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A Study on Physiological Aspects of Ellite Middle- And Long-Distance Runners

[1] Pedenla Bhutia, Dr. Adarsh Tiwari

[1] Research Scholar, Department of Physical Education, Sri Satya Sai University of Technology & Medical Sciences, Sehore, M.P.

Abstract

The aim of this study was to determine the Physiological Aspects Distinction between Elite Middle and Long Distance Runners. This study was to 50 university men athletes, namely middle and long distance runners. The sample were selected from 56th National Inter State Sr Athletics Championships-2016 and 57th National Inter State Senior Athletics Championships 2017. No differences were found in vital capacity of 800 m and 5000 m runners. No physiological differences were found between 5000 m and 10000 m runners.

KEYWORD: Track and field, Physiological variables, Vital capacity, Heart rate, Middle distance runner, Long distance runner.

1.1 INTRODUCTION

The sport of athletics, includes running, walking, jumping and throwing etcetera. Running includes many events such as sprints, middle distance running and long distance running.

Track and field events are split into three broad categories: track events, field events, and events combined. Many athletes prefer to specialize in just one event (or type of event) with the intention of improving their results, although the goal of athletes with combined events is to become skilled in a variety of disciplines. Track events involve running over a defined distance on a running and obstacles can be mounted on the track in the case of hurdling and steeplechase events. There are also relay races in which teams of athletes run and pass on a baton to their team member at the completion of a certain distance.

There are two kinds of events in the field: jumps and throws. Athletes are graded on the length or height of their jumps in jumping competitions. The score of distance jumping events is measured from a board or marker, and any competitor who reaches this mark is deemed to have fouled. An athlete has to clear his body in the height jumps over a crossbar without taking off the normal supports. While athletes leap vertically in the pole vault with purpose-built sticks, most jumping events are not helpful.

Sprinting events

100 meters,200 meters,400 meters ,100 meters Hurdles 110 meter Hurdles,4X 100 meters relay and 4X100 meters relay.

Middle distance events

800 meters,1500 meters,3000 meters and steeplechase.

Long distance events

5000 meters 10,000 meters 20000 meters, 25000 meters and 30000 meters.

Jumping events

Long jump,High jump ,triple jump and polevault

Throwing events

Throwing events will include the following shot put, discuss throw, Javaline throw and hammer throw.

Physiological Factors

Physiology is the study of human organism's functioning. Physiology, in its fundamental sense, requires the functioning of every major body system used in playing (e.g., skeletal muscles, cardiovascular system and respiratory system) and how these systems are interrelated Physiology, in its practical context, discusses how exercise influences the functioning of body systems as well as how they affect performance.

There can hardly be a science for the coach to know, understand, and be able to apply properly. If a coach knows the fundamental concepts of exercise. Teams will not only end up in "good shape" in exercise and how to apply them to training; they will also be able to play the game physically as well as learning how to save their strength while being less susceptible to fatigue-related injuries. As a bonus, they are physically ready to handle the next step up the ladder demanded by the coach (or the opposition).

Among all the factors, the physiological variables play an important role for the attainment of high level sports performance. Physiological variables can be defined as variables that are directly related to specific physiological systems such as heart rate, blood pressure, vital capacity, respiratory rate, and hemoglobin.

The physiological variables chosen for the study are:

- VO_2 max
- Resting Pulse Rate
- Respiratory Rate
- Breath Holding Time

VO_2 Max

Maximal oxygen uptake represents the maximal amount of oxygen that can be used at the cellular level for the entire body. It represents the upper limit of the cardio respiratory system and has long been considered as an important determinant of endurance performance (Saltin andAstrand, 1967).

According to the Fick principle, any alteration in VO_2 max is the consequence of a modification of maximal cardiac output (Q max) and/or maximal arteriovenous difference in oxygen (a-vD02 max). It is commonly accepted that increased VO_2 max caused by the greater part of the training results from an increase in blood flow, stroke volume and eventually Q max. Nevertheless, the increase in a-vDO_2 max, which results from a more effective distribution of arterial blood from inactive to active muscles together with a greater oxygen extraction and utilization capacity by these muscles, plays also an important role in cardio respiratory adaptations to endurance training.

Resting Pulse Rate

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The heart is a pump that pumps the body's blood. It is basically a muscle, which operates by contracting with the sinoatrial node, which is more commonly referred to as the ' pacemaker ' by electrical stimulation. The muscles contract as the heart pumps, driving blood through the arteries around the body supplying oxygen and nutrients to the different tissues that are distributed within the blood stream.

The stronger a muscle is, the less difficult it has to work to do its job. Like any other muscle, it gets bigger and stronger as the heart is conditioned. The bigger the heart is, the less it will pump to move the blood around the body efficiently. The lower the resting heart rate of a person is, as a general rule, the fitter they are:

Average values for resting heart rates are as follows

Normal adults	60-80 bpm.
Athletes	40-60 bpm
Children	70-100 bpm

It means the breathing rate is increasing and therefore we get the sensation of ' out of breath ' during exercise. The oxygen we inhale is sent through the bloodstream to the muscles. To order to satisfy it extra demand for oxygen, the heart must pump faster and faster (www.totalfit.wordpress.com).

Respiratory rate

Respiratory rate, also defined as respiration rate, lung ventilation rate, ventilation rate, or breathing frequency, is the number of breaths taken within a set amount of time, usually 60 seconds. A normal rate of breathing is called eupnea, an elevated rate of breathing is called tachypnea, and a lower rate of breathing is called bradypnea.

When a person is at rest, the rate of human respiration is measured and includes counting the number of breaths for a minute by measuring how many times the chest is rising. During a magnetic resonance imaging scan, an optical breath rate sensor may be used to track patients. The rate of respiration can increase with fever, disease, or other medical conditions. Medical

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research indicates that respiratory rate is the indicator of pulmonary dysfunction, which slowly worsens as a large number of chronic health conditions progress.

The number of respirations per minute or, more formally, the number of movements shows motivation and exhaustion per unit time. In theory, the rate of respiration is generally determined by calculating the number of times the chest increases or falls per minute. The object of breathing rate measurement is to decide whether breathing is regular, abnormally fast (tachypnea), abnormally slow (bradypnea).or it does not occur (apnea).

Pearce (1997) said that the respiratory rate is slightly quicker in men than in women. The normal respiratory rate for the new born child is forty. At twelve months it is thirty and two to five years it is twenty four and in adults it is ten to twenty per minute.

Breath holding time

It is the number of breaths taken in a minute or number of inspirations and expirations in a minute. Basic change in respiratory function during exercise is increase in ventilation and cardiac output. During mild exercise, rise in CO_2 tension in blood stimulates carotid sinus reflex and respiratory center causing increased pulmonary ventilation, which prevents further rise of CO_2 in alveoli. A sort of equilibrium is reached between the effect of increased CO_2 tension in arterial blood and that of increased respiratory activity in lowering CO_2 tension. Due to the impulses from the high center to respiratory center, there is increased respiratory rate even before the start of exercise. The increase in rate and amplitude of respiration is proportional to the type of exercise performed.

- Due to increased respiratory movement the CO_2 tension in blood falls below normal.
- Lack of Oxygen causes respiratory increase through stimulation of carotid body.
- Liberation of adrenaline also augments pulmonary ventilation.
- Pulmonary blood flow increases from 5 to 30 litres/minute.
- Oxygen intake and CO_2 output increase from 0.25 litres /minute to 4 litres per minute (Rajendrakumar, 2012).

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Physiological parameters

Recent years have witnessed a remarkable expansion of the application of scientific principles to physical education, exercise and sports for healthful living and better competitive performance. Application of science to the physical education and sports are especially evident in the field of physiology; indeed physical education and sports practitioners are quick to realize the importance of acquiring basic physiological knowledge that can be put to good effect.

Exercise has traditionally been used as a means of disrupting physiological systems to determine how they behaved under stress. Thus much information has been acquired in mainstream human physiology about acute physiological responses to exercise. This knowledge also helped in establishing the ceiling in human physiological responses and in attempting to identify those factors that limit performance in various conditions.

Physical exercise is an activity in which every human being engages, to one degree or another, during the course of his or her life. It is almost importance to know the physiological mechanisms that sustain and act as the basis of physical exertion a number of co-ordinated and compensatory adjustments take place throughout the body, which involves metabolic functions and the nervous, muscular, circulatory and respiratory system. Important roles are played by environmental conditions, stress, training and fatigue.

- **Heart rate In beats/min.**

The morning resting heart rate of the subject was taken. The subject was made to sit in the resting position and asked to semipronate his forearm and slightly flex the wrist. Three fingertips were placed on the radial artery at the lateral border of the wrist and the pulse was counted for one minute with the help of stopwatch two reading were taken and there average was held to be final score.

- **Vital capacity in cm**

Subject was made to sit in resting position. He was asked to take a force full inhalation. Than the mouth piece of Spiro meter was put in between his lips. After this he was asked to do a force full exhalation in to the mouth piece of Spiro meter. The reading was noted of two efforts and there average was held to be final score.

1.2 REVIEW OF LITERATURE

Berryman(2017) who checked the effect on distance running success of ST modalities alongside other endurance sports, have done so or are somewhat obsolete

Blagrove(2018) focuses on Strength training exercises that have been consistently demonstrated to boost running economy (RE) and neuromuscular characteristics in adult distance runners, such as force-producing capacity and maximum speed. Participants (n= 25, 13 female, 17.2 ± 1.2 yr) were grouped by sex and RE and randomly assigned to a 10-wk force training group (STG) or a control group that maintained their regular training.

Bailey Sp, Bartoli Wp, Powell Ke, Pate Rr, Macera Ca. (2003) researched the correlations of physiology, anthropometry and preparation of the running economy. In a heterogeneous group of normal distance runners, possible physiological, anthropometric and training factors of running economy (RE) were studied (N = 188, 119 males, 69 females).

Millet Gp, Bentley Dj, Dreano P. (2003) studied short and long distance triathletes ' physiological characteristics. This research aimed to compare the physiological responses of short-distance (ShD) and long-distance (LD) triathletes in cycling and running.

Billat V, Koralsztein Jp, Demarle A, Paiva M. (2002) examined the impact of training in elite marathon runners (males and females) on physiological performance factors.

Maldonado S, Padilla S, Mujika I. (2002) examined the effect of body mass and height on running energy costs in highly trained mid-and long-distance runners. The main purpose of this study was therefore to evaluate the effect of body mass (bm) and height (h) on running energy costs (Cr) in 38 highly trained male runners, either specialized in marathons (M, n=12), long middle distances (5000-10000 m, LMD, n=14) or short middle distances (800-1500 m, SMD, n=12), and to determine potential body dimensional variations for each case.

Billat V, Koralsztein Jp, Demarle A, Paiva M. (2002) examined the impact of training in elite marathon runners (males and females) on physiological performance factors. These researchers

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analyzed the impact on the physiological factors of marathon success in top-class marathon runners of 8 weeks of advanced marathon training before the Olympic trials.

Gabbett. (2002) describe the physiological features of sub elite junior and senior players in the rugby league and set performance standards for these athletes.

1.3 METHODOLOGY

Procedure

Review of related literature had given us appropriates guidance in adopting an objective method of assessing the difference in physical and physiological characteristics of middle and long distance runners. In this chapter the selection of subjects, criteria measures, tools and techniques used in collecting data and statistical method applied for its interpretation are described.

Selection Of Subjects:

This study was delimited to 50 university men athletes, namely middle and long distance runners. The sample were selected from

- 56th National Inter State Sr Athletics Championships-2016, held at Hyderabad, India on 28th June to 2nd July 2016 -Data of 6 athletes of 800m runners,8 athletes of 5000m runner and 11 athletes of 10000 m runners were collected, and
- 57th National Inter State Senior Athletics Championships 2017, 15 Jul, 2017 to 18 Jul, 2017 at Acharya Nagarjuna University, Guntur, Andhra Pradesh, India- Data of 8 athletes of 800m runners, 9 athletes of 5000m runner and 8 athletes of 10000 m runners were collected,

Sample:

For the purpose of this study three sample groups were formed.

1st group comprises of 14 elite 800 m runners, 2nd group comprises of 17 elite 5000 m runners and 3rd group comprises of 19 elite 10000 m runners.

Criteria Measures and Collection Of Data:

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Recording the variables as given below shall consist data in the form of various criterion measures selected for the study.

Physiological Variables:

- **Heart rate in beats/ min.**

The morning resting heart rate of the subject was taken. The subject was made to sit in the resting position and asked to semi- pronate his forearm and slightly flex the wrist. Three fingertips were placed on the radial artery at the lateral border of the wrist and the pulse was counted for one minute with the help of stopwatch two reading were taken and there average was held to be final score.

- **Vital capacity in cm 3 ·**

Subject was made to sit in resting position. He was asked to take a force full inhalation. Than the mouth piece of Spiro meter was put in between his lips. After this he was asked to do a force full exhalation in to the mouth piece of Spiro meter. The reading was noted of two efforts and there average was held to be final score.

Tools:

The following instruments were used to collect the relevant data. Weighing machine, Stadiometer, Sitting height table ,Steel measuring tape , Sliding caliper, Skin fold caliper, Stop watch, Spirometer etc.

The instruments were of standard quality; their accuracy was ensured by the manufacturer. International society for the advancement of Kinanthropometry's (ISAK) approved techniques were used for recording the various body measurements. The reliability was checked by test-retest methods and average co-efficient was found to be 0.96.

Statistical Procedure:

Reiterating the objective of the study we have to point out that we intend to investigate the differences in physical and physiological parameters of elite 800, 5000 and 10000 m runners of India for that the one way analysis of variance was used. Where significant differences were observed Scheffe's test was used to find out the ascending or descending order of means.

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Level of Significance:

The significance of differences in physical and physiological parameters of elite middle and long distance runners was tested at 0.05 level.

1. Results obtained through analysis of variance and scheffe's test for **heart rate** are produced below.

Table 4.40 : Analysis of variance and scheffe's test for heart rate

Source of variation	DF	SS	MSS	F- Value
Treatment	R- 1 = 2	181.25	90.62	12.91*
Error	N- R = 47	329.98	7.02	

* Significant at .05 level

Tab. F.05 (2, 47) = 3.20

Since the measured F value 12.91 is higher than the tabulated F value 3.20, we can infer that the mean heart rate of three groups is significantly different. Our H0 is therefore accepted at the level of significance of.05. In addition to finding out which group is larger than the other test we used scheffe's test, the analysis is given in table: 4.41.

Table: 4.41 : Comparison of mean heart rate of different runner groups.

Runner groups			Mean difference	CD at 5%
800 m	5000 m	10000 m		
50.36	46.53		3.83*	2.42
50.36		45.84	4.52*	2.36
	46.53	45.84	0.69	2.24

* Significant at 5% level

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Comparing the pair's wise mean difference with the critical difference, it is apparent that the mean heart rate of 800 m runners is significantly higher than 5000 m and 10000 m runners, whereas the mean heart rate of 5000 m and 10000 m runners is not significantly different.

2. Results obtained through analysis of variance and Scheffe's test for **vital capacity** are produced below.

Table- 4.42 : Analysis of variance and Scheffe's test for vital capacity

Source of variation	DF	SS	MSS	F- Value
Treatment	R-1=2	682936.30	341468.15	3.97*
Error	N- R = 47	4044263.70	86048.16	

* Significant at .05 level

Tab. F .05 (2, 47) = 3.20

Since the measured F value 3.97 is higher than the tabulated F value 3.20, we may conclude that the mean vital potential of three groups is significantly different. This is why our Ho is accepted at the level of significance of. 05. In addition to finding out which category is larger than the other Scheffe study, the analysis is given in table: 4.43

Table: 4.43 : Comparison of mean vital capacity of different runner groups.

Runner groups			Mean difference	CD at 5%
800 m	5000 m	10000 m		
5885.71	5711.76		173.95	267.74
5885.71		5594.74	290.97*	261.30
	5711.76	5594.74	117.02	247.67

.* Significant at 5% level

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Comparing the pair-wise mean difference with the critical difference, it is obvious that the mean vital capacity of 800 m runners is significantly greater than 10000 m runners, whereas the mean vital capacity of 800 m runners and 5000 m runners and also between 5000 m runners and 10000 m runners is not significantly different.

1.4 DISCUSSION OF FINDINGS

Heart rate:

The mean heart rate of 800 m runners is found to be significantly higher than 5000 m runners and 10000 m runners. Whereas the mean heart rate of 5000 m and 10000 m runners do not differ significantly.

S.Sundberg and R.Eiovainio (1982) carried out a study to ascertain the cardia respiratory difference between elite male endurance runners aged 12 to 16 years and ordinary boys of the same age group. They found out that elite endurance runners had over resting heart rate and larger heart volume than ordinary boys of the same age group.

The differentials of heart rate of middle and long distance runners are increased cardiac output due to increase ventricular volume and cardiac hypertrophy. Endurance training improves myocardial strength, which contributes to stroke power during systole (Frank L. Katch). At muscle level, it increases 02 intake because of greater capillary network. This causes increased efficiency of muscles in relation to 02 consumption. As a result, 02 requirement per kg. of muscles is decreased. Thus, decreased blood requirement, which leads to decreased heart rate.

Vital capacity:

It is found that the mean vital ability of 800 m runners is found to be significantly greater than 10,000 m runners. Whereas the mean vital capacity of 800 m and 5000 m runners and also the mean vital capacity of 5000 m and 10000 m runners are not significantly different.

Kohlrausch (1929) carried a similar study and observed similar results that the middle distance runners' averaged vital capacity was more than long distance runners.

This is due to the fact that lungs volume increases with training due to increased alveolar size. As a result it 02 make increase because of greater capillary network surrounding alveolar membrane. It also permits greater gaseous exchange which is vice-versa factor that enhances performance of middle and long distance runners groups.

These discussion of various research studies in light of our findings is leading us to conclude that the observed significant differences in the various physiological variables of middle and long distance runners are decisive determinants of the performance limits binding these runners which is confirming the fact that competitive sports demands event specific physical stature.

1.5 CONCLUSIONS:

Our findings is leading us to conclude that the observed significant differences in the various physiological variables of elite middle and long distance runners are decisive determinants of the performance limits binding these athletes. This is conforming the fact that competitive sport demands event specific physical structure.

The findings of our study had led us to draw the following conclusions:

800 m runners' had greater heart rate than 5000 m runners.

No differences were found in vital capacity of 800 m and 5000 m runners.

800 m runners' had greater heart rate and vital capacity than 10000 m runners.

No physiological differences were found between 5000 m and 10000 m runners.

1.6 REFERENCES

1. Berryman N, Mujika I, Arvisais D, et al. Strength training for middle- and long-distance performance: a meta-analysis. Int J Sports Physiol Perf. 2017; pp 1–27

2. Blagrove RC, Howatson G, Hayes PR. Test-retest reliability of physiological parameters in elite junior distance runners following allometric scaling. Eur J Sport Sci. 2017; pp 1–10.

3. Blagrove RC, Howe LP, Cushion EJ, Spence A, Howatson G, Pedlar CR, Hayes PR "Effects of Strength Training on Postpubertal Adolescent Distance Runners" Med Sci Sports Exerc.

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2018 Jun;50(6):1224-1232.

4. Blagrove RC, Howatson G, Hayes PR. Test-retest reliability of physiological parameters in elite junior distance runners following allometric scaling. Eur J Sport Sci. 2017; pp 1–10.

5. Blagrove RC, Howe LP, Cushion EJ, Spence A, Howatson G, Pedlar CR, Hayes PR "Effects of Strength Training on Postpubertal Adolescent Distance Runners" Med Sci Sports Exerc. 2018 Jun;50(6):1224-1232.

6. Millet Gp, Oreana P. and Bentley Dj. 2003. Physiological characteristics of elite short and long-distance triathletes. Finnish Sports Institute, Vierumaki, Finland.

7. Billat V, Demarle A, Paiva M, Koralsztein Jp. 2002. Faculty of Sport Science, University of Lille, France. Veronique.billat@wanadoo.france. Studied on effect of trainingon the physiological factors of performance in elite marathon runners (males and females).

8. Gabbett and Georgieff (2007) Physiological and Anthropometric Characteristics of Australian Junior National State and Novice Volleyball Players, Journal of Strength and Conditioning Research, 21 : 902-908