Journal for Research in Applied Sciences and Biotechnology

www.jrasb.com

ISSN: 2583-4053

Volume-2 Issue-3 || June 2023 || PP. 183-188

https://doi.org/10.55544/jrasb.2.3.24

Development of Discriminant Model for Classifying Sprinters and Throwers on the Basis of Anthropometric and Physical Fitness Variables

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www.jrasb.com || Vol. 2 No. 3 (2023): June Issue

Received: 25-05-2023	**Revised:** 11-06-2023	**Accepted:** 21-06-2023

ABSTRACT

In the present study, 100 athletes who competed at the state level was constitute up the sample; only male athletes from Madhya Pradesh in the senior category was included. During the morning and evening sessions, the necessary information on the subject was gathered using the random sampling method. before the National camps and practicing at TT Nagar Stadium Bhopal. The data were collected on anthropometric variables i.e. height, weight, sitting height, (leg, arm, hand) length, shoulder width, (chest, hip, thigh, calf) circumference, (back, shoulder, grip and leg explosive) strength. The anthropometric variables were measured by using selected standardized instruments and measuring tapes. Data collected was analysed at 0.05 level of significance, descriptive statistics and multiple discriminant analysis was applied to classify and predict group membership of the throwers into the sprinters and Throwers. The results showed that 100.0% of original grouped cases were correctly classified.

Keywords- Throwers, Sprinters, Anthropometry, Physical fitness, Athletes.

I. INTRODUCTION

From recent years, more focus has been given on identifying the various anthropometric and physical variables that can distinguish the position/role of an athlete in each sport. Several factors are responsible for an athlete to achieve good performance. These factors vary from sport to sport, individual to individual and in team as well as individual sport along with position to position. Out of these numerous factors, the human physique is one of the most important components for distinguishing an athlete. Several researchers have mentioned that specific physical or anthropometric characteristics can be used for identifying athletes who can perform well in a higher level of competition in their sport. Out of the numerous sports, nothing is being done before for classifying athletes, especially among throwers and sprinters based on physical and anthropometrical demands on track and field.

Depending upon the nature of the athletes, there are specific demands placed on an athlete for both throwers and sprinters. Generally, in Athletics as per the nature and the criteria of the sport, both physical and anthropometric necessary requirement changed a lot, preferences are given to athletes with better body composition with respect to the nature of event who can perform better. In the case of throwers (, it seems to be quite difficult, as they concentrate more on explosive upper limb strength and they hardly devote time in running sessions to improve their endurance ability. But it doesn't mean that they can't run or they never run.

Not only fitness but physique of a player is also equally important in most of the athletic events, and sometimes accordingly, the event of an athlete is determined. For example, among runners, developed muscular and explosive strength are considered to be better for sprinting events with white twitch fibres. In Track and Field sprinters & throwers have a unique role

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to play. A sprinter needs some specific qualities that are different from the throwers; similarly, a thrower needs some particular traits that make him different form sprinter. There are lots of reviews and researches were done on the comparison between these two groups (sprinters and throwers) in Track and Field. Few parameters were found to be significant, that shows the groups differ from one another. Out of these parameters, some parameters repeatedly show significant differences between the groups, which are selected in this study. But to the best of our knowledge, no single research has been done to develop a discriminant model out of these parameters that classify the Track and Field athletes into sprinters or throwers. This study aimed to develop a discriminant model for classifying athletes into sprinters and throwers based on selected anthropometric and physical variables.

II. METHODOLOGY

In the present study, 100 athletes who competed at the state level was constitute up the sample; only male athletes from Madhya Pradesh in the senior category was included. During the morning and evening sessions, the necessary information on the subject was gathered using the random sampling method. before the National camps and practicing at TT Nagar Stadium Bhopal.

The subjects were keenly examined and tested. Places where the players were approached 1) Training centre 2) coaching camps that are held Prior to competing in national level championships.

Selection of the Variables

1. Anthropometric measurements

a) Height b) Weight c) Sitting height d) Leg length e) Arm length f) Hand/Palm length g) Shoulder width h) Chest circumference i) Hip circumference j) Thigh circumference k) Calf circumference

2. Physical variables a) Back strength b) Shoulder strength c) Grip strength d) Explosive strength of legs

Criterion Measures:

The accuracy of all anthropometric measures was 1/10th of a centimetre. The length was measured using non-stretch measuring tape. The subjects' heights were measured using a Stadiometer. Measurements were made with a measuring tape for the standing broad jump and medicine ball throw. The measurement was accurate to within 1/10th of a centimetre. Hand grip strength: A handgrip dynamometer was utilized to assess each subject's grip power. The best outcome of the dominant hand was measured to within 0.1kg. Back and leg strength: Leg and back power A dynamometer was used to evaluate the strength of the legs and back. The weight was calculated to the closest 0.1kg.

Test and Criterian Measures Anthropometrical Measurement

PHYSICAL FITNESS			
S. No.	Variables	Test	Criterion Measures
1	Back strength	**Back strength dynamometer**	**performance was recorded nearest to the 0.1kg.**
2	Shoulder strength	**Medicine ball throw**	**Readings were recorded to the 0.1 cm**
3	Grip strength	**Grip strength dynamometer**	**performance was recorded nearest to the 0.1kg.**
4	Explosive strength of legs	**Standing Broad Jump**	**Readings were recorded to the 0.1 cm**

The following statistical methods were used to analyse the study's data:

1. In order to have a basic picture of performance at particular predictor variables, descriptive statistics were used.
2. Due to predictive variables, discriminant was used to place a person into one of the two categories.

III. RESULTS

Here in the above-mentioned Table no. 1, descriptive statistics has been shown with respect to different anthropometric and physical variables among sprint.

Table 1: Descriptive Statistics of Sprinters

	N	Minimum	Maximum	Mean	Std. Deviation
Height	**50**	**149.00**	**177.00**	**162.420**	**7.78562**
Weight	**50**	**53.00**	**81.00**	**65.3600**	**7.76901**
Sitting Height	**50**	**85.00**	**98.00**	**91.5400**	**5.13972**
Arm length	**50**	**60.00**	**87.00**	**74.6800**	**6.25460**
Leg length	**50**	**83.00**	**104.00**	**94.5400**	**4.72168**
Hand Length	**50**	**15.00**	**18.00**	**16.4500**	**.72316**

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Shoulder Width	**50**	**37.00**	**42.00**	**38.8800**	**1.27199**
Chest Circumference	**50**	**77.00**	**96.00**	**87.8400**	**3.81383**
Hip Circumference	**50**	**82.00**	**96.00**	**88.2200**	**2.72022**
Thigh Circumference	**50**	**51.00**	**57.00**	**52.9400**	**1.60878**
Calf Circumference	**50**	**31.00**	**38.00**	**34.6600**	**1.80261**
Back Strength	**50**	**61.00**	**98.00**	**78.9400**	**8.24475**
Shoulder Strength	**50**	**4.30**	**6.94**	**5.6006**	**.72313**
Grip Strength	**50**	**102.00**	**119.00**	**107.9000**	**4.70020**
Legs Explosive Strength	**50**	**2.03**	**2.70**	**2.3384**	**.19152**

Table 2: Descriptive Statistics of Throwers

	N	Minimum	Maximum	Mean	Std. Deviation
Height	**50**	**169.00**	**189.00**	**176.5200**	**5.13587**
Weight	**50**	**56.00**	**99.00**	**78.2400**	**12.02643**
Sitting Height	**50**	**86.00**	**114.00**	**105.3800**	**5.52874**
Arm length	**50**	**70.00**	**84.00**	**77.8000**	**2.96235**
Leg length	**50**	**93.00**	**110.00**	**100.7000**	**3.51817**
Hand Length	**50**	**17.50**	**19.50**	**18.6100**	**.58283**
Shoulder Width	**50**	**38.00**	**44.00**	**42.1600**	**1.23899**
Chest Circumference	**50**	**84.00**	**122.00**	**98.8200**	**7.76357**
Hip Circumference	**50**	**85.00**	**122.00**	**101.6400**	**7.93792**
Thigh Circumference	**50**	**51.00**	**60.00**	**55.7000**	**2.23379**
Calf Circumference	**50**	**33.00**	**40.00**	**37.2800**	**1.62932**
Back Strength	**50**	**72.00**	**110.00**	**88.0000**	**7.52953**
Shoulder Strength	**50**	**7.00**	**10.80**	**9.3604**	**.72540**
Grip Strength	**50**	**117.00**	**132.00**	**124.6600**	**3.61183**
Legs Explosive Strength	**50**	**1.62**	**2.70**	**2.3053**	**.23063**

Here in the above-mentioned Table no. 2, descriptive statistics has been shown with respect to different anthropometric and physical variables among throwers.

Table No. 3: Unstandardized Canonical Discriminant Function Coefficients

	Function
	1
Height	**.039**
Weight*	**-.002**
Sitting Height	**.030**
Arm length	**-.042**
Leg length	**.035**
Hand Length	**.492**
Shoulder Width	**-.036**
Chest Circumference	**.036**
Hip Circumference	**.029**
Thigh Circumference*	**.007**
Calf Circumference	**.134**
Back Strength*	**.000**
Shoulder Strength	**.892**

ISSN: 2583-4053
Volume-2 Issue-3 || June 2023 || PP. 183-188
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Grip Strength	**.142**
Legs Explosive Strength	**-.571**
Constant	**-50.09**

* Variables are excluded from discriminant function equation

These coefficients were used to develop the discriminant function. The resulting discriminant model included all variables except Leg length, Thigh Circumference and Shoulder Strength as their coefficient value is too small. Thus, the discriminant function 1 developed by using these discriminant coefficient was as follows:

$$= -50.09 + (.039 \times X_1) + (.030 \times X_2) + (-.042 \times X_3) + (.035 \times X_4) + (.492 \times X_5) + (-.036 \times X_6) + (.036 \times X_7) + (.029 \times X_8) + (.134 \times X_9) + (.892 \times X_{10}) + (.142 \times X_{11}) + (-.571 \times X_{12})$$

Table No. 4: Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	**.047**	**276.246**	**15**	**.000**

The value of Wilks' lambda distribution as shown in Table 3 is 0.047. The value of Wilks' lambda falls between 0 and 1. A lesser Wilk's lambda value indicates the robustness, whereas its higher value indicates the weakness of the model. Therefore, the discriminant model developed for function 1 can be considered to be good enough for developing a discriminant function.

Table No. 5: Classification Results

		Status	Predicted Group Membership		Total
			Sprinters	Throwers	
Original	**Count**	**Sprinters**	**50**	**0**	**50**
		Throwers	**0**	**50**	**50**
		Ungrouped cases	**0**	**76**	**76**
	%	**Sprinters**	**100.0**	**.0**	**100.0**
		Throwers	**.0**	**100.0**	**100.0**
		Ungrouped cases	**.0**	**100.0**	**100.0**

a. 100.0% of original grouped cases correctly classified.

Table 5 is a classification matrix which provides the summary of correct and incorrect classifications of subjects in both groups by the discriminant model. It can be seen that the percentage of correct classification amounted to 100%, which is good and therefore it may be concluded that discriminant model is efficient.

Table No. 6: Standardized Canonical Discriminant Function Coefficients

	Function
	1
Height	**.259**
Weight	**-.017**
Sitting Height	**.161**
Arm Length	**-.206**
Leg Length	**.146**
Hand Length	**.323**
Shoulder Width	**-.045**
Chest Circumference	**.221**
Hip Circumference	**.172**
Thigh Circumference	**.013**

ISSN: 2583-4053
Volume-2 Issue-3 || June 2023 || PP. 183-188
https://doi.org/10.55544/jrasb.2.3.24

Calf Circumference	**.231**
Back Strength	**.001**
Shoulder Strength	**.646**
Grip Strength	**.597**
Legs Explosive Strength	**-.121**

Table 6 shows that the relative strength of the variables selected in the discriminant model on the basis of their discriminating power. The variable with a higher coefficient is more powerful in discriminating between the two groups. Since the wilks' lambda of function 1 is insignificant, only coefficient of function 1 had been taken consideration. The coefficient value of shoulder strength is .646, i.e., maximum, therefore the discriminant power of this variable is maximum as well. On the other hand, the coefficient of back strength was 0.001, which shows that this variable had the least discriminant power among the fifteen variables.

Table No. 7: Functions at Group Centroids

Status	**Function**
	1
Sprinters	**-4.446**
Throwers	**4.446**

Unstandardized canonical discriminant functions evaluated at group means

Table 7 gives the new means for the transformed group's centroid. Thus, the new mean for Group 1 (sprinters) is -4.446, mean for group 2 (Throwers) is 4.446. This indicates that the mid-point between the two groups is zero. These two means can be plotted on a straight line by locating the mid-point as shown in Figure 1. This figure 1 gives the criteria for classifying any new subject. If the discriminant score of any athlete lies on the left side of the midpoint i.e. $Z < 0$, he may be classified into the Sprinters, whereas if it lies on the right side of the midpoint i.e. $Z > 0$, the athlete may be classified into the Throwers.

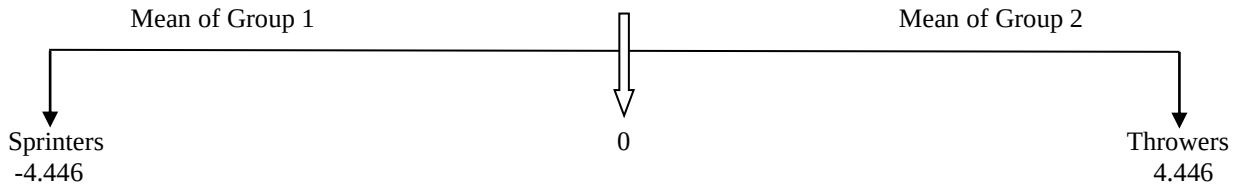

Figure 1: Means of the Transformed Group Centroids

IV. DISCUSSION AND CONCLUSIONS

For the purpose of the present investigation in the study, the sample were comprised of 100 athletes who had participated at state level competitions of senior category age group belonging to Madhya Pradesh. The random sampling technique was utilized to collect the required data of the subject during the evening and morning session before the National camps and practicing at TT Nagar Stadium Bhopal. The participants will be keenly examined and tested.

The discriminant model indicates high accuracy in classifying the subjects correctly into groups among sprinters and throwers. The classification matrices that serve as a yardstick in measuring the accuracy of the model in classifying a subject into one of the two groups, indicates, overall, 100% of the variables were correctly classified. Hence themodel is efficient in predicting the subjects into one of the two groups.

The fifteen predictor variables that were selected in the model are Height, Weight, sitting height, Leg length, Arm length, Hand length, Shoulder width, Chest circumference, Hip circumference, Thigh circumference, Calf circumference and physical variables were Back strength, Shoulder strength, Grip strength, Explosive strength of legs. Out of these fifteen predictor variables shoulder strength ability has the highest discriminating power in discriminating the two groups followed by back strength for least determinant factor.

CONFLICT OF INTEREST

Authors declare no conflict of interest

ISSN: 2583-4053

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https://doi.org/10.55544/jrasb.2.3.24

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