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ANALYZING PERFORMANCE OF SUCCESSFUL HIGH ENDURANCE ATHLETES ON THE BASIS OF ANTHROPOMETRIC INDICES & PULMONARY FUNCTIONS.

Physiology

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ABSTRACT

In endurance sports, particularly in long distance running enhanced respiratory ability is very much critical. The greater than average Vo2 max is probably genetically determined but we aim to specify objectively the ideal anthropometric and pulmonary function parameters for higher success in endurance training.

KEYWORDS

Vo2 max, endurance athletes, FEV1/ FVC ratio.

Introduction

Sprinters (short distance, rapid burst) are not much dependant on respiratory ability as they, in their brief endeavor, are not dependant on immediate oxygen supply but on anaerobic metabolic process running via a) adenosine tri phosphate system, b) creatin/phosphokinase system & c) glycogen lactic acid system. These systems work one after the other. The ATP stored within the working muscle mass gets utilized as soon as the muscle starts working (trained sprinter may have a higher storage due to bigger muscle mass) and then utilization of creatin phosphate starts, lasting for up to 10 seconds. Stored glycogen in muscle can be split into glucose and the glucose is then used for energy. This initially occurs without oxygen and, therefore, is anaerobic glycolysis. Each glucose molecule is split into two pyruvic acid molecules, and energy is released to form four ATP.Pyruvic acid then enters the Mitochondria of the muscle cells and reacts with oxygen to form still many more ATP molecules.[1]

But in case of a long distance runner it's completely a different ball game and enhanced respiratory ability is very much critical for endurance sports.

Exercising exhibit positive correlation for both oxygen consumption and pulmonary ventilation increases. It seems to increase up to 20 folds between resting state to minimal exercise in well trained athletes.[2,3] A marathoner may have 45% greater Vo2 max than an average person. How is It possible to increase it by that great a value?![2,4,5,6] Vo2 max of a marathoner is probably genetically determined,[7,8] that is, those people who have greater chest size in relation to body size and have stronger respiratory muscles, good circulatory capacity select themselves to become marathoners.[2,5,9] Hence, a person who is well nourished, with better oxygen transport to cell will do better in endurance sports than an average person.[2,10]

Anthropometric parameters such as Body mass, Body Mass index, Height, show an association with endurance sports performances.[11,12,13] It is stated that BMI is positively correlated with performance time.[14] Circumference of chest is positively correlated with running performance in more than 800m, 1500m, 5 km running, also height of the athlete is positively associated with performance in 10 km running.[15] Kenyans are among the world's best endurance runners. It is supposed that lower BMI and smaller body size are important factor for their success.[4,16] Benefits of marathon running include decreased risks of hypertension, high cholesterol and diabetes. Runners will have powerful lungs. It's a fun way to spend some time and those who run consistently can maintain a healthy weight and fitness level. This is probably the biggest of benefits of marathon running. Most runners find the adrenaline rush to be something that keeps them coming back. It's a natural high that's addictive. It will keep the diet in check. Eating a healthy diet comes easier. Runners lessen the risk for a heart attack. But marathon running is not risk-free and athletes are prone to injury so long distance running is not everyone's event. Proper training should be taken and genetic predisposition must be taken into account.

Most runners are only amateurs, but to be a successful elite marathoner it requires something extra and an effort to examine, specify objectively and formularize the ideal anthropometric and pulmonary function parameter for higher success in endurance training (positive correlation of Lung Function Indices and Anthropometric Indices such as height, weight, BMI, chest circumference, etc) in successful endurance athletes (long distance runners) of Darjeeling district of West Bengal will be attempted.

Materials and methods

This field study was undertaken mainly by the Department of Physiology North Bengal Medical College, Sushrutanagar, Darjeeling District,WB, India 734 012 with subjects/runners, all males within age group of 15 to 45 years with no clinically detectable abnormality in cardiovascular, respiratory or the locomotors system, from various areas of Northern Districts of West Bengal. Person chronically abusing tobacco or with history of drug intake or drug abuse were excluded Parameters recorded from only those who could complete (endure) the race were.

1. Height using AVERY stadiometer.
2. Weight using a ATCO standard electronic weighing machine.
3. BMI calculated.
4. Chest circumference measured (fiber soft tape)
5. Forced vital capacity measured using an electronic flow sensing spirometer by Nassan Inc. (Miestro DT Spirometer).[17,18]
6. Forced expiratory volume in 1 second (FEV1) was recorded
7. FEV1/FVC ratio was calculated using the data from the two previous data set..

Appropriate statistical tests were done was made using one way ANOVA and Pearson- correlation. The statistical analysis was done using SPSS 20.0

Results and Analysis

Run time performance was collected of the 10 athletes who could endure the race and statistically examined for significance of data using Pearson's correlations.

Performance time: They had a mean performance time of 3278.81 seconds with a standard deviation of 89.075. The range was between 3136.5 to 3355.2 seconds.

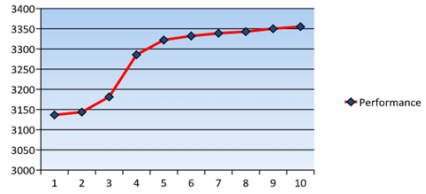


Figure 1. X axis - number of athletes,Y axis – performance/ completion time in seconds.

		Sum of Squares	df	Mean Square	F	Sig.
Age	Between Groups	16.133	1	16.133	.481	.492
	Within Groups	1275.467	38	33.565		
	Total	1291.600	39			
Height	Between Groups	118.008	1	118.008	1.623	.210
	Within Groups	2762.367	38	72.694		
	Total	2880.375	39			
Weight	Between Groups	52.404	1	52.404	.613	.438
	Within Groups	3246.876	38	85.444		
	Total	3299.280	39			
BMI	Between Groups	.008	1	.008	.001	.974
	Within Groups	261.697	38	6.887		
	Total	261.704	39			
Chest Circum'	Between Groups	40.833	1	40.833	.855	.361
	Within Groups	1814.267	38	47.744		
	Total	1855.100	39			
Expanded Chest Circum'	Between Groups	61.633	1	61.633	1.256	.270
	Within Groups	1865.267	38	49.086		
	Total	1926.900	39			
Vitalcapacity	Between Groups	6.003	1	6.003	4.852	.034
	Within Groups	47.016	38	1.237		
	Total	53.020	39			
FEV1	Between Groups	1.888	1	1.888	1.654	.206
	Within Groups	43.377	38	1.142		
	Total	45.265	39			
Ratio	Between Groups	209.009	1	209.009	.536	.469
	Within Groups	14827.792	38	390.205		
	Total	15036.801	39			

Chart 1. Statistical analysis by ANOVA of successful candidate

- Age: The athletes had a mean age of 21.8 years with a standard deviation of 2.34. With a range of maximum 25 years to minimum 17 years.
- Weight: The athletes had a mean weight of 61.63 kilogram with standard deviation of 6.17. The maximum and minimum weight ranged from 69.7 kilogram to 49 kilogram.
- Height: The subjects mean height were 172.1 centimeters with standard deviation value of 6.80. With a range of maximum 180 centimeters to minimum 156 centimeters. Figure – 12 show the height distribution With a range of maximum 22.78 KG/M2 to minimum 17.71 KG/M2.
- Chest circumference: Mean chest circumference of the study subjects/athletes were was 87.9 centimeter with a standard deviation of 4.7. With a range of maximum 94 centimeter to minimum 82 centimeter.
- Forced vital capacity: Mean forced vital capacity of the athletes were 4.47 liter with standard deviation of .97. With a range of maximum 6.82 liter to minimum 3.14 liter.
- FEV1: Mean FEV1 of the athletes were 3.55 liter with a standard deviation of .66. With a range of maximum 4.14 liter to minimum 2.32 liter.
- FEV1/ FVC ratio: Mean ratio of FEV1: FVC of the athletes were 80.59% with standard deviation of 13.09. With a range of maximum 97.1% to minimum 57.15%.
- BMI: The mean BMI of these athletes were 20.79 KG/M2, with standard deviation of 1.86. With a range of 17.19 to 29.88 KG/M2.

		Performance
Performance	Pearson Correlation	1
	Sig. (2-tailed)	
	N	10
Age	Pearson Correlation	.095
	Sig. (2-tailed)	.795
	N	10
Height	Pearson Correlation	-.139
	Sig. (2-tailed)	.702
	N	10
Weight	Pearson Correlation	-.443
	Sig. (2-tailed)	.200
	N	10
BMI	Pearson Correlation	-.453
	Sig. (2-tailed)	.189
	N	10
Chest Circum'	Pearson Correlation	-.053
	Sig. (2-tailed)	.883
	N	10
Expanded Chest Circum'	Pearson Correlation	-.198
	Sig. (2-tailed)	.583
	N	10
Vital capacity	Pearson Correlation	-.807**
	Sig. (2-tailed)	.005
	N	10
FEV1	Pearson Correlation	-.331
	Sig. (2-tailed)	.350
	N	10
Ratio	Pearson Correlation	.083
	Sig. (2-tailed)	.819
	N	10

Chart 2. Pearson's correlation used to determine the causal relationship of race performance time in seconds and bodily parameters.

- Age: Age is positively related to run time of the candidate to endure the race but it is not statistically significant. That is Weight increase in age decreases the ability of the candidate to endure the race. Pearson correlation was .095, significance .795.
- Height: Height is negatively correlated with performance time, i.e. with increase in height performance gets increased. But this was not statistically significant. Pearson correlation was -.139, significance .702.
- Weight: Weight is negatively correlated with performance time but it was not statistically significant. Pearson correlation was -.443, significance .200.
- BMI: BMI of the runners are negatively correlated with performance of the candidates i.e. lower BMI candidates lower finishing time of the race. But this value was not statistically significant. Pearson correlation was -.453, significance .189.
- Chest circumference: Normal as well as expanded chest circumferences of the candidates were negatively correlated with performance time, i.e. higher the chest circumference better the performance of the candidates. But this was not statistically significant. Pearson correlation was -.053 and -.198, significance .883 and .583 respectively.
- Forced vital capacity: The Forced vital capacities of the candidates were negatively correlated with the run performance time, and it was found to be statistically significant. Pearson correlation is .807, significance .005.
- Forced expiratory volume in one second: The candidate's expiratory volume in one second was negatively correlated with the run performance time, and it was found to be statistically insignificant. Pearson correlation is -.331, significance .350.
- FEV1/ FVC Percentage: The ratio of candidate's expiratory volume in one second and forced vital capacity was positively correlated with the run performance time, and it was found to be statistically insignificant. Pearson correlation was .083, significance .819.

Conclusion

Corroboration of data in the correlation chart of the successful athletes compared according to their performance time and their age, height, weight, BMI, chest circumference, expanded chest circumference, forced vital capacity, FEV1 and FEV1/FVC ratio shows that the performance time is positively related with age (Pearson's correlation= .095) and ratio of FEV1/ FVC ratio (Pearson's correlation=.083) but negatively related with height (Pearson's correlation=.139), weight (Pearson's correlation=.443), BMI (Pearson's correlation=.453), Chest circumference (Pearson's correlation=.053) , Expanded chest circumference (Pearson's correlation=.198), Vital capacity (Pearson's correlation=.807) and FEV1 (Pearson's correlation=.331). All those

values are within physiological limits, all of the successful athleteswere very fit and well nourished as per definition of a standard Indian man.In this study only the vital capacity is significant, which is negatively correlated with performance time. (Pearson's correlation= -.807 significance [two tailed] = .005). It signifies that with increase in Vital capacity there is a significant decrease in Marathon Performance time in endurance athletes. This finding supports the study of Pugh et al (1971) that a larger body size that faces the air resistance more during running increases the run time. While a smaller, leaner person faces lower air resistance during running which in turn decreases the run time.[19]

Although we presume that, a person with bigger lung size and higher vital capacity will do better in endurance running, no single research is adequate enough by itself. So studying a bigger sample size with participation by première elite athletes and defining more Anthropometric as well as Pulmonary Function parameters may improve the quality of the study.

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