PHYSICAL AND PHYSIOLOGICAL VARIABLES AS PREDICTORS IN RUNNING PERFORMANCE

Ethiopia Gebreyesus H. Mariam*

INTRODUCTION

Man aspired for excellence in physical performance even before the modern scientific age. The early ancestors of modern man sought proficiency in physical performance in order to survive. The ability to run quickly and efficiently allowed man to hunt animals for his food and to escape his deadly natural enemies. For the modern man proficiency in physical performance is associated with status, self esteem and financial reward . Whatever the reason may be, the desire to excell in such performances has brought about such a tremendous advancement in the training techniques and facilities to improve the standards of performance in athletes, that in the present world man is no longer fascinated by the records set in previous Olympic Games.

Despite the tremendous advancement in sport facilities, training methods and techniques physial educators and coaches are still confronted with various problems that call for their immediate attention. The first and foremost question confronting a track and field coach when he assembles his prospective candidates at the beginning of a season is: which of these persons possess the qualities both innate and acquired that go to make a good athlete in a particular event?Coaches often spend too much time on individuals that do not possess the esential innate capacities and fail to locate many athletes who do have the innate prerequisites.

As sports have developed into a distinct scientific discipline in itself and each nation is vying with another to produce top class players to win laurals in inter-nat ional competitions, considerable research is devoted to identify factors that help to predict a high level of achievement in a given sport with proper coaching, (Matveyev 1981) ,(Shukla 1982).

Broom (1962) has stated that sprinting (races upto and including 440 yds) demands a high degree of muscular strengh in the form of power.

Briggs (1973) conducted a study on ten college males, varsity middle distance runnesrs. The mean age of the subjects was 19.4 years. His study indicates that a runner trained for an endurance type of activity must possess a large aerobic capacity if he is to perform well at all levels of competition.

Katch (1972) and Crain (1979) studied the relationship between maximal debt capacity, aerobic power, brachial pulse as components and predicted (Vo2 Max) to Running performance. They respectively concluded that effective prediction of indiv-

*Mrs. Ethiopia G/Yesus H/Mariam is a senior instructor in the department of Physical Education Addis Ababa University. The manuscript is based on the author's M.A. Theses

idual differences in performance requires more than measured values of max debt and aerobic power (Vo2 max); endurance runing is evidently a total body involvement with training information manifesting some physiological expression not measured in laboratory tests.

Hagan, Smith and Gettman (1981) examined the relation ship of marathon performance time (MPT) with maximal aerobic power (Vo2 max), body composition and training factors recorded for 9 weeks prior to a race in fifty males, mean age 36 years. Their findings suggest that a high maximal aerobic power, low body mass, daily work outs and training runs of long duration and distance contribute to better performance times in the marathon.

Shreer (1975) conducted a study on a group of thirty untrained college males, aged 18 to 20 years who volunteered for tests on 100, 200, 400 and 800 yds runs as well as on 1,2 and 3 miles runs. In addition ,the subjects were tested for maximum aerobic capacity (MaxV02 intake) on a treadmill and an aerobic work capacity (as measured by method of Margaria). It was concluded that distances beyond half a mile are significantly related to the aerobic work capacity and distances upto and including a quarter of a mile are significantly related to anaerobic work capacity.

In Browning's (1970) study of a comparison of sprinter and distance runners on selected anatomical and physiological parameters, sixteen volunteers of the 1968 Florida State University track squad were devided into 2 groups: Sprint group 100 to 440 yds men, and distance group-880 to 2 mile men. The sprint group had significantly larger means than the distance group on weight, heart rate recovery time following the sprint work out, resting diastolic blood pressure preceding maximal work out, maximal recovery systolic blood pressure following the endurance work out, the distance men had a larger mean performance time of the endurance work out.

The purpose of the present study was to identify physical and physiological variables as predictors in running performance . The study was delimited to:-

a) the male sprint and middle distance runners of the LNCPE Gwalior, India;

b) the following physical and physiological variables;

Physical - speed ,strength, agility, flexibility, podnderal Index ,Crural Index, ratio of shoulder width and hip width.

Physiological - aerobic capacity, anaerobic capacity, skinfold measurement.

Hypothesis.

It was hypothesized that the selected physical and physiological variables may help in predicting running performance.

Significance of the Study

This investigation may help to enhance the knowledge of physical education teachers and coaches by throwing light on the important physical and physiological attributes that go to make immense contributions to the sprint and middle distance running. The selected physical and physiolgical variables may be used as a foundaation upon which scientific training programmes may be framed.

The study may also help athletes to realize their physical and physiological endowment and develop interest in order to exploit their potentialities when required.

PROCEDURE

Fifteen male sprinters and fifteen male middle distance runers of the LNCPE Gwalior, India preparing for the intercollegiate and Inter-varsity athletic meets were selected as subjects for the study. The average age of the subjects was 21 years. The subjects were made to take the following tests:-

i) 100 meters run recorded to the nearest 1/10 of a second,

ii) 800 meters run recorded in minutes and seconds,

iii) 50 meters dash recorded to the nearest 1/10 of a second,

iv Pull-ups- number of correctly executed pull-ups was recorded,

v) Bent knee sit-ups- number of correctly executed sit-ups was recorded,

vi) Standing broad jump recorded in meters and centimeters,

vii) Shuttle run recorded to the nearest 1/10 of a second

viii) Sit and reach- recorded in centimeters

ix) Ponderal Index computed by using the formula;
Ponderal Index $= \frac{\text{Height}}{\sqrt[3]{\text{weight}}}$ (Clarke 1976)

x) crural Index obtained by using the formula:
crural Index $= \frac{\text{Foreleg length}}{\text{Thigh length}}$ (Curetion 1951)

xi) Ration of Shoulder width and hip width (Tanner 1964)

xii) Cooper's 12 Minutes Run-Walk Test recorded to the nearest 50 meters,

xiii Margaria Anaerobic Power Test (Fig 1)

xiv) Skinfold thickness (Body composition) using skinfold caliper (Baskirk 1974).

FINDINGS

The scores of the independent variable of physical and physiological domains were coorelated with dependent variables namely 100 meters and 800 meteres run in order to find relationship between the dependent variables. The relationship between independent variables (physical and physiological) and dependent variables (100 meters run) is graphically presented in figures 2,3 and 4.

Fom the figures it is plain that 100 meters run is, significantly related to 50 meters dash (r=.737), standing broad jump (r=-.600)and anaerobic capacity (r= -.801) as the computed 'r' value for significance is greater than the required value (r=.514) at .05 level of confidence.

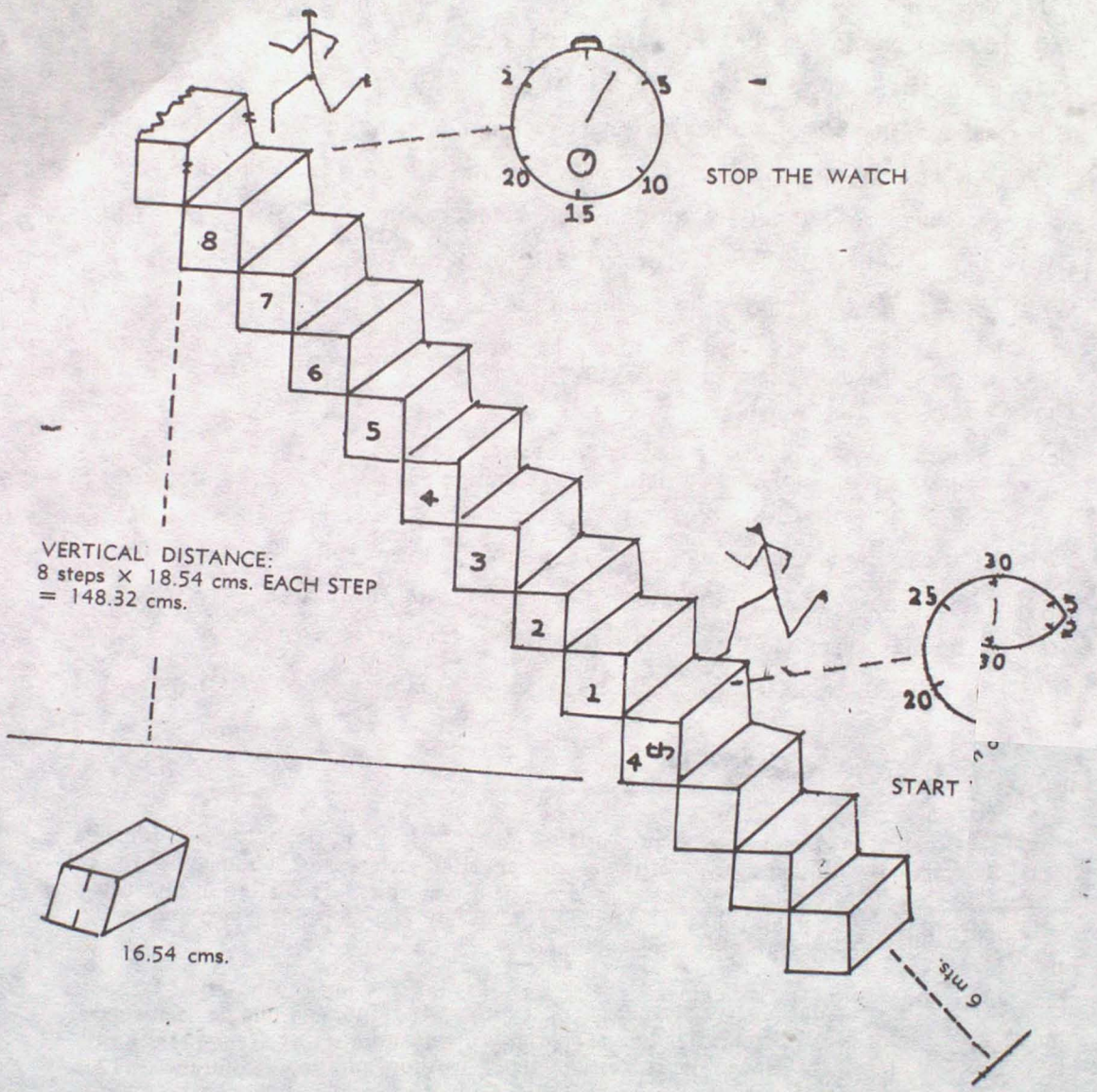

Fig. 1. MARGARIA ANAEROBIC POWER TEST

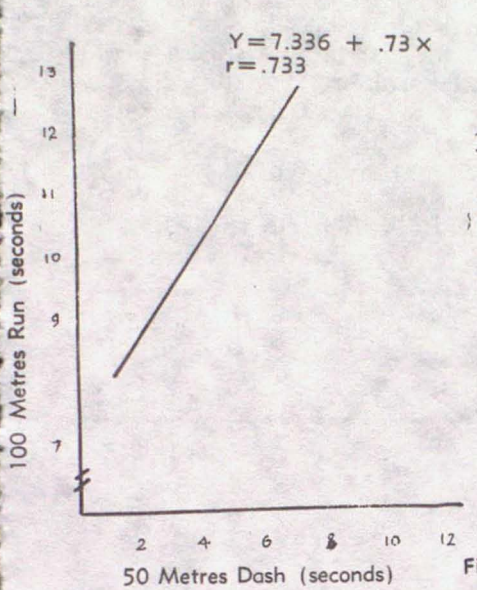

Fig. 2. Relationship between 100 Metres Run and 50 Metres Dash Capacity.

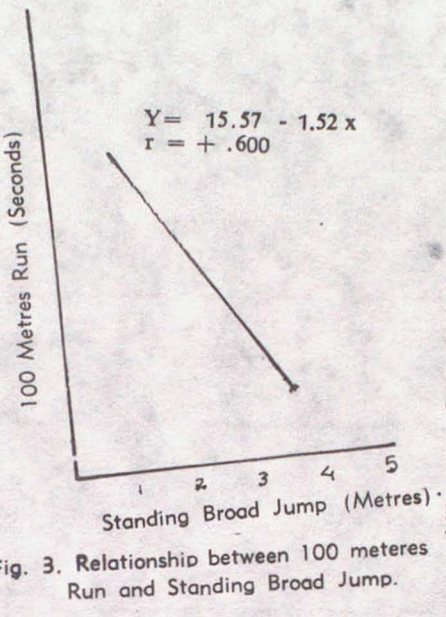

Fig. 3. Relationship between 100 meteres Run and Standing Broad Jump.

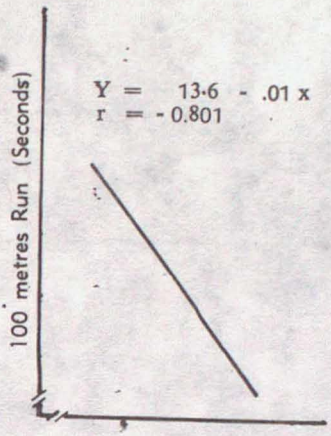

Fig. 4. Relationship Between 100Metres Run and Anaerobic

Table 1

RELATIONSHIP OF SELECTED PHYSIOLOGICAL VARIABLES TO 800 METERES RUN OF MIDDLE DISTANCE RUNNERS

Variables correlated	Correlation coefficient (r)
12 Minute Run-Walk and 800 M Run	.553*
Margaroa Test and 800 M Run	-.629*
Skinfold Measurement and 800 M Run	-.225

*significant at .05 level of confidence.
r.05 (13)= .514

As Table 1 discloses, a performance of 800 meters run of middle distance runners is significantly related to 12 Minute Run-walk Test (r=.553) and Margaria Test (r=.629). Hence it is certain that cardiorespiratory endurance (12 Minute Run-Walk Test) and explosive power (Margaria Test) have contribution to performance in 800 meters run of middle distance runners.

The coefficient of partial correlation (1st order) between physical variables (50 meters dash and Standing broad jump) and 100 meters run of sprinters with the effect of one variable eliminated is presented in Table 2.

In Table 2 speed (50 meters dash) had a significant relationship with 100 meters run of sprinters when the effect of standing broad jump (explosive leg strength) was partialled out. Standing broad jump did not show significant relationship with 100 meters run of sprinters when the effect of 50 meteres dash was partialled out.

Table 2

COEFFICEIENT OF PARTIAL CORRELATION BETWEEN PHYSICAL VARIABLES AND 100 METERES RUN OF SPRINTERS

Variables Correlated*	Variables Partialled out	Symbolic representation	Coefficient of partial correlation
100 M. Run and 50 M.	standing broad jump	c 12.4	.6646381*
100 M. Run and standing broad jump	50 M dash	c 14.2	.4066417

*Significant at. .05 level
r.05(13) =.514

The coefficient of partial correlation (1st order) between physiological variable 12 Minutes Run - Walk Test and Margeria Test and 800 meters run of middle distance runners with the effect of one variable eliminated is presented in Table 3.

Table 3

COEFFICIENT OF PARTIAL CORRELATION BETWEEN SELECTED PHYSIOLOGICAL VARIABLES AND 800 METERS RUN OF MIDDLE DISTANCE RUNNERS

Variables Correlated	Variables Partialled out	Symbolic representation	Coefficient of correletion
800 M. Run and 12 Minute Run-Walk	Margaria Test	rc 12.3	.8604556*
800M. Run and Mergaria Test	12 Minute Run Walk	rc 13.2	-.879761*

*Significant at .05 level.
r.05(13)=.514

Table 3 reveals that aerobic capacity (12 Minute Run Walk Test) had a significant relationship with 800 meters run of middle distance runners when the effect of Margaria Test (Anaerobic capacity) was partialled out. Margaria Test had also a significant relationship with 800 meters run of middle distance runners when the effect of 12 Minute Run-Walk Test was partialled out.

Combined contribution of physical variables to 100 meters and 800 meters running performance.

The multiple correlation coefficient (RCA.24) and (RCB.23) computed between criterion variables and independent variables are presented in Table 4 Figure 5 and in Table 5 Figure 6.

Table 4

COMBINED CONTRIBUTION OF PHYSICAL VARIABLES TO 100 METRES RUN OF SPRINTERS

Criterion variable	Independent variables	Multiple correlation	Coefficient of Multiple correlation
100M. Run ($^{C}_{A}$)	50M. Dash (speed) (2) Sit-ups (Abdominal strength) (3) standing Broad Jump (4) (Explosive Power) Pull-ups (Arm and Shoulder Girdle Strength) (5)		.8017*

* Significant at .05 level of confidence.
r.05 (12)=.512

Shuttle Run (Agility) (6)
Sit and Reach (Trunk and Hip Flexibility) (7)
Ponderal Index (8)
Crural Index (9)
Ratio of Shoulder Width and Hip width (10)

Table 4 has disclosed that the combined contribution of 50 meters dash and standing Broad Jump to 100 meters run of sprinters is significant at .05 level of confidence as the computed value of .8017 (RcA. 24) for multiple correlation was more than the value of .512 required for the multiple corralation coefficent to be signifIcant at .05 level of confidence with 12 degree of freedom.

Table 5

COMBINED CONTRIBUTION OF PHYSIOLOGICAL VARIABLES TO 800 METERS RUN OF MIDDLE DISTANCE RUNNERS

Griterion Variable	Independent Variables	Multiple Correlation	Coefficient of Multiple Correlation

800M Run (C_2)	12 Minute Run- Walk (2) (Aerobic Capacity)	RCB. 23	.7753*
	Margaria Test (3) (Anaerobic Capacity)		
	Percent Body Fat (4)		

Table 5 has pointed out that the combined contribution of 12 Minute Run-Walk (Aerobic Capacity) and Margaria Test (Anaerobic Capacity) and 800 meters performance of middle distance runnners is significant at .05 level of confidence as the computed value of .7753 (RCB. 23) for multiple correlation was more than the value of .532 required for the multiple correlation coefficient to be signficant at .05 level of confidence with 12 degree of freedom.

Multiple regression equation resulted in the following equations for physical (P) and physiological (ph) variables:

Physical variables -sprinters

100mt (P_1)- .6074452 P_2 (50mt. dash) + .3039486 P_3 (Standing Broad Jump) + .7345723.

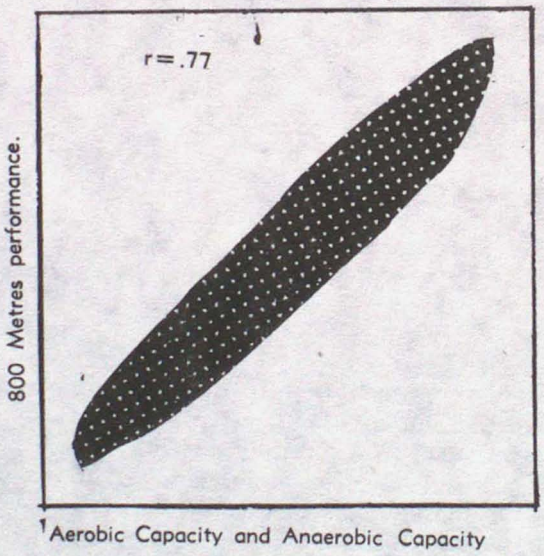

Fig. 6. Combined Cont ·tion of Physiological Variables to Middle Distance Performance.

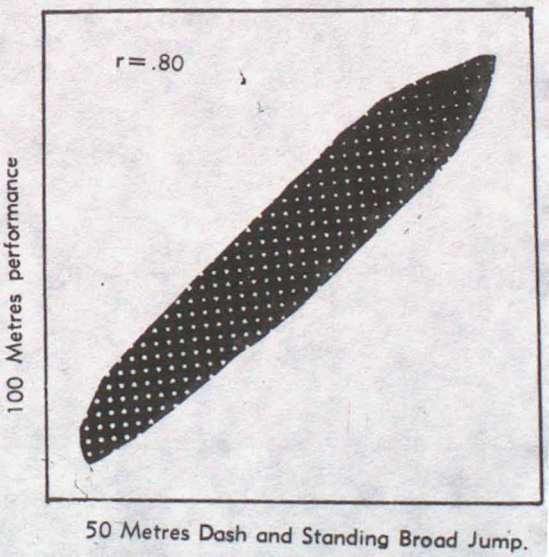

Fig. 5: Combined Contribution of Physical Variabl to Sprinters Performance.

DISCUSSION

In sprinting events runners go into total oxygen debt. In other words, almost all the oxygen that is used to create the short burst of speed comes from within the body; and hence, sprinting becomes an anaerobic exercise. The number of strides that can be taken in any one second, the length of stride, the muscular power, the explosive leg strength and the stride speed determine the performance of a sprinter. The analysis of data discloses that the phyaical variables namely speed (50

mt. dash), explosive power (standing broad Jump) and the physiological variable anaerobic capacity (Margaria Test) are significantly related to performance in 100 meters run. From this stand point the above physical and physiological variables could be taken as best predictors of sprinting performance. This result can be substantiated by Eric's (1962) opinion with regard to leg strength. With respect to anaerobic capacity it is in agreement with the findings of Shreer (1975).

The analysis of data pertaining to combined contribution of physical variables to 100 meters run reveals that a higher value of coefficient of multiple correlation is obtained when those physical variables which were found to be significantly related to 100 meters run are taken together. Thus, from the analysis it can be inferred that instead of considering each of the physical variables separately a combined contribution of these variables may be utilized to predict sprinting performance.

In the case of 800 meteres run, approximately two-thirds of the distance is run with oxygen. Thus, the cardiovascular system along with the muscle strength systems play an important role in this event .From the analysis of data, it appears that, none of the physical variables is significantly related to the performance in 800 meters run and thus could not serve as predictors of performance in 800 meters run. Although speed is the most important factor in track and field events, it does not show a significant relation to 800 metres run in this study, because the chosen speed test (50 mts. dash) is basically a test of sprinting speed.

Among the physiological variables selected for the study 12 Minute Run-Walk (Aerobic capacity) and Margaria Test (anaerobic capacity) have shown significant relationship with performance in 800 metres run. Therefore, the aerobic capacity and anaerobic capacity can serve as predictors of performance in 800 metres run. This result can be supported by Briggs (1973) conclusion that a runner trained for an endurance type of activity must possess large aerobic capacity if he is to perform well at all levels of competition.

Therefore, the hypothesis stated in the study has been accepted with regard to speed, explosive leg strength and anaerobic capacity for predicting performance in sprints. Regarding prediction of middle distance performance, the hypothesis was upheld in the case of aerobic and anaerobic capacity. The hypothesis was rejected in the case of the rest of physical and physiological variables for predicting performance in sprints. The hypothesis was also rejected in the case of all physical variables chosen for the study and the physiological variable percent body fat for predicting middle disrtance running performance.

Conclusions

Within the limitations of this study the following conclusions may be drawn:

1. The physical variables, namely, 50 meters dash and standing broad Jump and the physiological variable, namely anaerobic capacity are significantly related to performance in 100 metres run.

2. Among the physiological variables aerobic capacity and anaerobic capacity are significantly related to 800 meters run, while none of the physical variables was significantly related to 800 metres run.

3. The relationship of 50 meters dash to 100 metres run performance and standing broad jump to 100 metres run performance remained unchanged when explosive leg strength and speed respectively were partialled out.

4. The relationship of aerobic capacity to 800 metres run performance and anaerobic capacity to 800 meters run performance remained unchanged when aerobic capacity and anaerobic capacity were respectively partialled out.

5. Among physical variables the combined effect of 50 metres dash and standing broad jump contribute the most to 100 metres run performance.

6. The physiological variables, namely aerobic capacity and anaerobic capacity in combination contribute the most to 800 metres run performance.

Recommendations

In the light of this study, it is recommended that:

1. The results of this study may be used by physical educators and coaches in screening and selecting promising sprinters and middle distance runners.

2. Since 50 metres dash (speed) and standing broad jump (explosibe leg strength) are the important physical variables which influence 100 metres run performance, it is recommended that the training programmes for athletes belonging to the category of sprint should emphasize more on speed and explosive strength.

3. As aerobic capacity and anaerobic capacity are very essential for 800 metres run performance, more attention should be paid to the development of cardio-respiratory endurance and explosive power while framing a training programme for middle distance runners.

4. It is recommended that, a similar study may be conducted on women athletes.

5. A similar study may be carried out on athletes belonging to other event not employed in this study.

6. A similar study may also be undertaken to identify those physical and physiological variables which were not considered in this study but are associated with high performances in track and field events.

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