Prediction of 100 m Speed Performance in Relation to Anthropometric Measurements and Specific Fitness Tests

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ABSTRACT

The purpose of the study was to develop the regression equation for the prediction of 100 meter performance of male athletes and also to determine the correlation between the selected anthropometric and specific fitness tests. The ridge regression and product moment methods were used to develop regression equation and for calculation of correlation, respectively. The study was conducted on twentytwo 100 m male sprinters who were preparing for various competitions in Sports Authority of India Southern Centre, Bangalore, and various SAI training centres. In addition to 100 m competition performance, various selected specific fitness and anthropometric measurements were taken, on each athlete, by using standard instruments, following standardized techniques.

From the results, it was found that 100 meter performance is highly correlated with 30 m 60 m, and 300 m run, body weight, height, lean body mass, body fat, standing broad jump, 10 boundings and 4 kg overhead backward throw variables. A non-significant correlation was found between 100 m performance and trunk flexibility.

From this, it is clear that an increase in the readings of body weight, height lean body mass, standing broad jump, 10 bounding and 4 kg overhead backward throw will increase the performance of 100 sprinters.

We can also make out that a decrease in the BF% will increase the performance. Similarly, decrease in time taken to cover 30 m and 60 m will enhance the performance of 100 meter runner.

It has also been found that almost all the selected anthropometric and specific fitness variables were significantly inter-correlated, except for forward bend and reach variable.

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INTRODUCTION

Sports training is a long term training process; and for best results, it has to be controlled and regulated. Without effective control of sports training, the desired results cannot be achieved. On the basis of test results, one can conclude the nature and amount of training to be carried out, in future training cycle.

Recently, it has been clear that excellence in performance, in track and field events, can be achieved only when an individual, inherent and trained in physical capability, matches with the requirements of the specific events. The performance of a sportsman, in athletics, depends on various physical, morphological parameters, i.e., body composition. For achievement of high level performance in track and field, the development of high degree of conditional, technical and coordinative abilities are of utmost importance.

Analysis of training of the world's best track sprinters indicate that top performance, in short distance events, is not an outcome of training of one or two years. An intensive training with specific objectives over many years is the main reason for getting to the top (Schmolinsky, 1978; Arthur, 1981; Bauersfeld, 1998).

Chauhan et al (2003) conducted study on shcool boys of Haryana in relation to their anthropometric measurements and sprinting ability. It was found that body composition variables, lean body mass and fat weight have significant and negative correlations with sprinting performance in 100 meter run. This clearly shows that negative correlation of lean body mass and fat weight with performance decreases the time to complete the 100 meter sprint.

Singh et al (2009) conducted a study on the effect of plyometric drills, executed in vertical and horizontal plane, on running speed. He concluded that various jumping exercises executed in vertical and horizontal plane, lead to improvement in running speed.

Jain (2004) indicated in his study that there are many components in the body, e.g., its composition, muscle mass, bone mass and fat mass which also play an important role. Higher lean body mass (muscle mass and bone mass) and lower fat mass is an indicator of good health by means of scientific back up, because fat mass is less metabolically active than lean body mass. To keep body physically as well as mentally fit, the higher the lean body mass and the lower the fat mass, are necessary.

Jossen et al (2007) conducted a study on 60 boys of 11 to 15 years age group, to identify the relationship between thigh girth, leg strength, leg length and flexibility, on sprinting performance. It was found that among 11 and 12 year boys, there was positive and significant relationship between sprinting performance and thigh girth, leg strength and leg length. It was also found that there was no significant correlation between ankle flexibility and sit and reach to sprinting performance. When partial correlations were computed, there was significant correlation between sprinting performance and leg strength.

But, in the age group between 14 and 15 years boys there was significant correlation between sprinting performance and leg length and no significant correlation between thigh girth, leg strength, ankle flexibility and sit and reach. When partial correlation was computed, leg length had significant corelation to sprinting performance. Sprinting performance had no significant relationship with thigh girth, leg strength, ankle flexibility and sit and reach.

Dare et al (1998) suggested below mentioned tests to find out the sprinting ability of an athlete :

- 30m flying start...........To measure speed
- 30m crouch start.........To measure acceleration
- 60m crouch start.........To measure speed endurance (Alactic)
- Standing long jump... To measure leg power

The sprint is determined by the ability to accelerate, the magnitude of maximum velocity and the ability to maintain velocity against the onset of fatigue. Sprint performance depend on various fitness and body constitutional parameters. Improving one of these parameters may improve the whole performance. The sprinters require more than just the finish time, to evaluate and prepare properly their racing proficiency.

Selection of cyclic and acyclic exercises for the development of various competition performances or performance determining factors is very complex; and it should be done very carefully. Various studies in the field of competitive sports suggest specific exercises to develop competition performance, in a particular event/sports discipline (Singh et al, 2003).

Several research studies conducted by many scientists, i.e., Clarke (1957); Tanner (1964); Chauhan (2003); Singh et al (2003); Ranawat & Kang (2010) have given the characteristics of various sportsmen for specific events and relationship of body measurements with physical fitness of specific games and sports, to assist in the talent selection of sportsperson. They have also emphasized that top level performance, in a particular event, demands particular fitness and anthropometric characteristics.

Considering the above mentioned studies, one can conclude that various selected specific fitness and body constitutional parameters are very important for achieeving high level of performance in sprinting events.

Therefore, in this study, an attempt has been made to find out the relationship of selected fitness and anthropometric parameters with the performance of elite 100m male sprinters, during the process of developing the equation of prediction.

METHODOLOGY

The present study was conducted on twentytwo 100m male elite sprinters, who were preparing for various domestic meets, Asian and Commonwealth competitions, at SAI Southern Centre, Bangalore; and other south sub training centers.

The standard testing procedures were applied to measure selected anthropometric and specific fitness variables like height, body weight, body fat percentage, lean body mass, 30m run, 60m run, 300m run, standing broad jump (SBJ), 10 bounding and forward bend and reach(FBR) and over head backward throw of 4 kg shot (OHBT). 100m performance was recorded either during the domestic trial and/or domestic and international competitions.

To have a feel for the data, some descriptive statistics like Mean, SD and Standard Error (mean) were computed for the abovesaid variables. They are given in Table 1 and Table 2.

Further to meet the main objectives of the present study, Pearson's Product Moment Correlation Coefficient and Multiple Linear Regression statistical tools/techniques were used. During the process of developing regression equation passing through the origin, we came across the inter-dependency of the independent variables, which is evident from the correlation matrix given in Table 3. In statistical literature, this is called as multicollinearity problem. To tackle this problem, we used ridge regression estimation technique. After the multicollinearity problem was solved, since there were many predictors in the equation, we used Backward Variable Selection Method to select only those predictors which are significantly contributing to the model. The above said work was carried out using the statistical packages SPSS (version 11.5) and R.

RESULT & DISCUSSION

Table-1 : Mean, SD and Std. Error (Mean) Values of 100m Performance and Selected Specific Fitness Variables

Variables (Sec)	100m (Sec)	30m (Sec)	60m (Sec)	300m (cms)	S.B.J. (mts)	10 Boundings (mts)	4kg (cms)	FBR
Mean	10.773	3.7809	6.8036	35.8136	290.3182	28.9636	15.76	13.8636
SD	0.310	0.11731	0.1565	1.24223	17.45576	3.41079	2.31459	2.47455
SE mean	.0662	0.025	0.0334	0.2648	3.7216	0.7272	0.4935	0.5276

Table-2 : Mean, SD and Std. Error (Mean) of Selected Anthropometric Variables

Variables (cms)	Height (kgs)	Body weight (%)	Body Fat (kgs)	Lean body Mass
Mean	172.3636	66.8968	10.15	60.1764
SD	5.64249	6.88585	2.17382	6.31084
SE mean	1.203	1.4681	0.4635	1.3455

Table-3 : Correlation Coefficient Among 100m Performance and Selected Anthropometric Variables

Variables	Ht	Wt	BF%	LBM	30m	60m	300m	SBJ	10B	4kg	FBR
100m	-.50*	-.67**	.50*	-.75**	.67**	.79**	.68*	-.89**	-.88**	-.87**	0.08
Ht		.83**	.01	.80**	-.43*	-.39	-.44*	.57**	.35	.61**	-.01
BWt			-.03	.98**	-.45*	-.56**	-.46*	.62**	.49*	.68**	-.06
BF%				-.24	.42	.46*	.39	-.58*	-.66**	-.53*	.14
LBM					-.51*	-.64**	-.54*	.72**	.62**	.76**	-.10
30m						.71**	.35	-.75**	-.71**	-.68**	-.11
60m							.61*	-.80**	-.74**	-.72**	.07
300m								-.66**	-.68**	-.63**	-.00
SBJ									.86**	.86**	-.11
10B										.76**	-.12
4kg											.07
FBR											

** Correlation is significant at the 0.01 level. * Correlation is significant at the 0.05 level.

The results presented in Table 3 show the relationship of 100m performance with selected specific fitness and anthropometric variables.

The results show significant relationship between the 100m performance and other variables considered in the study, except for forward bend and reach variable. Jossen et al (2007) concluded similar findings in their study on 11 to 15 year old children.

A highly positive correlation of 100 meter performance values with 30m run, 60m run and 300m run indicates that shorter the 30 meter, 60 meter and 300 meter timings better the performance in 100 run i.e. decrease in 100 meter time.

On the other hand a negative correlation of 100 meter performance with body weight, height, lean body mass variables shows that an increase in the values of these test variables lead to decrease in the 100 meter timing i.e. improvement in 100 meter sprint performance. Further, 100m performance is positively correlated with body fat percentage. From this, it is clear that a decrease in the body fat percentage will lead to increase in 100 meter performance by causing decrease in the 100 meter performance values.

Chauhan et al (2003) concluded that body composition variables, lean body mass and fat weight have significant and negative correlations with sprinting performance (100meter run). This clearly shows that negative correlation with lean body mass and fat weight with performance decrease the time to complete the 100 meter sprint.

Similarly a high negative correlation of 100 meter performance with standing broad jump, 10 bounding and 4kg over head backward throw variables shows that an increase in the values of strength tests lead to decrease in the 100 meter timing i.e. improvement in 100 meter sprint performance. Similar conclusion were drawn by Jossen et al (2007) in their study on young children.

We also found that almost all the selected anthropometric and specific fitness variables were significantly inter correlated, except for forward bend and reach variable. It shows that trunk flexibility measured from standing position does not affect the values in running speed, leg strength, shoulder strength and selected anthropometric variables.

In addition to above given findings, we have also observed that there exists a significant correlation among the predictors.

Table-4 : Multiple Correlation and Regression Equation for Prediction of 100m Performance

Dependent Variable (y)	Selected Independent Variables	Regression Coefficients	Coefficient of Multiple Regression	Coefficient of Determination of Multiple Regression
100M performance (secs)	Body Weight (Kg)	0.020 (β_1)	0.999	0.9998
	Lean Body Mass (%)	-0.023 (β_2)		
	30m (secs)	1.209 (β_3)		
	300 m (secs)	0.117 (β_4)		

The multiple regression analysis was carried out to develop the equation of prediction of 100m performance (Y) based on the selected specific fitness and anthropometric variables given in Tables 1 and 2 and the resulted regression equation is as given below :

$$y = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4$$

i.e., $$y = 0.020 x_1 - 0.023 x_2 + 1.209 x_3 + 0.117 x_4$$

where, Y: 100 M performance, X_1: Height, X_2: LBM %, X_3 : 30m, X_4 : 300m

Hence, in simple words, the above equation of prediction is given by

100m performance = 0.020 Height – 0.023 LBM % + 1.209 (30m) + 0.117 (300m)

The proportion of variation in 100m performance explained by Height, LBM %, 30m and 300m is 0.999 (R^2 i.e., Coefficient of Determination).

CONCLUSION

- A decrease in 30m and 60m and 300 m timings leads to improvement in 100 meter performance value.
- An increase in the test values of height, body weight, lean body mass, standing broad jump, 10 bounding and 4 kg overhead back throw variables leads to improvement in 100 meter run timing.
- An increase in the 100 meter performance value is possible by decreasing the body fat % value.

- Trunk flexibility showed statistically insignificant correlation with 100m performance and other independent variables.
- The regression equation can be used for the prediction of 100m performance, based on the predictors: height, lean body mass %, 30m run and 300m run test values.

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