

An Analysis among Physiological and Physical Fitness of Middle Distance and Long Distance Runners

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Abstract

Present investigation was carried out in order to compare the Physiological and Physical Fitness among the Middle Distance and Long Distance Runners. A total of 20 Inter-varsity level Runners (i.e. Middle Distance N=10 and Long Distance Runners N=10) age ranged from 18 to 25 yrs were selected from Lakshmibai National Institute of Physical Education, Gwalior. Through both the critical and allied literature pertaining to the problem under consideration the following Physiological and Physical Fitness variables were selected- Speed, Agility, Cardio-Respiratory Endurance, Vital Capacity, Resting Respiratory Rate, Resting Pulse Rate, Peak Expiratory Flow Rate. The entire analysis has been carried out by using statistical software (SPSS 17 version) to address the objectives of the study. To find out the mean difference among the selected variable of Physical and Physiological variables, Multi-Variate Statistical Technique MANOVA was applied, further to find out the critical difference Uni-Variate Statistical technique, One-Way Analysis of Variance was applied in the selected variable, Further to find out the real difference LSD Post hoc test needs to be done. The result indicates that a significant difference was found in all the Physical Variables i.e. Speed, Agility and Endurance of Middle Distance and Long Distance Runners. Also a significant difference was found in some of the Physiological variable i.e. Resting respiratory rate, Resting Pulse rate Whereas an insignificant

difference was found in the Vital Capacity and Peak expiratory flow rate of Middle Distance and Long Distance Runners.

Keywords

Speed, Agility, Cardio-Respiratory Endurance, Vital Capacity, Resting Respiratory Rate, Resting Pulse Rate, Peak Expiratory Flow Rate.

1. Introduction

Faster, Superior, Stronger: the famous words are always in the mind of the athletes from the ancient times[7]. For the same circumstance, integrative physiology has long been served by so-called 'experiments in nature' [1]. By repeatedly involved in bouts exercises for a longer longer duration causes numerous physiological changes that result in improved performance in that exercise activity. The magnitude of the training response depends on the duration of the exercise bouts, their intensity and frequency with which they are performed, along with the initial training status, genetic potential, age and gender of the individual [2]. Preparing for perseverance athletes by and large accentuates investment in long-term low- or moderate-force activity amid the base or planning period of the season; with the consideration of shorter-length of time high-power endeavours as the focused stage approaches [3]. Physiological characteristics of individual athletes are considered to be an important determinant of success in sport. The different anthropometric and physiological characteristics affect the running performance at various levels [4].

2. Methodology Selection of Subjects

Present investigation was carried out in order to compare the Physiological and Physical variables among the Middle Distance and Long Distance Runners. Total of Twenty Inter-varsity level Runners (i.e. Middle Distance N=10 and Long Distance Runners (N=10) age ranged from 18 to 25 yrs were

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selected from Lakshmibai National Institute of Physical Education, Gwalior.

3. Selection of Variables

After doing a lot of literature review, expert's knowledge and with researcher's own understanding the following variables were selected-

1. Speed
2. Agility
3. Cardio-Respiratory Endurance
4. Vital Capacity
5. Resting Respiratory Rate
6. Resting Pulse Rate
7. Peak Expiratory Flow Rate

The selection of these variables was also based on the feasibility criteria and the equipment available as well as the scholar owns experience in conducting the test and measurement to these variables.

4. Administration of the Test Physical Fitness

Speed

To measure the speed 50 meters dash test was conducted in the cinder track of LNIPE Gwalior and After proper warm-up the subjects were asked to run for the given distance. Only one trial was given to all the subjects. The time was measured in seconds nearest 100th of a second. The speed was calculated by dividing the distance (i.e. 50 meters) by the timing of the subjects.

Agility

To measure the agility 4×10 meters shuttle run test was used. Two parallel lines were marked with a distance of 10 meters. Each subject started from behind the starting line on the signal 'GO' the subject ran towards the blocks which were placed exactly 10 meter away, in front from the starting line. He picked one of the blocks and returned towards the starting line and placed the blocked behind the starting line. The same process repeated with the second block. Two trials were given and the best time taken by the subject to complete the 4×10 meter shuttled run was recorded.

Endurance

To measure the Endurance, Cooper's 12 minute run/walk test was used. The test was conducted at the 200 meter track of LNUPE Gwalior. The segments of 25 meters were marked carefully in the track. The subjects were asked to run on the sound of the

clapper. A separate lap scorer was assigned for each and every athlete [6]. A distance covered by the subject after a complication of 12 minutes was considered the score and recorded by each lap scorer nearest to the 25 meters.

5. Physiological Variables

The physiological variables used in the study were as follow: VC, RRR, RPR and PEFR. Vital capacity: VC is the maximum amount of air a person can expel from the lungs after a maximum inhalation [8]. Maximal volume compellingly lapsed after maximal enthusiasm was measured with the assistance of dry Spiro-meter in cubic centimetres [9]. Resting respiratory rate: RRR of each of the subject was recorded in the morning on their bed, just after the sound sleep. It was recorded through palpation method [6]. Resting pulse rate: RPR of each of the subject was recorded in the morning on their bed, just after the sound sleep [10]. It was recorded through the radial artery. Peak expiratory flow rate: PEFR is the maximum flow rate generated during a forceful exhalation, starting from full lung inflation. The PEFR of the subjects was measured with peak flow meter. It was recorded in litres per minute [10].

6. Tester's Competency

The researcher himself was a PhD Scholar at 'Lakshmibai National Institute of Physical Education' is quite well acquainted with the techniques of conducting the test items. However, he had gone through a number of practice sessions for testing procedure to acquire proficiency in testing. Some of the PhD Scholars were also trained about testing procedure for assisting the researcher in the final data collection.

7. Statistical Analysis

The entire analysis has been carried out by using statistical software (SPSS 17 version) to address the objectives of the study. To find out the mean difference among the selected variable of Physical Fitness, Multi-Variate Statistical Technique MANOVA was applied, further to find out the critical difference Uni-Variate Statistical technique, One-Way Analysis of Variance was applied in the selected variable of Physical Fitness, Further to find out the real difference LSD Post hoc test needs to be done, The descriptive table for the obtained data is givenbelow.

Table 1: Descriptive Statistics of Physiological and Physical Variable of Middle Distance and Long Distance Runners

	Runners	Mean	Std. Deviation	N
Speed	Middle Distance Runners	6.44	0.44	10
	Long Distance Runners	7.64	0.44	10
	Total	7.04	0.75	20
Agility	Middle Distance Runners	9.24	0.50	10
	Long Distance Runners	10.2400	.50596	10
	Total	9.7400	.71111	20
Endurance	Middle Distance Runners	2522.50	145.98	10
	Long Distance Runners	2722.50	145.98	10
	Total	2622.50	175.26	20
RRR	Middle Distance Runners	15.78	0.48	10
	Long Distance Runners	14.68	0.48	10
	Total	15.23	0.73	20
RPR	Middle Distance Runners	57.90	2.96	10
	Long Distance Runners	54.90	2.96	10
	Total	56.4000	3.26706	20
VC	Middle Distance Runners	3841.28	62.52	10
	Long Distance Runners	3871.28	62.52	10
	Total	3856.28	62.77	20
PEFR	Middle Distance Runners	605.97	8.52	10
	Long Distance Runners	610.97	8.52	10
	Total	608.47	8.68	20

Table 1 reveals that, the mean $\pm$ standard deviations of the following variable i.e. Speed, Agility, Endurance, Resting Respiratory Rate, Resting Pulse Rate, Vital Capacity, and Peak expiratory flow rate of the Middle Distance and Long Distance Runners are :

6.44 $\pm$ 0.44, 7.64 $\pm$ 0.44, 9.24 $\pm$ 0.50, 10.24 $\pm$ 0.50, 2522.50 $\pm$ 145.98, 2722.50 $\pm$ 145.98, 15.78 $\pm$ 0.48, 14.68 $\pm$ 0.48, 57.90 $\pm$ 2.96, 54.90 $\pm$ 2.96, 3841.28 $\pm$ 62.52, 3871.28 $\pm$ 62.52, 605.97 $\pm$ 8.52, 610.97 $\pm$ 8.52 respectively.

Table 2:Box's M Test of Equality of Covariance Matrices

Box's M	0.000
F	0.000
df1	28
df2	1129.002
Sig.	1.000

The Box's Test of Equality of Covariance Matrices checks the assumption of homogeneity of Covariance

across the groups using $P < .001$ as a criterion. From the above table it is stated that the Box's M test

(0.000) is found to be significant as the P- value (1.000) > α (.001) indicating that there is significant

differences between the co-variances.

Table 3: MANOVA Table for the Data on Physiological and Physical Variable of Middle Distance and Long Distance Runners

Effect	Value	F	Hypothesis df	Error df	Sig.
Pillai's Trace	.963	44.681 ^a	7.00	12.00	.000
Wilks' Lambda	.037	44.681 ^a	7.00	12.00	.000
Hotelling's Trace	26.064	44.681 ^a	7.00	12.00	.000
Roy's Largest Root	26.064	44.681 ^a	7.00	12.00	.000

Table 3 reveals that in this multivariate statistics MANOVA, Wilk's Lambda test was used at an alpha level of .05, the above table stated that this test is significant, Wilk's lambda = 0.037, F = 44.68, as the P value is < .001. This significant F indicates that there are significant differences among the selected Physiological and physical variables of Middle

Distance and Long Distance Runners. If we had violated the assumption of homogeneity of variance-covariance, one could use the Pillai's Trace test (a test statistic that is very robust and not highly linked to assumptions about the normality of the distribution of the data).

Table 4: Univariate Statistics for the Data on Physiological and Physical Variables of Middle Distance and Long Distance Runners

Dependent Variable		Sum of Squares	df	Mean Square	F	Sig.
Speed	Contrast	7.200	1	7.200	35.920	.000
	Error	3.608	18	.200		
Agility	Contrast	5.000	1	5.000	19.531	.000
	Error	4.608	18	.256		
Endurance	Contrast	200000.000	1	200000.000	9.384	.007
	Error	383625.000	18	21312.500		
RRR	Contrast	6.050	1	6.050	25.313	.000
	Error	4.302	18	.239		
RPR	Contrast	45.000	1	45.000	5.133	.036
	Error	157.800	18	8.767		
VC	Contrast	4500.000	1	4500.000	1.151	.298
	Error	70375.324	18	3909.740		
PEFR	Contrast	125.000	1	125.000	1.721	.206
	Error	1307.178	18	72.621		

Table 4 reveals that because the MANOVA was significant, we must now examine the univariate, because a significant difference was found among the selected Physiological and Physical variables of Middle Distance and Long Distance Runners. To find out the critical differences among the groups post hoc tests needs to be done, The p- values for the ANOVAs on the MANOVA output do not take into account that multiple ANOVAs have been conducted. We can use a traditional Bonferroni procedure, To

protect against Type I error, test each ANOVA at the .007 level (.05 divided by the number of ANOVAs conducted, which should equal the number of dependent variables). As can be seen, all the Physiological and Physical Variables are significant whereas but in the case of vital capacity and Peak expiratory flow rate of the Middle Distance and Long Distance Runners were found to be insignificant.

Table 5: Post Hoc Test (LSD) for Physiological and Physical Variables of Middle Distance and Long Distance Runners

Dependent Variable	(I) Runners	(J) Runners	Mean Difference (I-J)	Std. Error	Sig.^a
Speed	Middle Distance Runners	Long Distance Runners	-1.200*	.200	.000
Agility	Middle Distance Runners	Long Distance Runners	-1.000*	.226	.000
Endurance	Middle Distance Runners	Long Distance Runners	-200.000*	65.288	.007
RRR	Middle Distance Runners	Long Distance Runners	1.100*	.219	.000
RPR	Middle Distance Runners	Long Distance Runners	3.000*	1.324	.036
VC	Middle Distance Runners	Long Distance Runners	-30.000	27.963	.298
PEFR	Middle Distance Runners	Long Distance Runners	-5.000	3.811	.206

The results of the Pair wise comparisons are shown above. We had previously controlled for Type I error across the two Univariate ANOVAs by testing each at the .007 alpha level. To be consistent with this decision, we also need to control the probability of committing one or more Type I errors across the multiple Pair wise comparisons for the dependent variable at the .007 alpha level. We are able to maintain this family wise error rate across comparisons for a dependent variable by selecting .025 for the Significance Level in the Multivariate: Options dialog box in SPSS.

The above table stated the Post hoc test (LSD) for the critical difference between the means of the selected variables, a significant difference was found in Speed, Agility, Endurance Resting respiratory rate, Resting Pulse rate of Middle Distance and Long Distance Runners as the p values are 0.000, 0.000, 0.007, 0.000 whereas an insignificant difference was found in the Vital Capacity and Peak expiratory flow rate of Middle Distance and Long Distance Runners as the p - value are 0.298 and 0.206.

8. Discussion of findings

Present investigation was carried out in order to compare the Physiological and Physical Fitness among the Middle Distance and Long Distance Runners. The obtained data was analyzed by applying One Way MANOVA, J.E. and C.J. Klett. (1972). The results indicates that a significant difference was found in all the Physical Variables i.e. Speed, Agility and Endurance of Middle Distance and Long Distance Runners, this may be due to the

fact that, This is a sure phenomenon that the Middle distance runners are quite better in speed as compared to the Long Distance Runners, this difference occurs due to the intensity and nature of training of the middle distance runners. The Count of WBC's have more in the Middle Distance Runners, which leads to more explosive strength, as the requirement of the Physical Variables selected in the study were also same. This may also be reason that, the Endurance is trainable and can be greatly increase through systematic program planning, because endurance and training are directly proportional to each other hence difference occurs in the endurance may be due the nature and volume of training. Similar results were also found by the Kumar (2014), he attempted to compared physiological fitness of under graduate and post graduate handball players of university.

Also a significant difference was found in some of the Physiological variable i.e. Resting respiratory rate, Resting Pulse rate of Middle Distance and Long Distance Runners this may be due to the fact that respiratory system generally deals with the alveolar CO₂ levels, and a lots of textbooks on exercise physiology propose that, endurance runners consists of arterial CO₂. The level of CO₂ goes up with the different exercise intensity's levels, as the way of breathing during exercise is mouth or nasal or combined. All the dynamic functions of the lung depend upon the obedience of the thorax-lung system, airway resistance and muscular strength of the respiratory muscles (Cotes, 1975)[5].

There are some of the factors which enhance the respiratory rate i.e. Chemoreceptor which is found in aorta and carotid arteries (Peripheral Chemoreceptor), this chemoreceptor (stimulated more by increased CO₂ levels than by decreased O₂ levels) is greater than stimulate rhythmicity area which is also greater than results and leads to increase in rate of respiration. It is also a fact that to perform the high intensity load also increases the rate of respiration. The exchange of gases (O₂ & CO₂) between the alveoli and the blood take place by simple diffusion, O₂ diffusing from the alveoli into the blood and CO₂ from the blood into the alveoli. Diffusion requires a concentration gradient. So, the level of concentration of O₂ in the alveoli must be higher than in the blood, or we can say that the concentration of CO₂ in the blood must be higher than in alveoli. These findings are also in consonance with the findings of dhillon (2007) who also found that middle distance runners were significantly differ than the long distance runners in relation to physiological variables.

Whereas an insignificant difference was found in the Vital Capacity and Peak expiratory flow rate of Middle Distance and Long Distance Runners this may be due to the fact that, the primary factors that affect PEFR are the expiratory muscles's strength and its contraction force, whereas The vital capacity to a great extent depends upon the stature and size of the lungs.

Vital Capacity is the maximum volume of air that can be expelled at the normal rate of exhalation after a maximum inspiration, representing the greatest possible breathing capacity. The average normal value of Vital Capacity affected by some of the factors i.e., age, physical dimensions of the chest cage, physical fitness, posture, and gender. The Vital Capacity may be condensed by a decrease in the amount of functioning lung tissue, chest deformity, neuromuscular disease, pregnancy; or by airway obstruction.

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