level of participation: competitive sports for young people and adults, and health and conditioning sports for older people. The level of competition intensity is another factor used to rank competitive sports. The greatest level of competition is regarded as the top sport when the level of physical exertion causes the athlete's heart rate to increase to roughly 180–200 beats per minute. Sports are evolving into a scientific field as they get more and more sophisticated. Each country competes with the others to

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produce elite athletes who can win medals in international tournaments. It takes a lot of research and development to pinpoint the several elements that can help athletes who are receiving the right coaching achieve high levels of skill performance (Harrold, 1969).

All of these may help to explain why kids might become so enthusiastic when playing badminton for the first time. It feels like a lot accomplished and a tonne that is doable. If global participation and spectator counts are any indications, the excitement is contagious and seems to extend to the adult population. The new coach faces difficulty in figuring out how to channel all this energy into a fun badminton introduction.

One of the most well-liked sports in the world is badminton, a fast-paced game with ancient roots. The intricacy of the game is revealed through a variety of performance criteria. The sport is distinguished by its sporadic, high-intensity movements. The activity in the game requires both aerobic and anaerobic energy.

Physical fitness psychological and physiological profiles significantly influence performance in various sports and games. Some games, like chess, may not be greatly influenced by a player's physical attributes, physiological profile, or level of physical fitness. Every sport has certain requirements that must be met to excel. Many athletes, including Michael Phelps in swimming, Michael Jordan in basketball, Usain Bolt in athletics, P.V. Sindhu, and Saina Nehwal in badminton, have demonstrated how physique psychological and physiological profiles affect performance.

Objective:

- To establish a regression equation for predicting Dependent Variables based on Independent Variables
- To find out the correlation between Independent Variables (physical fitness components - cardiovascular endurance, explosive strength, flexibility, speed, coordinative ability) and Dependent Variable (Badminton performance).
- To study the joint contribution of Independent Variables in estimating Dependent Variables.

METHODOLOGY

Selection of subjects: For this study All-Indian University Women Badminton Championship L.P.U. Jalandhar 2022-2023. Number of subjects fourteen (40) players were selected. The age of the subjects was ranging between 18 to 25 years.

Dependent variables: The following dependent and independent variables were selected:

Independent variables

Physical Fitness Components:

- Cardiovascular Endurance,
- Explosive Strength
- Flexibility
- Speed
- Coordinative Ability

Criterion measures: The following were the criterion measures selected for the study:

Physical Fitness Components:

- Cardiovascular Endurance was measured with the help of the Harvard Step Test.
- Explosive Strength was measured with the help of the vertical jump test.
- Flexibility measured with the help of the sit and reach test.
- Speed measured of the 50m dash.
- Coordinative Ability measured by the badminton-specific ability test (**Hughes & Bopf, 2005)**.

BADMINTON SKILLS TEST

Badminton performance was measured by video recording of matches. The 3 panel of judges there used a self-made questionnaire. Three professional panels evaluated match performance by judging the player's skill abilities. A total of self-made 14 questions. The scoring sheets were evaluated using a five-point Likert scale, ranging from Strongly Agree (5) to Strongly Disagree (1). The options included: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. Respondents were instructed to tick the column that best reflected their opinion. for each criterion maximum of 5 marks and overall, 70 marks were awarded for measuring the performance.

Table 1: All India Inter University (WOMEN) Badminton Championship 2022-2023

SL. NO.	NORTH	EAST	WEST	SOUTH
1	D.U N	Bra Bihar University	Devi Ahilya University Indore	University Of Madras
2	M.D.U Rohtak	Manipur University	L.N.I.P.E Gwalior	SRM University
3	MJPRU Bareilly	Ranchi University	SPP University Pune	Jain University,
4	AMU Aligrh	Adamas University	RTM Nagpur University	Rayalaseema University

RESULT AND DISCUSSION

The Product Moment Method of correlation was used to find out the correlation between Independent

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Variables (physical fitness components - cardiovascular endurance, explosive strength, flexibility, speed, and coordinative ability) and Dependent variables (Badminton performance). Multiple correlation method was used to study the joint contribution of Independent Variables in estimating Dependent Variable. A regression equation was established for predicting Dependent Variable based on Independent Variables.

Table 2: Descriptive Statistics of Badminton Performance and Physical Components

Variable	Mean	Std. Deviation	N
Cardiovascular Endurance	95.3385	4.64777	40
Explosive Strength	36.4500	7.34829	40
Flexibility	28.9933	4.17954	40
Speed	7.0480	.50384	40
Sideway agility	22.0255	4.90107	40
Four corner agility	36.6118	5.16809	40

Table 3: Correlation Between Dependent Variable (Badminton Performance) And Independent Variables (Cardiovascular Endurance, Explosive Strength, Flexibility, Speed, Sideway Agility and Four Corner Agility)

Independent Variables	N	Correlation Coefficient (r)	Sig.(2-tailed)
Cardiovascular Endurance	40	.063	0.702
Explosive Strength	40	.203	0.208
Flexibility	40	.345	0.030
Speed	40	.003	0.986
Sideway agility	40	-.028	0.866
Four corner agility	40	-.089	0.586

***Correlation is significant at the 0.05 level (2-tailed), r.05 (38) = 0.312**

Table 3 indicates that there exists a significant relationship between Badminton Performance and Independent Variables i.e. Independent Variable Flexibility as the correlation coefficient value was found to be lower than the tabulated value at .05 level of significance (p=0.030<0.05) moderate correlation and other Independent Variable Cardiovascular Endurance, Explosive Strength, speed and coordination ability as the correlation coefficient value was found lower than the tabulated value at .05 level of not significant.

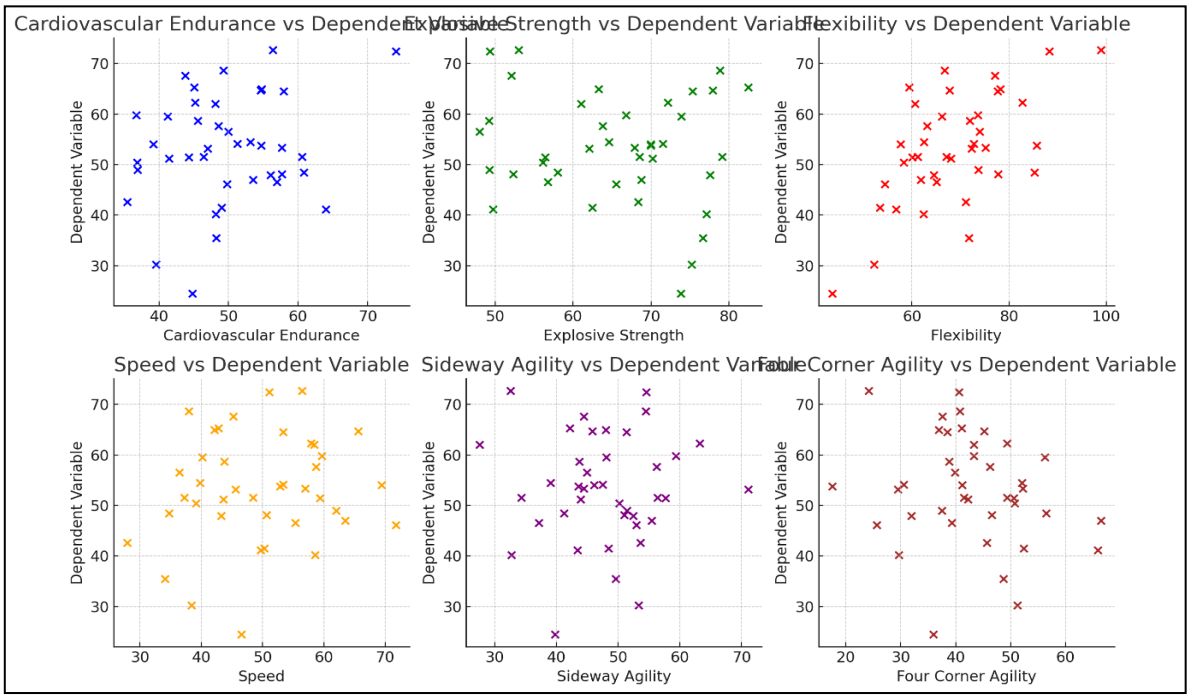

Figure 1: Correlation Between Dependent Variable (Badminton Performance) And Independent Variables

Here is a series of **scatter plots** showing the relationship between each independent variable and the dependent variable. These plots are based on the correlation values you provided:

- **Cardiovascular Endurance**: Very weak positive correlation.
- **Explosive Strength**: Weak positive correlation.

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- **Flexibility**: Moderate positive correlation (the strongest correlation in your data).
- **Speed**: Almost no correlation.
- **Sideway Agility**: Very weak negative correlation.
- **Four Corner Agility**: Weak negative correlation.

Table 4: Correlation Matrix Among Variables

Variables	Cardiovascular Endurance	Explosive Strength	Flexibility	Speed	Sideway agility	Four corner agility
Cardiovascular Endurance	1.000	.098	-.116	-.193	.053	.132
Explosive Strength	.098	1.000	.427	-.262	-.198	-.260
Flexibility	-.116	.427	1.000	-.082	-.173	-.368
Speed	-.193	-.262	-.082	1.000	.047	.083
Sideway agility	.053	-.198	-.173	.047	1.000	.124
Four corner agility	.132	-.260	-.368	.083	.124	1.000

Table 5: Joint Contribution of Independent Variables in Predicting Dependent Variable

	R	R^2	Adjusted R Square	Std. Error of the Estimate	Sig.
Model	.345[a]	.119	.096	5.27334	.029[a]

a. Predictors: (Constant), Cardiovascular Endurance, Speed, Flexibility, Explosive strength, Agility

Table 5 indicates that a significant relationship was found between the criterion variable (Badminton Performance) and independent variables (Four Corner Agility, Speed, Sideway Agility, Cardiovascular Endurance, Flexibility, Explosive Strength) as the coefficient of multiple correlations (R) was found to be significant at 0.05 level of significance.

1. **Model** – This refers to the statistical regression model being analyzed.
2. **R (0.345)** – This is the correlation coefficient, which indicates the strength and direction of the linear relationship between the independent and dependent variables. A value of 0.345 suggests a weak to moderate positive relationship.
3. **R^2 (0.119)** – This is the coefficient of determination, which explains how much of the variance in the dependent variable is accounted for by the independent variables. Here, 11.9% of the variance in the dependent variable is explained by the predictors.
4. **Adjusted R^2 (0.096)** – This adjusts R^2 for the number of predictors in the model to avoid overestimation. Since it is slightly lower than R^2, it suggests that adding predictors does not significantly improve the model.
5. **Std. Error of the Estimate (5.27334)** – This represents the average distance that the observed values fall from the regression line. A lower value indicates a better fit.
6. **Sig. (0.029)** – This is the significance level (p-value). A value of 0.029 suggests that the model is statistically significant at the 5% level ($p < 0.05$), meaning there is enough evidence to suggest a relationship between the predictor(s) and the outcome variable.

Interpretation

- The regression model shows a weak to moderate relationship between predictors and the dependent variable.
- The model explains only about 11.9% of the variance in the dependent variable.
- The adjusted R^2 suggests a similar level of explanatory power.
- The model is statistically significant ($p = 0.029$), indicating that at least one of the predictors has a meaningful effect.

Table 6: Regression Coefficient of Selected Variable in Predicting Dependent Variable (Badminton Performance)

MODEL	Unstandardized Coefficients		Standardized Coefficients		
(Constant)	**B**	**SEB**	**β**	**t**	**Sig**
(Constant)	13.587	27.892		.487	.629
Cardiovascular Endurance	.121	.202	.101	.599	.553
Explosive Strength	.059	.143	.079	.416	.680
Flexibility	.461	.251	.348	1.837	.075
Speed	.736	1.874	.067	.393	.697
Sideway agility	.039	.188	.035	.209	.836
Four corner agility	.039	.190	.036	.206	.838

The above table displays the coefficient values in the regression equation and measures the probability that a linear relationship existed between Badminton performance and the independent variables.

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Multiple Regression Analysis

Y = 13.587 .121 X1 + .059 X2 - .461 X3 – .736 X4 + .039 X5 + .039 X6

Where-

Y = Estimation of Badminton Performance
X1 = Cardiovascular Endurance
X2 = Explosive Strength
X3 =Flexibility
X4 = Speed
X5 = Sideway agility
X6 = Four corner agility

Table 7: Anova Table of Dependent Variable (Badminton Performance)

Model	df	Sum of Squares	Mean Square	F-ratio	Sig.
1	1	142.338	142.33	5.11	.029 [b]
Regression	3	1056.710	8	9	
Residual	8	0	27.808		
Total	3	1199.04			
	9	8			

a. Dependent variable: Badminton performance
b. Predictors: (Constant), Flexibility,

ANOVA tests the null hypothesis that there was no linear relationship between the Badminton performance and Cardiovascular endurance, Explosive Strength, Flexibility, Speed, and Coordination Agility of All India University Badminton players. In the above table, the significance level associated with an observed value of F (5.119) was found to be greater than the tabulated value. Thus, the null hypothesis could be rejected and we may conclude that there was a significant linear relationship between the dependent variable (Badminton performance) and independent variable (Cardiovascular endurance, Explosive Strength, Flexibility, Speed, and Coordination Agility).

DISCUSSION

The statistical analysis of data revealed that Badminton playing ability is significantly related to, Flexibility. It was found that there was a significant difference in cardiovascular endurance, explosive strength, flexibility and speed among the All India university-ranked badminton players. Studies reveal that the probable significant difference in cardiovascular endurance, explosive strength, flexibility, and speed among players is due to the different training programs received by the players at different training centers. Further, it is also supported by a study conducted by **Jeyaraman (2012)** that various essential physical characteristics required for a badminton player are leg explosive strength. A study conducted by **Vijayaragavan et al. (2012)** also supports that strength endurance is an essential element for the study. Strength endurance is one of the types of endurance.

CONCLUSIONS

1. An insignificant relationship was found between Badminton Performance and Cardiovascular Endurance (r =.063, p > .05).
2. An insignificant relationship was found between Badminton Performance and Explosive Strength (r = .203, p > .05).
3. A significant relationship was found between Badminton Performance and Flexibility (r = .345, p < .05).
4. Insignificant relationship was found between Badminton Performance and Speed (r = .003, p > .05).
5. An insignificant relationship was found between Badminton Performance and sideway agility (r = -.028, p > .05).
6. An insignificant relationship was found between Badminton Performance and four-corner agility (r = -.089, p > .05).
7. Insignificant relationship was found between criterion variables (Badminton Performance) and Independent Variables i.e. Cardiovascular Endurance, Explosive Strength, Flexibility, Speed and Coordination Agility (R = .372, p < .05).
8. Regression equation (Badminton Performance = 13.587 .121 Cardiovascular Endurance + .059 Explosive Strength + .461 Flexibility + .736 Speed + .039 sideway agility + .039 four corner agility) was found fructiferous in estimating Badminton Performance on the basis of selected variables (. Cardiovascular Endurance, Explosive Strength, Flexibility, Speed and Coordination Agility).

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