



Relationship Between VO_2 Max And Specific Fitness Component With Time Domain Parameter Of HRV In Elite Female Kho-Kho Player

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Abstract

Introduction

Heart rate variability (HRV) indexes the autonomic nervous system, and HRV values are found highly correlated with VO_2 max and Speed in elite kho-kho players. So, Kho-kho player's VO_2 max and Speed has a direct influence on sporting performance, this study will analyse the correlation between HRV and VO_2 max, Speed. The primary aim of the study is to analyse the correlation among HRV, VO_2 max and Speed of elite kho-kho players.

Methodology

The total no of 20 female kho-kho players($n=20$) were taken as the subject for the study who had represented at State and National level competition. The training age of the subject was minimum 5 years. The age of the subjects was ranged from 16 to 25 years. Subjects were selected from Nadia District of West Bengal. Subjects were tested Queens college step test for VO_2 max and 50 Yards Dash for Speed test.

Results

Pearson product moment correlation was performed for analysing with using Microsoft Excel V10.0. HRV and VO_2 max scores had a positive correlation, as indicated by Pearson correlation analysis ($r=0.876$, $P < 0.01$) and HRV and Speed scores had a positive correlation ($r=0.672$, $P < 0.01$).

Conclusions

The findings demonstrated a strong correlation between elite kho-kho players' HRV, $VO_2\max$, and speed scores. Future studies need to be conducted on a large scale to evaluate the correlation in a diverse population.

Key Words: LnRMSSD, $VO_2\max$, Speed, HRV, Kho-kho players

INTRODUCTION

One of the most appreciated traditional sports in India is kho-kho. Though its exact origins are unknown, many historians assume that Kho-Kho is a modified version of "Run Chase," which, in its most basic form, consists of chasing and touching a person. Beginning in Maharashtra, Kho-Kho was once called as Rathore and was played on "raths," or chariots ("**Indian Game**," ND.). The game's rules were established during the start of the 20th century. In order to establish the regulations for Gymkhana Poona, a committee was constituted in 1914. The Gymkhana Baroda released the first Kho-Kho rules in 1924. The inaugural national Kho-Kho championship was held at Vijayawada, Andhra Pradesh, in 1959–1960. Kho-Kho can be played by men, women, and children of all ages. The game requires a very small piece of evenly surfaced ground, rectangular in shape, and 27m by 16m. The only equipment required are the two poles. The game lasts no more than 48 minutes (**Nataraj, H.V., 2023**).

Most physical fitness components, including strength, speed, and endurance, are needed to play the game Kho-Kho. Improvement and maintenance of physical fitness is the most important aim of sports training (**Roy, De, & Nandi, 2016**). Athletes' physical fitness determines how well they perform in any given game or competition. Physiological parameters are the key motor abilities that determine physical fitness or condition, and these abilities play a major role in sports performance across all sports. Heart rate (HR) is easily monitored, and the literature has provided a number of methods for estimating VO_2 from HR data (**Li et al., 1993; Spurr et al., 1988**). Maximal oxygen uptake ($VO_2\max$) was the best indicator of aerobic capacity of an organism, and at the same time, the best indicator of an athlete's physical capacity (**Rankovic et.al.,2010**).

Heart rate variability (HRV) is the physiological phenomenon of variation in the time interval between heartbeats. It is measured by the variation in the beat-to-beat interval. Other terms used include: "cycle length variability", "RR variability" (where R is a point corresponding to the peak of the QRS complex of the ECG wave; and RR is the interval between successive Rs), and "heart period variability". Methods used to detect beats include: ECG, blood pressure and the pulse wave signal derived from a photo plethysmograph (PPG). ECG is considered superior because it provides a clear waveform, which makes it easier to exclude heartbeats not originating in the senatorial node. The term "NN" is used in place of RR to emphasize the fact that the processed beats are "normal" beat. According to Berkoff et.al (2007) Sympathetic and parasympathetic balance can now be studied using heart rate variability (HRV). Heart rate monitor, which is less expensive and complex than the classical respiratory measurement devices

(Cottin, F.,2007). The purpose of the study to find out the relationship between Heart Rate Variability with VO_2 max and physical fitness of female kho-kho players.

METHODOLOGY

A purposive study was conducted on State and National Level Female Kho-Kho Players from Nadia District of West Bengal. To conduct the study, the data selected were Personal data (Age, Height, Weight), Physical Fitness Components (Speed) and Physiological Fitness (VO_2 Max).

Subjects

The totals no of 20 female kho-kho players ($n=20$) were taken as the subject for the study who had represented at State and National level competition. The training age of the subject was minimum 5 years. The age of the subjects was ranged from 16 to 25 years. Subjects were selected from Nadia District of West Bengal.

Procedure

- **Personal Data-**

For collecting personal data of the subjects, birth certificate was used as age proof, Height was measured by stadiometer with ± 0.1 accuracy. The weight measured by weighing machine. The procedure followed for collecting data for this measure were as follows-

- **Physical Fitness Test-**

Queens College Step Test (VO_2 max):

Purpose: this sub-maximal test provides a measure of cardio respiratory or endurance

Equipment required: 16.25 inches/41.3 cm step, stopwatch, metronome or cadence tape, heart rate monitor (optional).

Procedure: The athlete steps up and down on the platform at a rate of 22 steps per minute for females and at 24 steps per minute for males. The subjects are to step using a four-step cadence, 'up-up-down-down' for 3 minutes. The athlete stops immediately on completion of the test, and the heart beats are counted for 15 seconds from 5-20 seconds of recovery. Multiply these 15 second readings by 4 will give the beats per minute (bpm) value to be used in the calculation below. See video of this test being performed.

Scoring: A rating can be determined using the VO_2 max norms (McArdle et al., 1972).

Men VO_2 max (ml/kg/min)= $111.33-(0.42 \times \text{heart rate in bpm})$

Women: VO_2 max (ml/kg/min) $65.81-(0.1847 \times \text{heart rate in bpm})$

50 Yards Dash (Speed Test):

Purpose: The aim of this test is to determine acceleration and speed

Equipment required: Measuring Tape, Marked Track, Stopwatch, Cone Markers

Procedure: The test consists of a single, maximum 50-meter sprint, with timing recorded. A thorough warm-up should be done, along with a few tests starts and accelerations. began by putting one foot in front of the other while remaining still (hands were off the ground). Repositioning the front foot from the starting line is required. As soon as the subject was ready and still, the starter gave the orders "set" and "go". The tester should give the participant advice on how to maximize speed, such as remaining low and using strong arm and leg force, and should implore them not to slow down before crossing the finish line.

Scoring: The time interval between the start signals and the student's crossing of the finish line, calculated to the nearest tenth of a second, determines the score.

RECORDING OF ECG

ECG machine was used for recording of RR interval and corresponding Root mean square distance value of RR interval was calculated using SYSTAT Software, a man recording of one complete cycle of ECG waves i.e. PQRS in each lead data were recorded in graph paper. ECG recording was done after immediate completion of the test to get the recording of RR interval.

Measurement procedure of in RMSSD of RR interval from ECG records. RR interval was calculated in all the leads as shown in the figure. The RR interval value was square rooted and the corresponding sums of all the RR intervals were calculated which was again converted to in RMSSD value by taking their natural logarithm by the online available software.

Statistical Analysis

Pearson product moment correlation was performed between each of parameters except for personal data. Mean and standard deviations were calculated for all the parameters. All the statistical calculations were done in Microsoft Excel V10.0.

RESULTS

Different standardized tests were used to measure Queen's College step Test, 50 Yard Dash, and ECG.

Table-1 represent Personal Data (Mean±SD) of the subjects

Variables	N	Mean±SD
Age(Years)		20.8±3.10
Height(cm)	25	153.75±6.49
Weight(kg)		46.9±7.77

Table-1 represented in the Table-1 that the Mean and SD value of Age(years), Height(cm), Weight(kg) of Kho-Kho players were 20.8±3.10, 153.75±6.49 and 46.9±7.77 respectively.

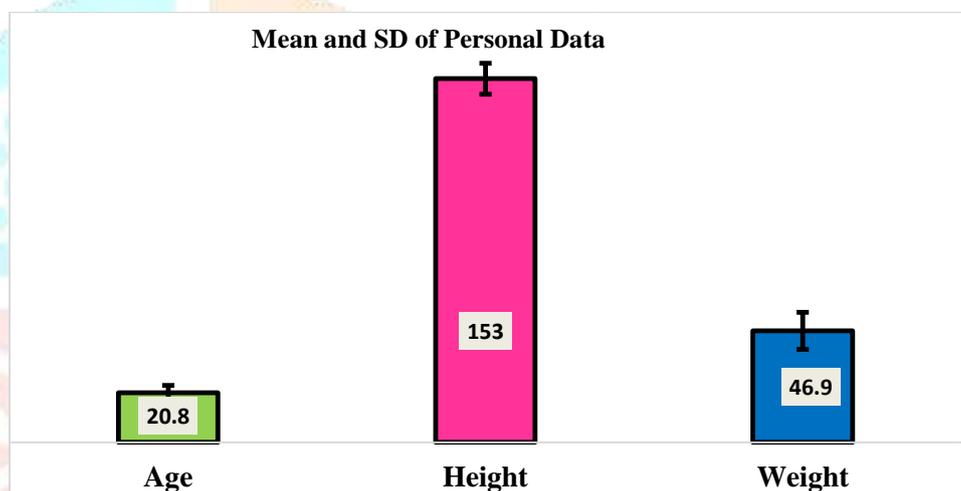


Figure-1 represented Mean and SD value of age, height and weight of Kho-kho players

Table-2 represented Correlation between LnRMSSD and VO₂max of female kho-kho players

Variables	Mean±SD	r-value
LnRMSSD	0.522±0.048	
VO ₂ max(ml/kg/bodyweight)	36.57±2.39	0.876 ^S

LnRMSSD=Logarithm of the root mean sum of square distance of RR interval, S- Significance of 0.01 level of confidence, $t_{0.01}^{18}=0.549$

Table 2 represented the Mean and SD value of LnRMSSD and VO₂max were 0.522±0.048 and 36.57±2.39 respectively. It was observed that the r value was 0.876. It was significant at 0.01 level. So LnRMSSD was positively correlated with VO₂max i.e. more VO₂max will be the value of more LnRMSSD.

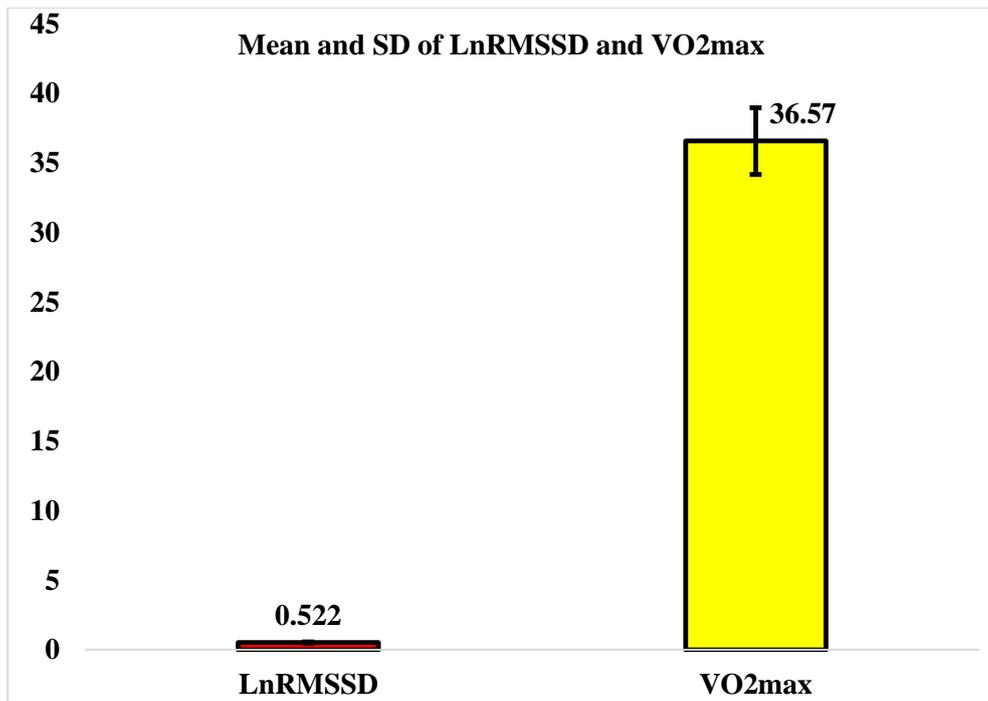


Figure-2 represented Mean and SD value of LnRMSSD and VO₂max

Table-3 represented Correlation between LnRMSSD and Speed of female kho-kho players

Variables	Mean±SD	r-value
LnRMSSD	0.522±0.048	0.672 ^S
Speed	0.164±0.010	

LnRMSSD=Logarithm of the root mean sum of square distance of RR interval, S- Significance of 0.01 level of confidence, $t_{0.01}^{18}=0.549$

Table 3 represented the Mean and SD value of LnRMSSD and speed were 0.522±0.048 and 0.164±0.010 respectively. It was observed that the r value was 0.672. It was significant at 0.01 level. So LnRMSSD was positively correlated with speed i.e. more speed will be the value of more LnRMSSD.

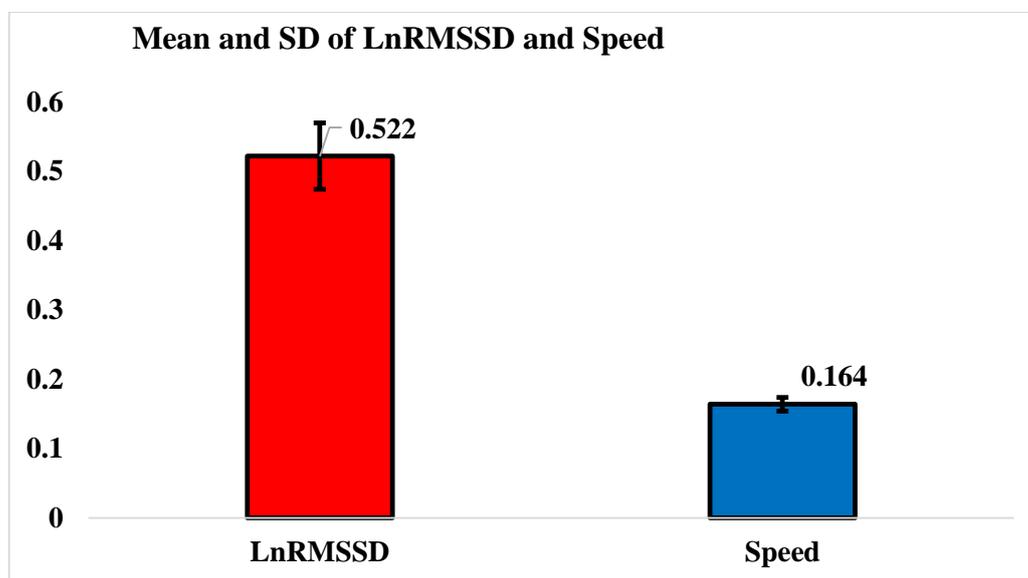


Figure-3 represented Mean and SD value of LnRMSSD and Speed

DISCUSSION

In recent years, there has been an increasing amount of study and analysis on the use of HRV to identify ANS alterations in athletic performance, nevertheless, this technique has mostly been applied to trained athletes. There hasn't been much research done on the potential applications and usage in sports training. Unlike the typical laboratory tests used to gauge sports ability (such VO₂ max). According to **Makivic et.al (2016)** the use of the non-invasive HRV represents an inexpensive alternative to evaluate and promote training to enhance performance in both the highly trained and the less-trained athletes. **Bocalini et.al (2017)** reported that HRV was a research and clinical tool and provided a great degree of information the inner working of an individual's body and their overall health. In the present study researcher investigate the relation between heart rate variability with vo₂ max and physical fitness (Speed and Agility). **Perini and Veicsteinas (2003)** explored heart rate variability (HRV) and autonomic activity during rest and exercise across different physiological conditions. According to correlation values categorized by **Sugiyono (2013)**, correlation values are defined as very weak if values are less than 0.199, weak if they fall between 0.20 and 0.399, medium from 0.40 to 0.599, strong from 0.60 to 0.799, and very strong from 0.80 to 1.00. The correlation value in this study was 0.876, indicating a significant and very strong positive correlation ($P < 0.01$) between HRV values and VO₂max. The correlation value in this study was 0.672, indicating a significant and strong positive correlation ($P < 0.01$) between HRV values and Speed scores.

Conclusion

In accordance with this study, it was observed that VO₂max and Speed scores are significantly correlated and as good as the LnRMSSD, better will be the Speed in kho-kho players with higher HRV values. The findings demonstrated a strong correlation between LnRMSSD, VO₂max, and speed in female Kho-kho players. For further study in a diverse population, larger-scale research projects are required in the future.

However, sports medicine doctors, athletes, and coaches may use this study as a foundation for evaluating HRV as a measure of VO₂max and speed performance in kho-kho players.

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