



Multivariate Analysis of Physical, Psychological, and Anthropometric Variables in Sports Performance

Ajay Kumar¹, Dr. Parvin Kumar²

¹ (Research Scholar), Department of Physical Education, Desh Bhagat University, Mandi Gobindgarh, Fatehgarh Sahib

² (HOD), Department of Physical Education, Desh Bhagat University, Mandi Gobindgarh, Fatehgarh Sahib.

Article Info

Article History:

Published: 31 May 2026

Publication Issue:

Volume 3, Issue 5
May-2026

Page Number:

593-600

Corresponding Author:

Ajay Kumar

Abstract:

The present study investigated the multivariate association of physical fitness, psychological variables and anthropometric characteristics on sports performance of national level athletes. A total of 500 athletes aged 18–25 years were purposively selected. Physical fitness variables such as endurance, strength, speed, agility and flexibility were measured by standardised field tests. Psychological variables such as stress, motivation, anxiety, focus and resilience were measured by validated psychometric scales. Anthropometric measures such as height, weight, BMI and body fat percentage were also recorded. Data was analysed using Descriptive statistics, Pearson correlation and Multivariate Analysis of Variance (MANOVA). Results A significant combined effect of physical, psychological and anthropometric variables on sports performance was found (Wilks' Lambda = 0.65, F = 6.72, p < 0.001). Physical fitness variables had the highest contribution to variance in performance and stress was negatively associated with athletic performance. It concludes that sports performance is multidimensional and demands integrated athlete development approaches which combine physical conditioning, psychological training and physiological assessment.

Keywords: Physical Fitness, Psychological Variables, Anthropometry, Sports Performance, Multivariate Analysis, Athlete Performance, MANOVA.

1. Introduction

Sports performance is a complex construct influenced by physical fitness, psychological readiness, and anthropometric features. The physical fitness components such as endurance, strength, speed, agility and flexibility are the structural foundation for athletic performance that has a significant influence on movement efficiency, efficiency of technical execution and competitive effectiveness (Singh & Singh, 2016). However, physical ability is not enough to attain excellence at the national and international levels. Psychological variables such as motivation, confidence, focus, resilience, stress management, and anxiety control are major factors in an athlete's ability to perform under pressure. Competitive stress and performance anxiety are common among athletes and if left unchecked can affect their focus, emotional stability and tactical decisions (Kanchan & Titus, 2018). High level of stress has also been found to have adverse effects on athletic performance and consistency in performance (Mahi & Kaur, 2018).

Anthropometric characteristics such as height, weight, body composition, and body mass index (BMI) also have an important role in sports performance. Suitable body composition is a factor in agility, efficiency of endurance and economy of movement. The structural features of the body may contribute to success in sports such as basketball,

wrestling and athletics (Bhagat et al., 2015). Kumar (2024) also emphasised the importance of anthropometric variables in the assessment and talent identification of athletes. Current sports science acknowledges that athletic achievement is a consequence of the interplay of physiological, psychological, and structural factors rather than a single determinant of performance (Soni, 2023). The differences in the physiological and fitness characteristics of athletes have also been linked to differences in their competitive performance levels (Sanyal, 2018). Hence, integrated analytical approaches are needed to understand the combined effect of multiple variables on sports performance.

Most of the earlier studies have either studied physical fitness or psychological variables separately and very few studies in India have used multivariate analytical techniques to study their combined effect along with anthropometric characteristics. Hence, there is a research gap in understanding the multidimensional determinants of athletic performance by using advanced statistical procedures such as Multivariate Analysis of Variance (MANOVA). In the present study, an attempt has been made to fill this gap by studying the combined effect of physical fitness, psychological variables and anthropometric characteristics on sports performance in national level athletes. The findings may offer useful implications for coaches, trainers, sports scientists and athlete development programs who are seeking evidence-based strategies to optimise performance.

1.1 Need of study

The growing competitiveness in sports nowadays demands the evidence-based development of athletes supported by scientific evaluation models. The sports performance has been studied independently with respect to the physical fitness, psychological readiness and anthropometric characteristics (Bhagat et al., 2015; Singh and Singh, 2016). Psychological factors such as motivation, stress management and focus are also important for athletes in terms of competitive consistency and emotional stability (Kanchan & Titus, 2018). Furthermore, the execution and concentration of athletes during competition have been reported to be negatively affected by high levels of stress (Mahi & Kaur, 2018). Modern sports science emphasises that sports performance is the result of the interaction of physiological, psychological and structural factors rather than isolated performance determinants (Soni, 2023). However, very few Indian researchers have used multivariate analytical techniques to study the combined contribution of physical, psychological and anthropometric variables among national level athletes. The present study tries to address this void by using an integrated statistical analysis to recognise the multidimensional effects on sports performance. The findings could help coaches, trainers and sports scientists to develop evidence-based frameworks for monitoring, training and talent identification of athletes.

2. Objectives of the Study

1. To assess selected physical fitness components among national-level athletes.
2. To evaluate psychological variables influencing sports performance.
3. To examine anthropometric characteristics associated with athletic performance.
4. To analyze the relationship among physical fitness, psychological, and anthropometric variables.

- To determine the combined effect of physical fitness, psychological, and anthropometric variables on sports performance using multivariate analysis.

3. Hypotheses

- H₀₁:** There is no significant relationship between physical fitness variables and sports performance.
- H₀₂:** There is no significant relationship between psychological variables and sports performance.
- H₀₃:** There is no significant relationship between anthropometric variables and sports performance.
- H₀₄:** There is no significant combined effect of physical, psychological, and anthropometric variables on sports performance.

4. Methodology

4.1 Research Design

A descriptive and comparative research design was used.

4.2 Sample

- Total participants: 500 national-level athletes
- Age group: 18–25 years
- Sampling technique: Purposive sampling

4.3 Variables

Table 1: Classification of Study Variables Used for Multivariate Analysis

Variable Type	Variables
Physical Fitness	Endurance, Strength, Speed, Agility, Flexibility
Psychological	Stress, Motivation, Anxiety, Focus, Resilience
Anthropometric	Height, Weight, BMI, Body Fat %
Dependent Variable	Sports Performance

4.4 Tools and Instruments

Table 2: Tools and Instruments Used for Measurement of Study Variables

Variable	Tool / Instrument Used
Endurance	12-Minute Cooper Run Test
Strength	Hand Grip Dynamometer
Speed	50-Meter Sprint Test
Agility	Illinois Agility Test
Flexibility	Sit and Reach Test
Stress	Perceived Stress Scale (PSS)
Motivation	Sports Motivation Scale (SMS)
Anxiety	Competitive State Anxiety Inventory-2 (CSAI-2)
Resilience	Connor-Davidson Resilience Scale (CD-RISC)

5. Statistical Techniques

Descriptive and inferential statistical technique were used to analyse the collected data to investigate the relationship and combined influences of physical fitness, psychological and anthropometric variables on sports performance of national level athletes. The data were analysed using Mean and Standard Deviation. Pearson Product Moment Correlation was used to analyse the relationships between the variables and sports performance. MANOVA (Multivariate Analysis of Variance) was used to determine the combined multivariate effect of the independent variables on the athletic performance. Prior to MANOVA assumptions of normality, homogeneity of variance-covariance matrices and multicollinearity were checked. The normal distribution was confirmed by Shapiro–Wilk tests ($p > 0.05$) and the equality of covariance matrices by Box’s M test (Box’s $M = 21.48$, $p = 0.084$). The Variance Inflation Factor (VIF) values ranged from 1.24 to 2.11, which confirmed the absence of multicollinearity among the independent variables.

6. Results

6.1 Descriptive Statistics

The descriptive analysis showed that the athletes' characteristics in terms of physical fitness were balanced, and in terms of psychological fitness were at a moderate to high level. Overall, endurance and agility scores were satisfactory and required for competitive sports. The psychological measures indicated high levels of motivation and resilience,

and stress levels were moderate. The lower value of standard deviation indicated the homogeneity and consistency of the samples when responding to the questions.

Table 3: Descriptive Statistics of Physical Fitness, Psychological, and Anthropometric Variables Among National-Level Athletes

Variable	Mean	SD
Endurance	72.46	8.31
Strength	41.72	5.28
Speed	6.84	0.54
Agility	15.62	1.21
Flexibility	28.74	4.16
Motivation	31.58	3.84
Focus	29.76	4.02
Stress	18.42	3.96
Resilience	30.14	4.37
BMI	22.36	2.14

6.2 Correlation Analysis

Table 4: Correlation Analysis Between Selected Variables and Sports Performance Among National-Level Athletes

Variables	Performance
Endurance	0.69*
Strength	0.57*
Agility	0.63*
Motivation	0.66*
Focus	0.61*
Stress	-0.48*
BMI	0.39*

Note : *Significant at 0.05 level

The results of the correlation analysis showed that there were significant positive correlations between sports performance and the four factors. and agility, focus, motivation and endurance. Endurance proved to have the best A positive relationship is shown and represents the need for continued physiological efficiency. competitive sports. The results indicated that there was a negative relationship between stress and performance, meaning that high psychological stress negatively impacts on athletic performance and focus. Moderate The positive correlation between BMI and performance suggested that the body weight is the right weight. composition has a positive effect on efficiency of movement and recovery.

6.3 Multivariate Analysis (MANOVA)

The MANOVA showed that the physical, psychological and anthropometric variables significantly affected the sports performance when analysed as a whole. The most significant variables were physical fitness variables with high effect size (Partial Eta Squared = 0.31), suggesting their significant role in the performance outcomes. Other psychological factors, specifically those regarding motivation, concentration and stress management were also important predictors of athletic performance. The anthropometric variables moderately but significantly indicated that physiological structure and body composition have an influence on movement economy and biomechanical efficiency. The integrated assessment models proved to be useful for assessing sports performance, as the significant combined effect was shown (Wilks' Lambda = 0.65, $p < 0.001$), meaning sports performance is multidimensional.

Table 5: Multivariate Analysis of Variance (MANOVA) Showing Combined Effect of Physical Fitness, Psychological, and Anthropometric Variables on Sports Performance

Source	Wilks' Lambda	F-value	p-value	Partial Eta Squared
Physical Fitness Variables	0.68	5.84	0.001	0.31
Psychological Variables	0.74	4.91	0.003	0.26
Anthropometric Variables	0.81	3.26	0.017	0.18
Combined Effect	0.65	6.72	0.001	0.36

7. Discussion

The findings of the study confirm the multidimensionality of sports performance and its influence, which is the result of a combined interaction between physical fitness, psychological readiness and anthropometric characteristics. Physical fitness variables were most important for athletic performance, emphasizing the need for endurance, strength and agility for an athletic competitive efficiency and quality of movement. The psychological variables (motivation and focus) positively affected on the consistency of performance, while the intensive stress negatively affected on concentration and execution in competition. Anthropometric parameters also were important factors for movement economy and biomechanical efficiency. The findings are in line with the existing literature in sports science that

stresses the fact that athletic success is not attributed to single factors of performance. The important MANOVA findings also highlight the value of the multivariate statistical approaches in examining the overall influence of several determinants on sports performance. This study thus suggests that an integrated approach to athlete development be implemented to encompass physical conditioning, psychological skills training, nutritional support and anthropometric monitoring. The results have implications for coaches, trainers and sport scientists who are working with athletes for monitoring and talent identification. Multidimensional assessment modalities and psychological conditioning can enhance performance optimization and LAT. Further longitudinal and sport specific studies can build upon these findings.

8. Conclusion and Recommendations

The conclusion of the study is that physical fitness, psychological readiness and anthropometric characteristics influence sports performance of national level athletes significantly, independently and collectively. The multivariate results support the view that athletic success is a function of an integrated interaction of physiological, psychological and structural factors and not isolated determinants of performance. Physical fitness variables were found to be the most important contributors to sports performance while psychological factors like motivation and focus showed significant secondary influence. Anthropometric characteristics also contributed to efficiency of movement and effectiveness in competition. The results from the MANOVA analyses confirm the hypothesis that integrated assessment models are more effective than analytical approaches to the assessment of athletes' performance. Based on this, the study recommends the application of interdisciplinary athlete development systems, which include physical training, psychological skills training, nutrition management, and anthropometric monitoring. The results have practical implications for coaches, trainers and sports scientists who are interested in evidence-based approaches to optimize performance. The paper also suggests that the following areas need attention in sports: psychological training of athletes, individualized training depending on anthropometric profile, multivariate analysis for talent identification, improved access to sports science support systems, and region-specific models of athlete development.

References

1. Bhagat, U., Singh, A., & Deol, N. S. (2015). Comparative study of selected anthropometric, physical fitness and psychological variables. *Indian Journal of Applied Research*, 5(6), 557–560.
2. Kanchan, & Titus, S. (2018). Psychological variables in sports performance. *Paripex Journal*, 7(8), 39–41.
3. Kumar, V. (2024). Anthropometric variables in school athletes. *International Journal of Sports Science*, 11(5), 112–114.
4. Mahi, K. P. S., & Kaur, S. (2018). Study of stress in boxing players. *International Journal of Sports Sciences*, 3(1), 719–720.
5. Sanyal, O. (2018). Physiological differences in football players. *Journal of Sports Science*, 3(1), 70–72.

6. Singh, H., & Singh, P. (2016). Comparative analysis of physical fitness among hockey players. *International Journal of Physical Education*, 3(4), 82–84.
7. Soni, V. (2023). Psychological and physiological variables in badminton players. *International Journal of Physical Education*, 10(1), 366–368.