

HEART RATE VARIABILITY OF ELITE SPRINTERS MIDDLE DISTANCE AND LONG DISTANCE RUNNERS

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ABSTRACT

The purpose of the present study was to compare and assess the Heart Rate Variability of elite sprinters middle distance and long distance runners of Maharashtra state. The total numbers of athletes of the track event were 30, who have taken part in national and international level tournaments organized time to time in the different coroners of India and out of India. The 30 Athletes were selected as a sample for the study in their performance order to complete and fulfill the aim of the study. High frequency and low frequency parameters of heart rate variability of the athletes were to be analyzed by an instrument called Biopac that was discovered by Jean Charcot in the Russian scientific research laboratory in 1995 (reliability=0.98 and validity=0.95). To assess the heart rate variability of the track athletes i.e. sprinters middle distance and long distance runners, ANOVA test with LSD Post Hoc test were computed from raw scores. The result of the study revealed that the Sprinters and middle distance runners had almost same HRV by comparing their MD (mean difference). Hence their fitness level, either physically or mentally are also same and it is only due to their conditioning and training that is almost same. Whereas long distance runners had higher HRV than the sprinters and long distance runners. Hence the fitness level of long distance runners is higher than sprinters and middle distance runner

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INTRODUCTION

The human heart is a bio-electrical pump beating at an ever changing rate: it is not like a clock that beats at a steady, unchanging rate. This variability in heart rate is an adaptive quality in a healthy body. Measuring Heart Rate Variability though long used in hospitals for treating heart patients, is a relatively new biofeedback concept for athletes. Soviet Union sports scientists started keeping track of their elite athletes' heart rate variability in 70s. In the past decade, college sports team and the world class athletes have been increasingly using HRV to monitor fatigue and recovery from work outs.

Heart rate variability is the degree of fluctuation in the length of the intervals between heart beats. HRV is mirroring the regularity of heart beats: bigger regularity - lowers HRV (and vice versa). Regularity of heartbeats is derived from a quantity of numbers; equal to the times elapsed between successive heartbeats. They are named R - R intervals and are measured in millisecond (ms).

The intrinsic heart rate (HR) generated by the senatorial node (SA node) in the absence of any neural or hormonal influence is about 100 to 120 beats per minute (BPM). However in healthy individual resting HR would never be that high. In a healthy individual(adult), the HR is ranging between 60 and 90 beats per minute(BPM) and the HR estimated at any given time represents the net effect of the parasympathetic (vague) nerves, which slow HR, and the sympathetic nerves, which accelerate it.

The physiological origins of HRV are the fluctuations of the activity of cardiovascular vasoconstrictors and vasodilatory centers in brain. Normally these fluctuations are a result of blood pressure oscillation, respiration, thermoregulation and circadian biorhythm. All these factors can influence the length of beat-to-beat intervals, named R-R intervals.

Simple measures of the small changes in each beat of your heart can provide a wealth of information on the health of your heart & nervous system; such measures are called heart rate variability or HRV. Originally applied to assess the risks for patients who suffered a heart attack, HRV analysis is now becoming a standard tool in sports science research & coaching practice.

Since researchers first found significant changes in the nervous systems of athletes involved in hard training for the rowing world championships, a number of studies have tried to use HRV as a tool to monitor overtraining. In general such studies show that HRV is much lower in overt trained athletes than healthy ones.

The problem is, when you are over trained it is too late. It might take weeks or months to get back to full fitness, so what you need is a daily measure to tell you how well your nervous system is doing. Daily monitoring using standard HRV methods have shown that listening to heart via HRV can not only stop you overtraining but actually make your training more effective.

The idea is quite simple. Monitor your HRV every morning and train as normal. If your HRV drops significantly, take this as an early warning that you are overloading the system. A small drop is OK as long as you recover. Training is, after all, about stress and recovery and a hard session, especially on top of accumulated fatigue, will lower your HRV.

But if your HRV stays low even with rest you could be on the edge of trouble. In my opinion, using daily HRV to monitor training stress is the best thing you can do to make your training safe and effective. So listen to your heart.

Heart rate monitors provide important feedback about the intensity of exercise, but can't measure the cumulative fatigue of workouts or the subsequent training effects. However, new innovations using heart rate variability (HRV) data mean that's about to change.

Sports Scientist & Coach Eddie Fletcher has collected extensive data from a number of sports and endurance activities, and explains that, in general there is a tendency for training to be at the high end of extreme with a prevalence of over training and under recovery. There is a general belief amongst athletes that 'working hard' is a virtue when it comes to improving fitness. Equally at the social end of participation (charity running for example) many competitors are under prepared for the physiological effort required.

Simply put HRV is a measure of the time gap between individual heart beats while body is at rest. The heart, in fact, speeds up when we inhale, and slows down when we exhale. This difference is known as HRV [heart rate variability]. A healthy, well-rested body will produce a larger gap, and higher HRV than a stressed-out, over trained body.

Heart Rate Variability (usually known as HRV) is a relatively new method for assessing the effects of stress on the body. High HRV indicates good health, high level of physical fitness and less stress & tension. Whereas low HRV is linked to stress, fatigue and even burn out. Different athletes of track events are under stress either physically or mentally. Therefore, it was thought to assess physical fitness as well as mental fitness in terms of HRV of different runners objectively.

The objective of the study is to assess the variations in the heart rate among the athletes including; sprinters, middle distance and long distance runners in order to know their health and fitness level. It was also hypothesized that there may be significant difference in the beat to beat intervals of various elite runners including sprinters, middle distance and long distance runners.

METHODOLOGY

Selection of subject:

The population of the study was the male elite runners of Maharashtra state. The present study was conducted on a minimum of 30 athletes. Purposive sampling technique was applied for the selection of the sample. The athletes were sprinters, middle distance and long distance runners of Maharashtra state were included. The age ranged of the athletes was between 18 to 25 years.

Selection of Variable

The variable of the study was heart rate variability (HRV) in which the high and low frequency parameters were analyzed.

Tools used:

BIOPAC instrument was used to conduct this study. Instrument's reliability and validity were 0.98 and 0.95 respectively.

Research Design:

The present investigation is a survey study under descriptive research, which has been conducted with a view to measure and compares the HRV of the elite runners. There were total three groups viz., Group A(sprinters n=10), Group B (middle distance runners n=10), Group C(long distance runners n =10). Survey on the HRV of the subjects belongs to these three groups was conducted and the result was compared and correlated.

Statistical techniques:

ANOVA test was applied. In order to find out the significance differences between paired means, LSD test of Post-hoc comparison was applied. The level of significant was set at 0.05 level of confidence.

RESULTS AND DISCUSSION

To compare the level of heart rate variability of elite sprinters, middle distance and long distance runners the analysis of variance (ANOVA) was applied to find out the paired means significant difference. The level of significance fixed at 0.05. The analysis of the result and finding of the present study are exposed by the researcher in the following tables.

The following table illustrates the statistical result of the comparison among elite runners in relation to heart rate variability. Mean differences among the groups under study are also presented in the consecutive table.

TABLE 1
ANALYSIS OF THE VARIANCE OF THREE DIFFERENT TRACK EVENT
ATHLETES IN RELATION TO HEART
RATE VARIABILITY

Source of variance	df	SS	mss	f-ratio
Between	2	64.91201(SST)	32.456005	17.19*
With in	27	50.95369(SSE)	1.8871737	

*Significant at 0.05 level

F.05 (2, 27) =17.19

Table-1 reveals that the calculated “f” value is 17.19 which is greater than the table “f” value 3.35 at the degree of freedom of (2,27) at the level of significance 0.05 it means that there is a significance difference among the group in health related physical fitness.

As the ANOVA was significant then LSD post Hoc Test was applied to find out paired mean significance difference and the level of significance was 0.050.

TABLE 2
MEAN DIFFERENCE OF LSD POST HOC TEST FOR HEART RATE
VARIABILITY

S. No.	G1 (Sprinters)	G2 (Middle Distance Runners)	G3 (Long Distance Runners)	M.D	C.D
1	3.32	4.33		1.01	1.25
2	3.32		6.82	3.5	1.25
3		4.33	6.82	2.49	1.25

Significant at 0.05 level.

The mean scores of heart rate variability of sprinters, middle distance and long distance runners have been depicted in the following figure.

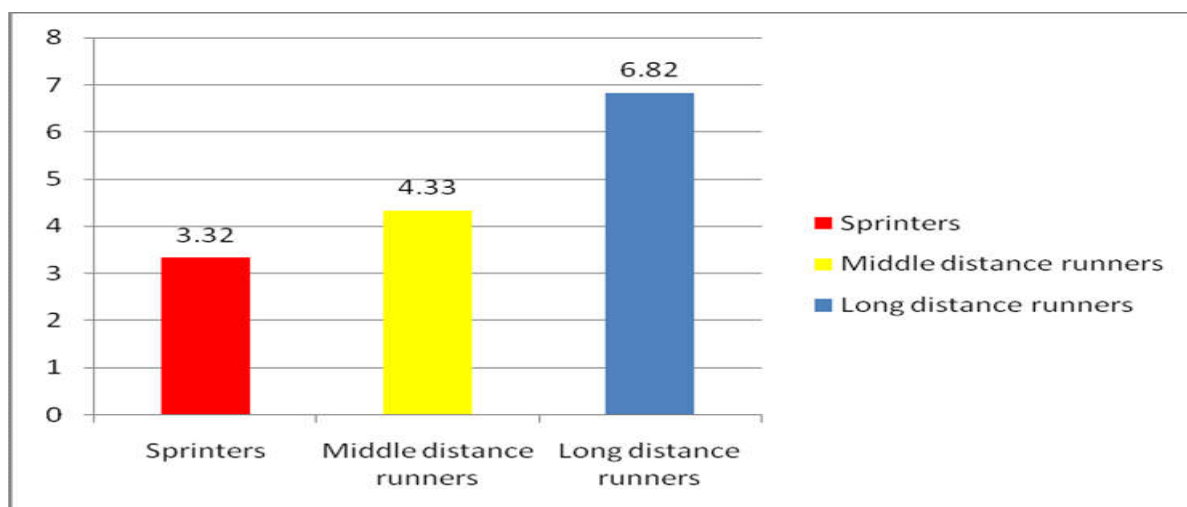


Fig-1. Graphical representation of heart rate variability of different track athletes.

Sprinters and middle distance runners had almost same HRV by comparing their MD (mean difference). Hence their fitness level, either physically or mentally are also same and it is only due to their conditioning and training that is almost same.

Whereas long distance runners had higher HRV than the sprinters and long distance runners. Hence the fitness level of long distance runners is higher than sprinters and middle distance runners.

DISCUSSION

The mean shows that sprinters and Middle distance runners have the same heart rate variability. It indicates that both sprinters and middle distance runners conditioning process are almost same.

The mean shows that long distance runners has more heart rate variability than sprinters, it may be due to the nature of their conditioning, practice and exercises as long distance runners perform hard and more exercises than the sprinters.

The mean shows that the long distance runners have slightly more heart rate variability than middle distance runners; it may be due to their training and conditioning process as long distance runners' training is slightly harder than the middle distance runners.

As we know, HRV is a relatively new method for assessing the effects of stress on the body. Earlier research evidence increasingly links high HRV to good health and high level of fitness while decreased HRV is linked to stress, fatigue and even burnout.

In the present study, all the athletes i.e. sprinters, middle distance long distance runners have high HRV then the normal range 0.064 to 0.196 Hz. But according to the purpose of the study which group has high level of fitness then the others. This study indicates that sprinters and middle distance runners have almost the same level of fitness because of their almost same HRV (middle distance runners have slightly higher than the sprinters). But the HRV of long distance runners has higher than the sprinters and middle distance runners. Therefore long distance runners group is more physically fit and psychologically sound than the sprinters and middle distance runners.

Earlier it was hypothesized that there was significant difference in the heart rate variability of elite sprinters, middle distance and long distance runners.

On the basis of the findings of the present study the hypothesis which was stated earlier that there was significant in the heart rate variability of elite sprinters, middle distance and long distance runners is rejected in regard to sprinters and middle distance runners.

Further the hypothesis there was significant difference in the heart rate variability of elite sprinters, middle distance and long distance runners is accepted in regard to sprinters and long distance runners and middle distance and long distance runners.

CONCLUSION

1. All the runners of different track events have high level of HRV than the normal range. Therefore all these athletes have high level of physical fitness.
2. Sprinters and middle distance runners have the same level of physical fitness because of their same level HRV.
3. Long distance runners have high level of HRV than sprinters therefore their fitness level is also higher than the sprinters.
4. Middle distance runners have low level of HRV than long distance runners, therefore the fitness level of middle distance runners is also lowest than the long distance runners.

RECOMMENDATIONS

1. A study may be conducted on female athletes.
2. A study may be conduct on comparison of HRV (heart rate variability) between male and female athletes.
3. A study may be conducted on collegiate students.
4. A study may conduct on different states, zonal wise and even at national and international level.
5. The study may recommend the coaches and athletes should select effective means to lower down the athletes' heart rate variability in order to achieve high level of fitness.

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