ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 12, Dec 2022

PREDICTION OF 100M SPRINT PERFORMANCE BASED ON SELECTED PHYSICAL AND ANTHROPOMETRIC VARIABLES

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Abstract

Purpose of the study: purpose of the study was to predict a model of 100m sprint performance with the help of selected physical and anthropometric variable. Running is one of the important part of all the sports and 100m sprint is one of the shortest and fastest event of trach and field. **Materials and methods:** Subjects were selected from the different places according to the availability of male sprinters with age ranges between 18-25 years. 33 male sprinters were selected for the study. Selected physical variables were body weight, reaction time, explosive power of legs and speed and anthropometric variables were lean body mass and fat % for the study. Body weight was measured with the help of weighing machine, reaction time was measured through ruler drop test, explosive power of legs was measured with the help of standing broad jump, speed was measured with 50m dash and both the anthropometric variable were measured through the bio-electrical impedance. **Results:** All the selected variables were significantly correlated with the 100m performance but body weight and explosive power of legs shows the highest correlation (r= -.868, r= -.836) respectively and fat percentage had the lowest correlation (r= .436). Two models were developed by the SPSS, in first model it included body weight only which explained 75.3% of total variation and second model along with body weight and explosive power of legs explained 87.7% of variation which was highest. So, second model was used to make regression equation of the study. **Conclusion:** It was concluded that body weight and explosive power of legs of male sprinters were maximum affect 100m performance.

Keyword: physical, anthropometric, sprinter, SBJ, bio-electrical impedance and LBM.

Introduction

Previous researchers investigated the different physiological, physical, biomechanical and psychological factors which enhance 100m sprint performance separately. But, researcher in this study wanted to predict a model of 100m sprint performance including physiological and anthropometric variables both and see the contribution of this researches with others.

Running has a wide range of varieties and people can engaged in it in number of ways, including road, sprint, middle distance, long distance and marathon. One of the most popular sports in the world is running.

Sprinters and mid-range runners will develop various physical traits and training regimens depending on the amount of race they competing. The 100-meter sprint is a relatively easy sprinting event compared to other sprinting competitions, making it perfect for learning the fundamentals of sprint running.

The 100 m sprint does not require a track curve, unlike other track and field sprints like the 200 m or 400 m race. The main goal of the 100-meter sprint, like every sprint race, is to complete the distance in the quickest amount of time. The 100m sprint is the current shortest competition in outdoor track and field running events. Performance in all running events is based on the time required to complete the transition distance, which is also known as the average speed for the entire run. Performance during a 100-meter sprint is influenced by a number of variables, which we have divided into four categories: ambient, mechanical/equipment, biomechanical, and psycho-physiological (Majumdar & Robergs, 2011) (Pd & Kes, 2020).

The key determinants of these complicated physical abilities have been the subject of several studies due to the significance of acceleration and speed in many sports. More recently, it has been demonstrated that a critical factor in sprinting performance is the capacity to apply the resultant force vector with a forward orientation throughout the acceleration phase of the movement (i.e., velocity-oriented force-velocity profile) (Loturco et al., 2019).Numerous variables, including muscular strength, neuromuscular coordination, technique, tactics, and motivation, among others, affect sports performance. Each of these factors plays a different role in various events; for example, the aerobic capacity dominates endurance competitions like long-distance running, walking, and games, whereas the anaerobic capacity plays a role in short-distance swimming and sprinting, and the muscle power in activities like throwing, boxing, and wrestling. These roles in the top athletes and sportsmen of their nations have been researched by a variety of researchers (Van Der Zwaard et al., 2018) (Malhotra, 1972).

Sprinters reach up to 55% of their top speed in the first ten meter, 70-80% in the next twenty meter and 85-95% in the final three. Sprinters attain their top speed (greater than 11.5 m/s) between 50 and 80 meters, and after 80 to 90 meters, the speed is reduced. The duration of time between the detection of sensory-motor stimulus and the subsequent behaviour of the athlete's body is known as motor reaction time. The three separate phases of the 100-meter sprint are block start with acceleration, top speed, and deceleration. The capacity to generate a significant amount of concentric force or power and high velocity while accelerating is crucial at the start of the sprint run (Maćkała et al., 2015).

Reaction time is defined as the interval between the gun signal (firing) and the moment the athlete applies force to the starting blocks (imprinting). This interval takes into account the distance travelled by sound from the

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sound source to the athlete, the athlete's response to the sound, and the mechanical activation of false start technology built into the starting block (Pavlović, 2021).The capacity of a sprinter to produce their maximum strength and power during the 100 m dash primarily depends on the structural and mechanical characteristics of the muscle itself as well as how the nervous system interacts with that muscle.

One of the most popular sporting events is track and field, which represents humanity's spirit of pushing the envelope and making new discoveries. One of the things that impacts sprint runners' performance is their response time. (Abe et al., 2020) (Zhang et al., 2021).Sprint is an athletic discipline that concentrate on one aspect of physical fitness: speed. Participants or students in short distance running (sprint) run as quickly as possible along the distance that needs to be covered. Because the distance covered was brief or close, it is known as a short distance run. Running involves propelling the body forward as swiftly as possible while both legs are hovering above the ground or floor (Alexon et al., 2021).

Hypothesis: it was hypothesized that 100m sprint performance could be predict with the help of selected physiological and anthropometric variables.

Purpose of the study: The main purpose of the study was to predict the performance of 100m sprint based on selected physical and anthropometric variables of male sprinters. It was hypothesized that physical and anthropometric variables have the significant role of 100m sprint performance.

Methodology

Selection of subjects

Total 30 male participated in All India Inter University sprinters were selected for the study. Subjects age ranges between 18-25 years. All subjects were purposively selected from Madhya Pradesh and Jharkhand. All subject were participated All India University and have good timing in their events. Purposive sampling technique was used to select the subject. All athlete were free from injuries and any type of diseases. consent letter was taken from all the subject before taking their data.

Selection of variables

Physical and anthropometric variables were selected for this study, physical variables were body weight, reaction time, explosive power of legs and speed and anthropometric variables were lean body mass and fat %.

Table-I Criterion measures of all the selected variables

S. N.	Variables	Test and instrument	Criterion measures
1	Body weight	Weighing machine	kg

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2	Reaction time	Ruler drop test	second
3	Explosive power of legs	Standing broad jump	meter
4	Speed	50m dash	second
5	Lean body mass	Bio-electrical impedance	kg
6	Fat %	Bio-electrical impedance	

Table -I shows the criterion of all the selected variables for the study.

Data collection procedure

From the table -I Body weight of the subject were measured through the weighing machine. Subject were asked to stand on weighing machine by remove all extra cloth and shoes and then measure subject's weight and record in kg. reaction time was measured through ruler drop test. Subjects were asked to sit on chair or table and keep their left hand on other tables which was kept in front of subject slight above than previous one. Researcher was holds scale and drop it down and subject had to hold as soon as possible with thumb and index finger and it was recorded in cm but later it converted into second. Standing broad jump was used to measure explosive power of les. Subject were asked to stand on long jump pit and marked one line as a starting point. Subject were asked to jump with both legs as much as he can further. It was recorded in meter. Speed was measured through the 50m dash. Subject were asked to stand behind the 50m starting line and on command go subject asked to run fast as he can and researcher was recorder their time in second. Both anthropometric variables were measured through the bio-electrical impedance. Subject were asked to lie down on table or any wooden material. Researcher was fixed two electrodes on right hand and right legs and filled the name and age of that subject in machine and start the machine. Subject were asked to remove their all the metal things before test this. Within one minute result was shown on screen of machine. Lean body mass was recorded in kg and fat percentage in percent. With the help of these data collection procedure researcher was completed this method.

Statistical analysis

Data of the study was analyzed with the help of IBM SPSS version 20. Mean and Standard deviation were calculated to check their differences and multiple regression test was used to know the prediction model of the 100m performance of the sprinters. 0.05 level of significance was used to test the hypothesis for the study.

Results

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Table -II test of normality

Tests of Normality

Variable	**Shapiro-Wilk**		
	Statistic	**df**	**Sig.**
Body weight	.960	33	.260
Reaction time	.974	33	.596
Explosive power of legs	.967	33	.394
Speed	.973	33	.569
Lean body mass	.981	33	.810
Fat %	.945	33	.094
100m performance	.940	33	.067

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table -II showed the test of normality. From above table it could be conclude that all the selected variables including dependent variables were norzmally distributed the scores. All the data were significant ($p<0.05$) significant thus all data were normally distributed the whole scores.

Table – III Descriptive statistics for selected physical and anthropometric variable

Variable	**N**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Body weight	33	52.00	87.00	65.6061	8.68526
Reaction time	33	.06	.15	.1024	.02166
Explosive power of legs	33	2.10	2.73	2.4588	.16077
Speed	33	5.20	7.10	6.2636	.47346
Lean body mass	33	38.88	59.52	49.2400	4.88477
Fat %	33	15.72	40.45	25.8594	6.86417

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Table -III shown the value of mean, standard deviation, maximum and minimum of all the selected physical and anthropometric variable. These scores could be used for further analysis.

Table -IV correlation of selected physical and anthropometric variables and 100m performance.

variable	Pearson correlation	Sign.
Body weight	-.868	.00
Reaction time	.725	.00
Explosive power of legs	-.836	.00
Speed	.587	.00
Lean body mass	-.543	.001
Fat %	.486	.002

Table-IV showed the correlation between selected physical, anthropometric variable and the 100m performance of sprinters with their significance value. The 100m performance of sprinters was significantly correlated with body weight, reaction time, explosive power of legs, speed lean body mass and fat % at 0.05 level of significance.

Model	R	R Square	Adjusted R Square	Change Statistics				
				R Square Change	F Change	df1	df2	Sig. F Change
1	.868[a]	.753	.745	.753	94.369	1	31	.000
2	.936[b]	.877	.869	.124	30.264	1	30	.000

a. Predictors: (Constant), Body weight

b. Predictors: (Constant), Body weight, Explosive power of legs

Table -V Model summary along with the value of R, R square and adjusted R square

Table-V showed the value of R, R square and adjusted R square along with model summary. From above table it could be shown that two regression model models were generated by the SPSS. The value of R^2 was .877 in the second model and this model was used to make regression equation because of its maximum value. From the above table it was shown that two independent variables (body weight and explosive power of legs) were

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included in the third model and regression equation was formed with two variables. These two variables were explained 87.7% variation in 100m performance of sprinters.

Table - VI showing ANOVA table with F-value of both the model

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	14.384	1	14.384	94.369	.000[b]
1	Residual	4.725	31	.152		
	Total	19.109	32			
	Regression	16.757	2	8.378	106.858	.000[c]
2	Residual	2.352	30	.078		
	Total	19.109	32			

a. Dependent Variable: 100m performance

b. Predictors: (Constant), Body weight

c. Predictors: (Constant), Body weight, Explosive power of legs

Table -VI showed the ANOVA table with F-value of both the models. From the above table it could be shown that second model was highly significant. So it was concluded that selected model for the study was also highly significant.

Table – VII Regression coefficient of selected variable for both model

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	16.746	.526		31.853	.000
	Body weight	-.077	.008	-.868	-9.714	.000
2	(Constant)	20.478	.776		26.386	.000
	Body weight	-.050	.008	-.560	-6.594	.000
	Explosive power of legs	-2.247	.408	-.468	-5.501	.000

a. Dependent Variable: 100m performance

ISSN PRINT 2319 1775 Online 2320 7876

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Table- VII showed the regression coefficient of selected variable for both the model along with t value and p value. Above table shown the unstandardized and standardized regression coefficient of both the model. Unstandardized coefficient was used to develop the model which was also called as "B" coefficient.

Regression equation

100m performance = 20.478+0.5x (Body weight) – 2.247x (EPL)

Discussion of findings

The aim of the present study was to predict a best model for 100m performance based on physical and anthropometric variable. From this study researcher accept the mentioned hypothesis and find the best model fitted for the 100m performance.

From the descriptive statistics it was find that body weight of male sprinters were heavier than female, explosive power of legs were more in male sprinters, fat % of male athletes were less compare to female and lean body mass of male athlete for upper limb was slightly more than female athletes (Mansour et al., 2021).

From the correlation table it was clearly indicated that all the selected physical and anthropometric variables were significantly correlated with 100m performance of male sprinters. There was significant negative correlation between explosive power of legs and speed and same result find in this study also (r=-.836) (Baro et al., 2017). Strong correlation was shown between explosive power of legs and 100m sprint which means there was great relationship of explosive power of legs an d100m sprint performance and it affect the performance of sprinters (Alexon et al., 2021). There was significant positive correlation (r= .725) was observed between reaction time and 100m performance and the same result was find male athletes and it was reveal that short reaction time has a positive reaction with the speed and good reaction time at starting of 100m race was affect the 100m timing (Pavlović, 2021). Another study show that there was a correlation between reaction time and 100m competition result but the correlation was not absolute. Significant Positive correlation (r= .486) was find between fat % and 100m performance of male athletes but it was low correlation and greater correlation was find for fat % in female athletes (Abe et al., 2020). Contrast to this research, Yuki Aikawa et al. find the negative significant correlation between fat % and the sprint performance from IAAF scores (Aikawa et al., 2020).

From the findings it was indicated that prediction model of 100m performance with the physical and anthropometric variables were good. From the multiple regression analysis, it was shown that two models were identified from the selected physical and anthropometric variable. In the first model 75.3% of variation was explained by body weight only and variation explained in second model was significantly increased as 87.7% when combined the both variables that was body weight and explosive power of legs. Anthropometric variable was not included in both the model in this study which means anthropometric variable were not much affect the 100m performance even though it was showed the significant correlation. Second model showed the maximum

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variance 87.7% including body weight and explosive power of legs this might be due to its high correlation shown in the table -4. This study was supported by Malhotra et al, they also observed the high correlation of body weight and explosive power of legs for the sprinters and jumpers (Malhotra, 1972).

Conclusion

From the study it was concluded that two model were developed by the SPSS and second model was best model. It was explained 87.7% variation including body weight and explosive power of legs as a variable. All the selected physical and physiological variables were significantly correlated but only two variables (body weight and explosive power of legs were included in the best model which was used to develop a regression equation. It was concluded that bodyweight and explosive power of legs were more affect the 100m performance of male sprinters.

Acknowledgement

Firs and foremost, praise and thanks to the god for his blessing throughout my research work to complete my research paper successfully.

I would like to express my sincere and deep gratitude to my research supervisor Dr. Deepak Sharma, HOD of department of exercise physiology LNIPE, Gwalior foe giving me opportunity to do research and provide valuable guidance to throughout the research work. It was great privilege and honor to work and study under your guidance.

I would like to express my gratitude from my heart to all my friends who always support me and encourage me to complete this research paper.

I am extremely thankful to my parents and family members for their love, prayers, caring and sacrifices for educating me and preparing me for my future. I am very much thankful to my father and my both brother for always support me financially and emotionally and always fight for me form the society for my education.

At last, I express my sincere thanks to everyone who support me directly and indirectly.

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