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Comparison of maximum oxygen consumption (VO_{2max}) among 5,000 MTS and 10,000 MTS distance runners

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Abstract

Physiological study in relation to exercise and actual physical demand during event is very important to critically understand physiological basis of performance. The fatigue causing factors workload, recovery pattern from fatigue etc. should be very specifically understood in real terms. For the purpose of this study 20 male Junior National level Long distance runners (10 athletes each of 5,000mts and 10,000mts) from Tata Athletics Academy, Jamshedpur (Jharkhand) were selected. The age of the subjects ranged between 16-20 years. For the purpose of this study Heart rate, Respiratory rate and VO_2 max. were chosen as the Indicators of physiological responses and fatigue of long distance runners. The cardio-respiratory parameters were indicators as well as basis of aerobic and anaerobic performance capacity. Comparison of maximum oxygen consumption (VO_2 max.) of 5000m and 10000m distance For assessing the Maximum Oxygen Consumption (VO_2 max.) Cooper's 12-minutes run/walk test was administered and the distance covered in 12-minutes was recorded and put in the formula to calculate the VO_2 Max. in ml/kg/min. (VO_2 max.)= (D12 -505)/45. where D12 = distance run in 12- minutes. In order to analyze the data descriptive statistics and independent- test was applied and level of significance was set at 0.05 level. It is evident that t-value is 1.32 which is not significant at 0.05 level with 18 degree of freedom. It indicates that mean scores of maximum oxygen consumption (VO_2 max) of 5000 mts and 10,000 mts runners do not differ significantly. Thus, it implies statistically the difference between the mean scores of VO_2 max of both the groups 74.22 and 75.56 were insignificant. The long distance running events like 5000mts and 10,000mts are not absolutely aerobic event. The anaerobic proportion of Long distance running 5000mts and 10,000mts is of significant level and fatigue caused in these events are due to anaerobic glycolysis and lactate accumulation is also in significant proportion along with aerobic part of the activity. The anaerobic lactate threshold of 5000mts and 10,000mts runners normally starts at 75-80% of VO_2 max. Heart rate assessment is one of the most effective and comprehensive method to examine load intensity, load factor or fatigue evaluation. A typical 5,000mts and 10,000mts events places workload demand intensity between 80-85% of maximum when observed in terms of heart rate at the end of the event.

Keywords: maximum oxygen consumption, VO_{2max} , 5,000 MTS and 10,000 MTS

Introduction

Physiological study in relation to exercise and actual physical demand during event is very important to critically understand physiological basis of performance. The fatigue causing factors workload, recovery pattern from fatigue etc. should be very specifically understood in real terms. In this context an in-depth investigation on Physiological basis of long-distance runners is crucially important for high performance training implications. It was found in this respect that there were two groups of parameters that were considered significant indicator and basis of aerobic as well as anaerobic capacity.

Understanding this background, the present study was designed to investigate in- depth and detailed Physiological responses of two long-distance running events 5000 mts and 10000 mts. For the purpose of this study Heart rate, Respiratory rate and VO_2 max. were chosen as the indicators of physiological responses and fatigue of long-distance runners. The parameter groups were cardio-respiratory parameters. The cardio-respiratory parameters were indicators as well as basis of aerobic and anaerobic performance capacity.

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Methods

For the purpose of this study Heart rate, Respiratory rate and VO₂ max. were chosen as the indicators of physiological responses and fatigue of long-distance runners. An understanding of various physiological responses and recovery pattern is utmost necessity for understanding in depth about training as well as performance implications for long distance runners. The fact is that the selected physiological parameters provide basis for performance as well as are significant indicators of performance capacity. For the purpose of this study 20 male Junior National level long-distance runners (10 athletes each of 5,000mts and 10,000mts) from Tata Athletics Academy, Jamshedpur (Jharkhand) were selected. The age of

the subjects ranged between 16-20 years. For assessing the Maximum Oxygen Consumption (VO₂ max.) Cooper's 12-minutes run/walk test was administered and the distance covered in 12-minutes was recorded and put in the formula to calculate the VO₂ Max. in ml/kg/min. (VO₂ max.) = (D12 - 505)/45, where D12 = distance run in 12- minutes. Heart rate was monitored through palpation method. Breathing rate was self-reported by the athletes. In order to analyze the data descriptive statistics and independent- test was applied and level of significance was set at 0.05 level.

Results

Table 1: Descriptive analysis of 5000m runners

Variables	Experimental Conditions	Mean	S.D.	Minimum	Maximum	Range
Heart Rate	Pre-test	64.60	8.28	54.0	78.0	24.0
	Post-test	175.80	11.68	162.0	192.0	30.0
Respiratory Rate	Pre-test	15.10	2.38	11.0	18.0	7.0
	Post-test	35.30	4.69	28.0	42.0	14.0
VO ₂ max.	Cooper's 12 minutes Run/ Walk test	74.22	2.04	71.56	77.67	6.11

The mean and standard deviation of long distance runners pertaining to selected variables i.e. Heart rate, Respiratory rate and VO₂ max are presented in Table-1.

The mean and standard deviation for Heart rate for different

experimental conditions are as follows: Pre-test (64.60 ± 8.28), Post-test (175.80 ± 11.68); for Respiratory rate, Pre-test (15.10 ± 2.38), Post-test (35.30 ± 4.69); for VO₂ max mean and standard deviation is 74.22 ± 2.04.

Table 2: Descriptive analysis of 10,000mts runners

Variables	Experimental Conditions	Mean	S.D.	Minimum	Maximum	Range
Heart Rate	Pre-test	70.80	5.90	60.0	80.0	20.0
	Post-test	177.50	11.97	156.0	192.0	36.0
Respiratory Rate	Pre-test	15.80	2.10	13.0	19.0	6.0
	Post-test	38.10	3.35	34.0	44.0	10.0
VO ₂ max.	Cooper's 12 minutes Run/ Walk test	75.56	2.47	72.11	80.44	8.33

The descriptive statistics of Physiological responses and recovery pattern of 10,000 meters runners and the mean and standard deviation of all variables are presented below in Table- 2.

The mean and standard deviation for heart rate for

different experimental conditions are Pre-test (70.80 ± 5.90), Post-test (177.50 ± 11.97); for respiratory rate, Pre-test (15.80 ± 2.10), Post-test (38.10 ± 3.35); for VO₂ max mean and standard deviation is 75.56± 2.47.

Table 3: Groupwise mean, standard deviation and t-value for maximum oxygen consumption (Vo₂ max)

Long Distance Runners	Number	Mean	Standard Deviation	df	t-value
5,000 mts.	10	74.22	2.04	18	1.32
10,000 mts.	10	75.56	2.47		

* Significant at 0.05 level.

Tab t_{0.05} (18) =2.10

From Table-3, it is evident that t-value is 1.32 which is not significant at 0.05 level with 18 degree of freedom. It indicates that mean scores of maximum oxygen consumption (VO₂ max) of 5000 mts and 10,000 mts runners do not differ significantly. Thus, it implies statistically the difference

between the mean scores of VO₂ max of both the groups 74.22 and 75.56 were insignificant.

The graphical representation of mean of VO₂ max. is shown in Figure 1

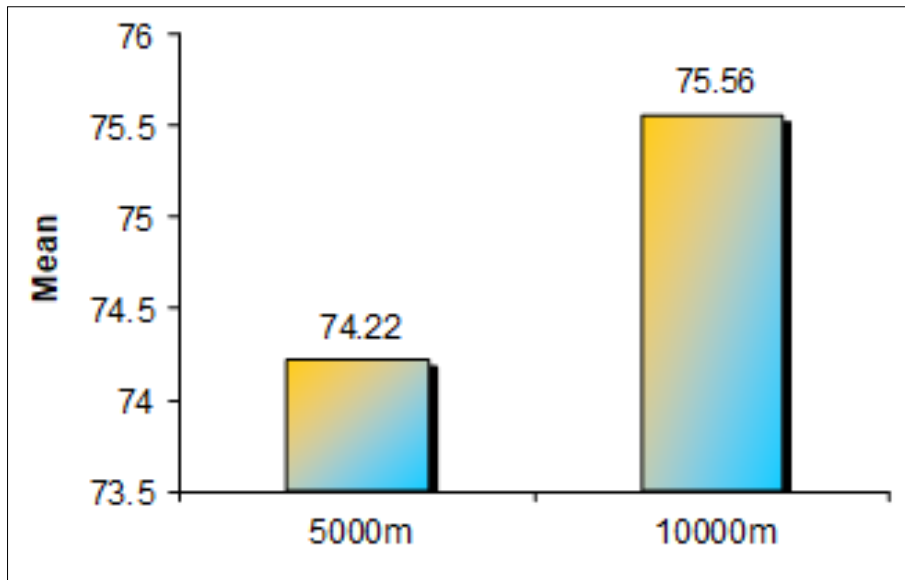


Fig 1: Mean of VO₂ max among 5,000mts and 10,000mts runners

Discussions

The runners were compared on VO₂ max. and no significant difference was observed between 5000mts and 10,000mts events, which signify maximum Oxygen (O₂) consumption rate for both long distance event are of similar level or in other words the two events have more or less equal aerobic demands.

The VO₂ max. analysis showed there is no significant difference between 5000mts and 10,000mts runners implying the two events in terms of their aerobic characteristic and maximal oxygen utilization (VO₂ max.) of similar level. The VO₂ max. values 74.4 and 75.6 ml/min/kg respectively found for 5000m and 10,000m runners are of significant higher level and it characterizes pre-dominance of aerobic energy system for 5000mts and 10,000mts events. The VO₂ max. measured for 5000mts and 10,000mts runners is not having significant difference may be due to the fact that both are basically endurance based activity and normally possess very high amount of VO₂ max.

Earlier the concept of aerobic performance was that any long distance or endurance based activity was related to VO₂ max. only. But, after the invention of anaerobic threshold level we know that high VO₂ max. is not the only criteria for good performance in an endurance activity. According to modern concept of exercise Physiology and Bio-chemistry along with VO₂ max., high level of anaerobic threshold of the runners is very vital.

Conclusions

1. The long-distance running events like 5000mts and 10,000mts are not absolutely aerobic event.
2. The anaerobic proportion of long-distance running 5000mts and 10,000mts is of significant level and fatigue caused in these events are due to anaerobic glycolysis and lactate accumulation is also in significant proportion along with aerobic part of the activity.
3. Heart rate assessment is one of the most effective and comprehensive method to examine load intensity, load factor or fatigue evaluation.
4. A typical 5,000mts and 10,000mts events places workload demand intensity between 80-85% of maximum when observed in terms of heart rate at the end of the event.
5. The anaerobic lactate threshold of 5000mts and 10,000mts runners normally starts at 75-80% of VO₂ max.

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