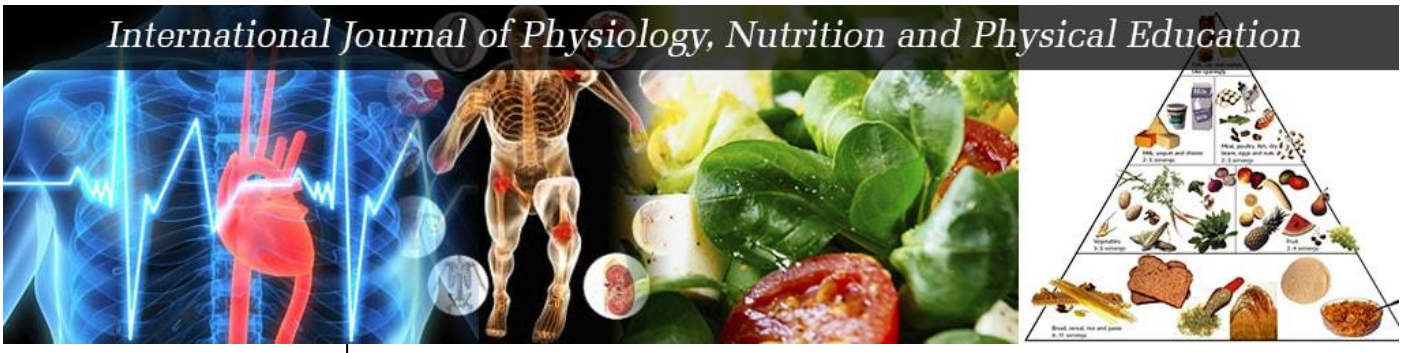

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Analysis of anthropometric, power, intermittent gait and performance related variables of sprinters

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Abstract
The purpose of the present study was to analyze the anthropometric, power, intermittent gait and performance related variables of sprinters. The data were collected from 20 sprinters from various SDAT centers and University of Madras summer camp held during the year 2016-2017. The age of the selected subjects ranged from 18 to 25 years. The present study consists of one criterion variable namely performance of sprinters in 100mts dash and twelve predictor variables namely height, arm girth, thigh girth, calf girth, arm length, leg length, explosive power, elastic power, stride length, stride rate, muscular strength and anaerobic power were selected for this study. They were measured by standard tests. The collected data were statistical analysis to determine the relationship between criterion and predictor variables by using the pearson's product moment correlation. The step wise selection method of multiple regressions was used in this study to find out the contributing variables that have the highest correlation with the criterion variable. The variables were entered into the equation depending on the contribution of each predictor. In all cases 0.05 level of significance was fixed. The results indicate that, the anthropometric, power, intermittent gait and performance related variables are significantly related to sprinting performance.

Keywords: Anthropometric, power, intermittent gait and performance related variables

Introduction

Sports in the present day has become extremely competitive and previous records are being broken at every level of competition. The field of sports is currently undergoing remarkable scientific change and research has improved the whole concept of sports. The advancement of scientific knowledge and technique in the field of physical education and sports help players to attain top level performance. Now sportsmen are able to give outstanding performance because of involvement of new, scientifically substantiated training methods and means of execution of sports exercise such as sports techniques and tactics, improvements of sports gear, as well as other components and condition of system of sports training.

The identification of physical characteristics in a sport modality contributes to its success and enables to spot differences among athletes of different modalities, which is of great interest for both sport coaches and scientists. Sports performance is based in a complex and intricate diversity of variables, which include physical (general and specific conditions), psychological (personality and motivation) and body (body morphology, anthropometry and body composition) factors. The relationship between morphological variables and sports performance is the object of study of anthropometry and it's an important element to be analyzed. The performance of sprinter has been regularly influenced to a great extent by anthropometric variables, power, intermittent gait and performance related variables.

In prediction, results are anticipated beforehand. Usually, the anticipated results are not chance guesses but are based upon some known facts of relationship or carefully conceived beliefs. Anthropometric measurements, power and gait are the some of the factors which really dominates in the sprinting ability. Various studies have pointed out the importance of physical characteristics for different sports such as volleyball Malousaris *et al*., 2007) [6], rugby (Gabbett, 2002) [5], and basketball (Neto e and César, 2005) [3]. The changing nature of game demands better skill and increased physical abilities. It is a known fact that players should be better in morphological measures, body composition,

motor fitness components and physiological traits. But there is no previous study in India to determine the factors, which dominate in sprinting and also to determine the factors, which contribute for successful outcome in the performance. The present study is a sincere attempt on the above so-far unexplored area. Hence, based on the available literatures and the researcher has made an attempt, to explore the analysis of anthropometric, power, gait and performance related variables of sprinters.

Methods

Subjects

The purpose of the study was analyze the anthropometric, power, intermittent gait and performance related parameters of sprinters. To achieve these purpose 20 sprinters on the basis of performance from various SDAT and University of Madras summer camp held during the year 2016-17 were selected as subjects. The subject's age ranged from 18 to 25 years.

Variables

Athletes who are going to win medals at any standard are neither simply born nor made. Natural ability is no longer enough at any level for an essential basis upon which the carefully nurtured product is molded. Strangely enough, natural talent is very readily recognized, but the "stuff" which goes to make up the talent is most difficult to analyze. In track and field, hence the individual sprinting performance of 100 meters was selected as criterion variable.

Through intensive study of literature of sport and on the basis of the experience oriented observation and a number of factors affecting sports performance were identified. Some of these factors were found to be intrinsic while some extrinsic. The intrinsic factors were found to be internal whereas that of the extrinsic factors was found to be external. Internal factors are related to the player's own "interest, will, ability, inherited or acquired qualities" through genetics and environment while external factors are related to socio-cultural mile in which the players operates. Hence, considering the above facts and concepts, the anthropometric, power, intermittent gait and performance related parameters were selected as predictor variables for this study.

The selected criterion and predictor variables namely anthropometric, power, intermittent gait and performance related parameters and its respective tests are presented in the table-I.

Table 1: The selected criterion and predictor variables and its respective tests

S. No	Criterion Variable	
1.	100 meters Sprinting Performance	
	Predictor Variables	**Test items**
Anthropometric Variables		
1.	Height	Stadiometer
2.	Calf Girth	Lufkin Anthropometric Tape
3.	Arm Girth	Lufkin Anthropometric Tape
4.	Thigh Girth	Lufkin Anthropometric Tape
5.	Arm Length	Lufkin Anthropometric Tape
6.	Leg Length	Lufkin Anthropometric Tape
Power Variables		
7.	Explosive Power	Standing Broad Jump Jump
8.	Elastic Power	Bunny Hop Test
Intermittent Gait Variables		
9.	Stride Length	Digital Cameras For Pd 170
10.	Stride Rate	Digital Cameras For Pd 170
Performance Related Variables		
11.	Muscular Strength	Push-Ups
12.	Anaerobic Power	Margaria – Kalamen Test

Statistical Procedure

The present study consists of one criterion variable namely performance of sprinters and twelve predictor variables such as height, calf girth, arm girth, thigh girth, leg length, arm length, muscular strength, anaerobic power, stride length, stride rate, explosive power and elastic power. The collected data were subjected to statistical analysis as explained below. To determine the relationship between dependent variable and independent variable Pearson's product moment correlation was used. Step wise selection method of multiple regressions was used for the sprinters in this study. To find out the predictor variables that has the highest correlation with the criterion variable and it is entered into the equation first. The rest of the variables are entered into the equation depending on the contribution of each predictor. In all the cases 0.05 level of significance was fixed.

Results

The summary of the mean and standard deviation values on selected criterion and predictor variables have been presented in table-II.

Table 2: The summary of the mean and standard deviation values on selected criterion and predictor variables

S. No	Variables	Mean	Standard Deviation
1.	100mts Performance	11.88	0.46
2.	Height	170.65	5.54
3.	Arm girth	25.35	2.64
4.	Thigh Girth	55.60	3.66
5.	Calf Girth	35.45	2.08
6.	Arm Length	77.85	3.31
7.	Leg Length	89.32	10.60
8.	Explosive Power	2.58	0.20
9.	Elastic Power	9.77	0.12
10.	Stride Length	1.87	0.09
11.	Stride Rate	53.37	2.65
12.	Muscular Strength	26.15	3.23
13.	Anaerobic Power	108.22	4.14

The data on selected predictor and sprint performance variables were statistically analyzed by using co-efficient of correlation and the results were presented in table-III.

Table 3: Co-Efficient of Correlation between the Selected Predictor Variables and Performance of Sprinters

S. No	Variables	"R" Value
1.	Height	-0.45
2.	Arm girth	-0.42
3.	Thigh Girth	-0.68**
4.	Calf Girth	0.10
5.	Arm Length	-0.13
6.	Leg Length	-0.38
7.	Explosive Power	-0.33
8.	Elastic Power	0.21
9.	Stride Length	-.93**
10.	Stride Rate	0.92**
11.	Muscular Strength	0.24
12.	Anaerobic Power	0.77**

*Table value required for significance is 0.549 at .01 level of confidence

The table - III shows that the thigh girth, anaerobic power, stride length, and stride rate showed significant associations with performance of sprinters. The associations were moderate to high and ranged from - 0.68 to -0.93. The height, arm girth, calf girth, leg length, arm length, elastic power, explosive power and muscular strength showed no significant association with performance of sprinters.

The data on selected predictor and sprint performance variables were statistically analyzed by using pearson's product moment correlation and the results were presented in table-IV.

Table 4: Pearson's Product Moment Correlation between Criterion and Determinant Variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1	1											
2	.65**	1										
3	.07	.32	1									
4	-.18	.11	.04	1								
5	.58**	.47*	.16	-.25	1							
6	.79**	.53*	.18	-.48*	.76**	1						
7	-.00	.28	.21	-.01	-.40	-.07	1					
8	.21	.10	-.01	-.35	-.18	-.37	.08	1				
9	.07	.24	-.08	-.29	.08	.33	.37	.03	1			
10	.19	.06	.50*	-.22	-.01	.20	.18	-.02	-.32	1		
11	.39	.37	.68**	-.08	.07	.31	.37	-.10	-.29	.73**	1	
12	-.30	-.28	-.62**	.12	-.03	-.27	-.37	-.42	.26	-.84**	-.95**	1

*correlation at .05 level

** Correlation at .01 level.

1 -Height, 2- Calf girth, 3- Arm girth, 4 -Thigh girth, 5-Arm Length, 6- Leg Length, 7- Explosive power, 8-Elastic power, 9- Muscular strength, 10- Anaerobic power, 11- Stride length and 12- Stride rate.

Table-IV shows that, the height is having significant association with calf girth, arm length and leg length. The calf girth is having significant association with arm length and leg length. The arm girth is having significant association with anaerobic power, stride length and stride rate. The thigh girth is having significant association with leg length and the anaerobic power is having significant association with stride length and stride rate. The stride length is having significant association with stride rate. The association of these variables was moderate to high ranging from 0.47 to 0.95.

Multiple regression equation was computed since; the multiple correlations are sufficiently high to warrant prediction from it. Then, the correlation identifies the independent variables to be included and their order in the regression equation. Step wise multiple regressions were computed on data obtained from the various level sprinters and the results were presented in table-V.

Table 5: Multiple Correlation Co-Efficient for the Predictors of Performance of Sprinters

S. No	Variables (step wise method)	R	R- Square	Adjusted R- Square	R- Square Change
1	Height	.451	.204	.160	.204
2	Height Stride rate	.670	.449	.384	.245
3	Height Stride rate Stride length	.756	.571	.490	.122
4	Height Stride rate Stride length Anaerobic power	.891	.794	.739	.223
5	Height Stride rate Stride length Anaerobic power Thigh girth	.953	.909	.876	.115

From the table-V, it was found that the multiple correlation coefficient for predictors such as height, stride rate, stride length, anaerobic power and thigh girth 0.953 which produce highest multiple correlation with performance of sprinters. R square values showed that the percentage of contribution of predictors to the performance of sprinting ability (dependent variable) in the following order.

1. About 20% of the variation in the sprinting ability was explained by the regression model with one predictor variable namely height.
2. About 44% of the variation in the sprinting ability was explained by the regression model with two predictors, height and stride rate. An additional 24% of the variance in the sprinting ability is contributed by stride rate.
3. About 57% of the variation in the sprinting ability was explained by the regression model with three predictor's height, stride rate and stride length. An additional 13% of the variance in the sprinting ability is contributed by stride length.
4. About 79% of the variation in the sprinting ability was explained by the regression model with four predictor's height, stride rate, stride length and anaerobic power. An additional 22% of the variance in the sprinting ability is contributed by anaerobic power.
5. About 90% of the variation in the sprinting ability was explained by the regression model with five predictor's height, stride rate, stride length, anaerobic power and thigh girth. An additional 11% of the variance in the height, stride rate, stride length, anaerobic power and thigh girth ability is contributed by anaerobic power.
6. Multiple regression equation was computed and the results were presented in table-VI.

Table 6: Regression Coefficients for the Predicted Variables with Performance of Sprinters

Variables	Unstandardized Coefficients		Standardized Coefficients
	B	Std. Error	Beta
(Constant)	18.313	2.994	
Height	-.038	.018	-.451
(Constant)	15.299	2.788	
Height	-.048	.015	-.572
Stride rate	.089	.032	.509
(Constant)	-128.556	67.493	
Height	-.064	.016	-.763
Stride rate	1.480	.653	8.510
Stride length	38.503	18.052	7.965
(Constant)	-202.845	51.693	
Height	-.098	.014	-1.176
Stride rate	2.299	.510	13.219
Stride length	62.074	14.179	12.841
Anaerobic power	-.072	.018	-.647
(Constant)	-329.929	46.690	
Height	-.125	.012	-1.494
Stride rate	3.512	.454	20.196
Stride length	96.210	12.696	19.903
Anaerobic power	-.078	.012	-.700
Thigh girth	.061	.014	.483

From the table-VI, the following regression equations were derived for sprinters with Predicted variables.

1 -Regression Equation in obtained scores form = Performance

Performance = - 329.92 + (- 0.125 x Height) + (3.512 x Stride rate) + (96.210 x Stride length) + (-0.078 x Anaerobic power) + (0.061 x Thigh girth)

The regression equation for the prediction of sprinting ability includes height, stride rate, stride length, anaerobic power and thigh girth. As the multiple correlations on sprinting 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. Thus, this equation may be successfully utilized in selecting the sprinters.

Findings

The identification of physical characteristics in a sport modality contributes to its success and enables to spot differences among athletes of different modalities, which is of great interest for both sport coaches and scientists. Sports performance is based in a complex and intricate diversity of variables, the performance of sprinter has been regularly influenced to a great extent by anthropometric variables, power, intermittent gait and performance related variables. The primary purpose of the study was to analyze the selected anthropometric, power, intermittent gait and performance related variables of sprinters. The number of related studies, books and research articles and found that significant relationship between performance and the entire selected anthropometric, power intermittent gait and performance related variables among sprinters. Abhariam (2011) [1], has predicted the performance ability of sprinters in relation to selected anthropometric measurements namely standing height, weight, upper leg length, hip width, shoulder width, and chest width are significantly related to 100mtrs sprint performance. Van Someren and Palmer (2003) [9], were determined that superior upper body dimensions and anaerobic capacities distinguish international-level kayakers from national-level athletes and may be used to predict 200-m performance. Abraham (2010) [2], stated that, the anthropometry and body composition associated with performance of university level male track and field athletes of South India. Niels (2005) [7], have compared the anthropometry of sprinters and people belonging to the normal population. These anthropometric characteristics typical of sprinters might be explained, in part, by the influence the anthropometric characteristics have on relative muscle strength and step length. Olmo and Castillo (2005) [8] have documented that the strength is an important factor in

athletic performance. Therefore the use of this parameter is recommended for measuring explosive strength related to sprinting performance in the athlete. Reference data for the RPI in high-level sprinters are provided. However, the present study has a significant relationship with selected predicted variables to sprinters.

Conclusions

Within the limitations and delimitations of this study, the following conclusions were made.

1. It concluded that, the predictor variables namely height, stride rate, stride length, anaerobic power and thigh girth can be used to predict the sprinting ability of sprinters.
2. The study concluded that, a significant relationship between selected anthropometric, power, intermittent gait, and performance related variables with 100 meters (sprinting) performance.

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