



## ESTIMATION OF RELATIONSHIP BETWEEN MAXIMAL OXYGEN CONSUMPTION AND REPEATED SPRINT ABILITY OF MALE HANDBALL PLAYERS

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**Abstract:** The purpose of the present study was to investigate the relationship between maximal oxygen consumption and repeated sprint ability of male university handball players. Twenty seven (27) male university handball players were selected from Department of Physical Education and Sports Sciences, Annamalai University, who voluntarily participated in this study (age:  $21.62 \pm 1.90$  years; height:  $172.07 \pm 7.25$  cm; body weight:  $64.59 \pm 9.92$  kg). Multistage 20 m shuttle run test was used for the estimation of maximal oxygen uptake and total distance covered. Repeated sprint ability was measured by 7×30 meters sprint with 25 second recovery. The results of product moment correlation analysis showed significant correlation between maximal oxygen consumption with fatigue index ( $r = 0.965, p = 0.000$ ), fast sprint time ( $r = 0.772, p = 0.000$ ), slowest sprint time ( $r = 0.875, p = 0.000$ ) and mean sprint time ( $r = 0.807, p = 0.000$ ). The findings of the present study indicated significant negative correlation among maximal oxygen consumption and repeated sprint ability of male handball players. This clearly shows that players with greater aerobic capacity will have better repeated sprint ability.

**Keywords:** Maximal oxygen consumption, repeated sprint ability, multistage fitness test, fatigue index, distance covered

### Introduction

Handball is a fast body contact game played around the world. Since its inception from 1936 Berlin Olympics this game had undergone several modifications in the rules and game pattern. The modification of rules like fast throw off, goalkeeper throw, timeouts during last five minutes, etcetera have clearly showed that fitness of players plays a vital role during competition.

The handball players require a high level of general and specific fitness. The actual length of a match is about 60 minutes, with consecutive attacks and defences, performed with high intensity. During a game, direct contact with opponents takes place, and players perform a lot of accelerations, turns and jumps. The diversity of efforts requires comprehensive preparation in terms of endurance, speed and strength. The energy required for handball competition derives from both aerobic and anaerobic processes. Good levels of general fitness, as well as a high aerobic and anaerobic capacity, form the foundation for success in handball [1-2]. The fatigue index is a term most often used to indicate the rate at which an athlete's power output declines. It can be used as an indicator of an athlete's aerobic endurance. According to Chittibabu (2013) fatigue



index shows temporal oscillation with greater decline in power output during morning than evening [3]. It is also noted that wing players have greater repeated sprint ability than back court, pivot and goal keepers [4]. However, repeated sprint ability importance cannot be neglected since all the field players in the court gets equal chance for fast break and quick counterattacks. The role of the repeated sprint ability is greater and which determines the result of the match [4]. The purpose of the present study was to investigate the relationship between maximal oxygen consumption and repeated sprint ability university level male handball players.

## Methods

### *Subjects*

Twenty seven (27) male university handball players were selected from Department of Physical Education and Sports Sciences, Annamalai University, who voluntarily participated in this study. Their mean (SD) for age, height, weight, percent body fat, lean body mass and fat mass were:  $21.62 \pm 1.90$  years;  $172.07 \pm 7.25$  cm;  $64.59 \pm 9.92$  kg;  $6.33 \pm 3.56\%$ ;  $59.93 \pm 8.20$  kg;  $4.65 \pm 3.48$  kg respectively. These selected players represented Annamalai University in Indian university competition from 2 to 8 years. All subjects were informed of the risks and benefits of the study and gave written consent.

### *Anthropometric measures*

Participants reported to the laboratory for the measurement of height, body mass and percentage body fat. Body mass was measured to the nearest 0.1 kg using an electronic weighing scale and height was measured to the nearest 0.001 m using a stadiometer. Skinfold thickness at four sites (biceps, triceps, subscapular, and suprailiac) was measured using a skinfold calliper by an experienced anthropometrist, and percentage body fat was calculated from these measurements using the equation of [5].

### *Maximal oxygen consumption*

A 20-m shuttle run test was performed to calculate the maximal aerobic capacity of each athlete. The endurance test was performed on the outdoor handball court. Participants were required to run the 20-m distance (a shuttle) as described by Leger and Gadoury (1989) [6]. The participants followed the 20- MST protocol by touching the appropriate 20-m line with a foot in tandem with an audio signal played through a sound system from a compact disc player. The test was terminated when the participant voluntarily dropped out due to exhaustion or could no longer maintain pace with the audio signals. Both lines were monitored closely by two testers at either end. Speed on the last stage to be successfully completed was recorded as the finishing maximal speed. Participants were instructed to complete as many stages as possible. Maximal oxygen uptake ( $VO_{2max}$ ) was estimated from the appropriate regression equation as described by Leger and Gadoury (1989) [6].

### *Repeated sprint ability*

To evaluate the repeated sprint ability and fatigue index all subjects completed multiple sprint running protocols, which consisted of  $7 \times 30$  m sprints repeated at 25 s



intervals [7]. The subjects were given verbal signal provided a 10 second countdown to start of each sprint and subjects were verbally encouraged to give maximal effort. All timing was recorded manually using a stop watch by establishing both tester and equipment reliability. The total sprint time was calculated by summation of all seven sprint time and fatigue index was calculated from sprint times using the following formulae:  $\text{Fatigue} = \{(\text{slowest sprint} - \text{fastest sprint}) / \text{fastest sprint}\} \times 100$ .

#### Statistical technique

The Statistical Package for Social Sciences (*SPSS 16 for Windows*) was used for all statistical analyses. The Pearson product moment correlation coefficient ( $r$ ) was used to determine the relationship between maximal oxygen consumption and repeated sprint ability. The level of significance was set at  $p < 0.05$ .

#### Results

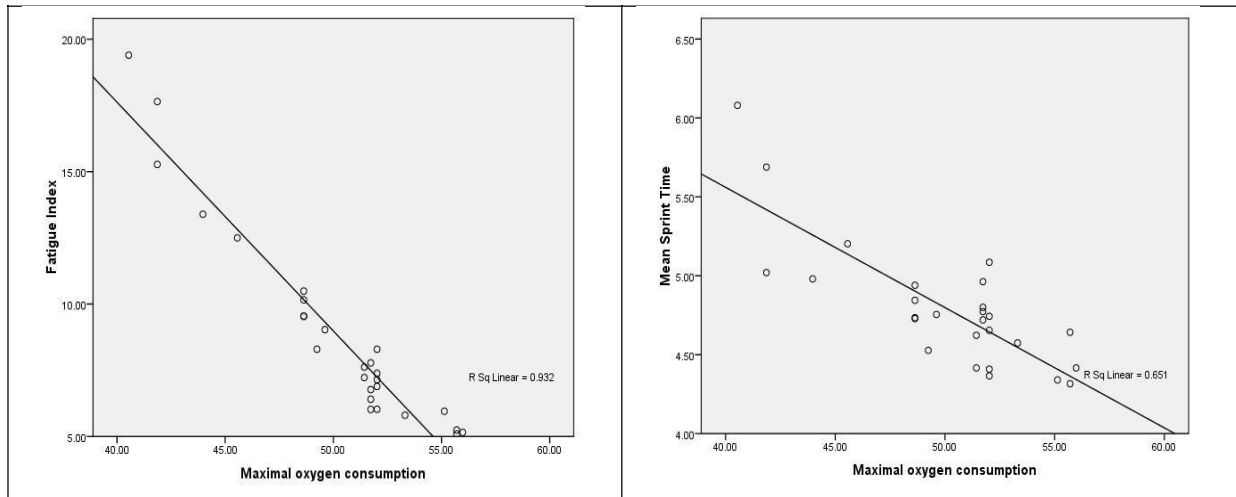
The result of the present study showed that product moment correlation analysis showed significant correlation between maximal oxygen consumption with fatigue index ( $r = 0.965, p = 0.000$ ), fast sprint time ( $r = 0.772, p = 0.000$ ), slowest sprint time ( $r = 0.875, p = 0.000$ ) and mean sprint time ( $r = 0.807, p = 0.000$ ) (Table 1).

Table 1: The relationship between maximal oxygen consumption and repeated sprint ability

Variables	Maximal Oxygen Consumption	Fatigue index	Mean sprint time
Maximal Oxygen Consumption	-	-0.965 ( $p = 0.000$ )	-0.807 ( $p = 0.000$ )
Fatigue index	-0.965 ( $p = 0.000$ )	-	0.818 ( $p = 0.000$ )
Mean sprint time	-0.807 ( $p = 0.000$ )	0.818 ( $p = 0.000$ )	-

The findings of the present study indicated significant negative correlation among maximal oxygen consumption and repeated sprint ability among male handball players (Figure 1). This clearly shows that players with greater aerobic capacity will have better repeated sprint ability.

Figure 1: Negative correlation of fatigue index and mean sprint time with maximal oxygen consumption



## Discussion

The purpose of the present study was to investigate the relationship between maximal oxygen consumption and repeated sprint ability university level male handball players. The results indicate that maximal oxygen consumption showed strong negative correlation with repeated sprint ability. In handball repeated sprint occur during a game were the players ran without fatigue. This clearly shows that repeated sprint require a greater aerobic fitness component with each successive sprint bouts [8-9]. Previous studies have concluded the aerobic metabolic pathways contribute an increasingly larger portion of ATP when high intensity bouts are repeated in succession [10-11-12].

In this study, significant correlations were found for maximal oxygen and fatigue index and mean sprint time (Table 1). These data are consistent with the previous finding that aerobic mechanisms contribute significant amounts of energy after the first bout (Bogdanis *et al.* 1996) and therefore an enhanced oxidative capacity would be an advantage during repeated sprint activities [8]. In addition, if endurance trained individuals are capable of faster lactate clearance (Bassett *et al.* 1991); there should be some advantage because of an attenuated decrement in force in successive bouts [13]. Though lactate was not measured during this investigation, it is safe to speculate that blood lactate can reach extremely high levels during exercise of this nature. Research has indicated that elevated H<sup>+</sup> concentration due to a high rate of lactate formation contributes to fatigue in various ways (Fitts 1994; Fuchs, Reddy, Briggs 1970; Powers & Howley 2004; Sahlin 1992), all of which lead to impaired force production. Therefore, it stands to reason that greater lactate clearance capability (which can only occur via oxidative means) should enhance performance on repeated bouts of anaerobic exercise [14-15-16-17].



## Conclusions

The findings of the present study indicated significant negative correlation among maximal oxygen consumption and repeated sprint ability of male handball players. This clearly shows that players with greater aerobic capacity will have better repeated sprint ability during a handball match.

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