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## Original Article

# Comparison between Standing Broad Jump test and Wingate test for assessing lower limb anaerobic power in elite sportsmen



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## ABSTRACT

**Background:** Lower limb explosive power is an important motor quality for sporting performance and indicates use of anaerobic energy systems like stored ATP and Creatine phosphate system. Weightlifting, Fencing and Wrestling use it for monitoring and identification of potential sportsmen. The Wingate test and Standing Broad Jump (SBJ) test are reliable and accurate tests for its assessment. This study conducted on elite Indian sportsmen tries to analyse feasibility of use of the SBJ test in sports and military medicine when Wingate test is impractical.

**Methods:** 95 elite sportsmen (51 Fencers, 17 Weight lifters and 27 Wrestlers) of a sports institute were administered Wingate cycle ergometer test and SBJ under standardised conditions. The results were analysed for mass and inter-discipline correlation.

**Results:** Analysis using Pearson's correlation showed significant positive correlation between Peak power ( $r = 0.446$ ,  $p < 0.0001$ ) and SBJ (distance) in all sportsmen. Inter-sport correlation showed positive correlation between SBJ and peak power ( $r = 0.335$ ,  $p < 0.016$ ) in Fencers and between SBJ, peak power ( $r = 0.686$ ,  $p < 0.002$ ) in Weightlifters. Bland-Altman plot analysis showed that about 94% pairs of peak power and SBJ were within limits of agreement for each discipline as well as among all sportsmen.

**Conclusion:** The test results show definite correlation and SBJ test can be used as a field test in performance monitoring, talent identification, military recruit screening and injury prevention.

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## Introduction

Anaerobic power is a critical component of success in sport and is important for performance in events where short-term explosive efforts are made. Alactic anaerobic power is vital in many sports like 100 m sprint, Weight lifting, Boxing, Wrestling, Fencing, etc. where highly explosive movements are required lasting up to approximately 8 s. High intensity exercise in short duration sports requires an immediate energy supply.<sup>1</sup> Energy is fuelled by immediate energy system (i.e. ATP and Creatine phosphate system) without significant contribution from the glycolytic pathway.<sup>1</sup>

Anaerobic power tests are implemented in both clinical and field settings to assess an athlete's capability to produce both power and speed in a short period of time or over a relatively short distance.

The Wingate Cycle ergometry test and Standing Broad Jump (SBJ) tests are commonly used tests to assess lower limb power in sportsmen for the purpose of providing vital information regarding anaerobic performance of sportsmen in a given sports. Wingate test and SBJ test rely on the capabilities of ATP/PC energy system which contributes to maximum anaerobic power.

The Wingate anaerobic test is a valid and reliable test.<sup>2,3</sup> The Wingate anaerobic test on a cycle ergometer has been used in laboratory settings for assessment of anaerobic performance.<sup>2</sup> The test was designed to be simple to administer, non-invasive, intended to measure muscle performance, safe to assume the peak power which is a reflection of the ability of the legs to produce high amounts of mechanical power. But it is an expensive method and requires equipment which is not feasible for administration to a wide variety of population.<sup>2</sup>

SBJ test is a commonly used field test to assess explosive leg power.<sup>4</sup> Due to its simple and time-efficient implementation that does not require any equipment,<sup>5</sup> it is routinely used by coaches of several sports for talent selection, measurement and prediction of anaerobic power. Wakai and Linthorne divided SBJ performance (distance) into three parts: (a) the take-off distance, which is defined as the horizontal distance between the take-off line and the jumper's centre of mass at the instant of take-off, (b) the flight distance, which is the horizontal distance travelled by the centre of mass while airborne and (c) the landing distance, which is defined as the distance between the centre of mass and the heels of the feet at the instant of landing.<sup>6</sup>

SBJ performance is highly correlated with physical characteristics, such as lean leg volume.<sup>7</sup> The distance that is achieved has a direct correlation with the amount of force that is produced by muscle fibres. Compared to Wingate cycle ergometer test, this test is inexpensive, easy to assess and since equipment is minimal, it can be easily used as a field test.<sup>3</sup>

Assessment of anaerobic power by various tests has been studied; however, no single test has been identified as an inexpensive and reliable indicator of anaerobic power. Wingate cycle ergometers are expensive and require trained manpower. This prevents this test from being used as a screening and monitoring tool extensively.

The main objective of this study is to determine if the results of the SBJ test can be correlated with Wingate test so that a reliable and inexpensive test is available for athlete monitoring, talent identification and military recruit screening.

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## Materials and methods

An exploratory study was conducted in an elite sports training institute between February and August 2014. The study was approved by the Institute Ethics committee. Male sportsmen between the ages of 18–26 years, who were involved in 6 months of regular training and participated in national level competition of three sports discipline namely Fencing, Weightlifting and Wrestling, were included in the study. In all 95 sportsmen, which include 51 Fencers, 17 Weightlifters and 27 Wrestlers, were selected for the study. Sportsmen who had history of hospitalisation for more than 2 weeks in the last 3 months due to any reason, suffering from any acute illness or injury during the time of the study and those who did not participate in training in the preceding 2 weeks were excluded from the study.

Monark Cycle Ergometer with Wingate testing software (894 E) was used to measure an absolute and relative peak power by Wingate test. Measuring tape, weighing machine and chalk were used to measure length of leap by SBJ along with anthropometric measurements viz. height (cm), weight (kg) for each of these sportsmen.

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## Testing procedure

The participants were tested over 2 days to enable enough time for recovery between the tests. Each participant was interviewed by an investigator during which all risks, benefits and the necessity of conducting the study were explained in detail. Participants who fulfilled the inclusion and exclusion criteria were encouraged to ask questions and sign the consent forms. Random selection was done and SBJ was performed on day 1. Wingate cycle ergometer test was conducted on day 2.

### Day 1: SBJ test

On the day prior to the performance tests, participants were advised to abstain from intense exercise. On each performance testing day, participants performed a standardised warm-up that included 5 min jogging and 5 min dynamic stretches. Each subject stood on the starting line with their legs parallel and feet shoulder-width apart. Participants were instructed to bend the knees (the depth of the flexion was self-selected) and bring the arms behind the body. Then, with a powerful drive they extended their legs, moved the arms forward and jumped as far as possible. The distance jumped was measured in centimeters.

### Day 2: Wingate cycle ergometer test

Warm-up was given for 5 min in an intermittent manner (alternating 30 s exercise with 30 s rest). The warm-up was

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