The Correlational Study of the Vertical Jump Test and Wingate Cycle Test as a Method to Assess Anaerobic Power in High School Basketball Players

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Abstract- Basketball is a prime example of a sport that predominantly utilizes anaerobic metabolism. The Wingate cycle and vertical jump tests have been used to assess anaerobic power in athletes for the purpose of providing information of anaerobic performance in a given sports. The lack of research in the field of more sport specific tests to assess anaerobic performance has lead to the development of the present proposed investigation.
Aims & Objectives: A study to correlate the vertical jump test and wingate cycle test as a method to assess anaerobic power in high school basketball players.
Materials & Methods: A correlational study was conducted on 100 high school basketball players between the age group of 14-18 years (15.6000 ± 1.14286 (SD)) was included from various sprts institutes of Rajkot. Subjects were selected by simple random sampling techniques. On the first day, anthropometric measurements and the vertical jump test were performed. Peak and mean anaerobic power were determined using equations based on each subject's individual vertical jump height in centimeters (cm), body mass in kilograms (kg), and height in centimeters (cm). On the second day, the subjects were performed the 30-second Wingate cycle ergometer test. Peak and mean anaerobic power over the 30-seconds, were calculated by a computer program during the test.
Results: Data were analyzed by Pearson Correlation coefficient which showed significant positive correlation between average power ($r = 0.970$, $p > 0.05$) & peak power of vertical jump test and Wingate test ($r = 0.263$, $p > 0.05$), demonstrating the validity of the vertical jump as a field test of anaerobic power.
Conclusion: The result suggested that vertical jump tests may be accept as field measures of anaerobic power in high school basketball players.

Keywords- Vertical jump test, Wingate cycle test, Anaerobic power

I. Introduction

Anaerobic power, or anaerobic fitness, represents a local characteristic of a muscle that exists independent of blood and oxygen supply to that muscle.[1] It is the ability of the body's musculature to generate significant amounts of power is considered to be a strong predictor of athletic success.[2] Currently anaerobic power tests are implemented in both clinical and field settings and assess an athlete's capability to produce both power and speed in a short period of time or over a relatively short distance.[3]

Basketball is a sport that mainly utilizes anaerobic metabolism [4] that would benefit from anaerobic testing procedures which incorporate sport specific movements. Functional movements, such as jumping and sprinting, are significantly related to playing time and performance in basketball.[3,4] Therefore, it seems logical that testing procedures that incorporate anaerobic power and sports specific movements would provide a valuable tool to assess and monitor components of basketball performance.[3]

To date, numerous tests have been used in an attempt to successfully measure anaerobic power and output in basketball players, however no particular test has gained acceptance as a standard measure of anaerobic power in basketball players.[3] The Wingate cycle and vertical jump tests have been commonly used tests to assess anaerobic power in athletes for the purpose of providing vital information regarding anaerobic performance of athletes in a given sports.[5,6]

The Wingate anaerobic test on a cycle ergometer has been used in laboratory settings both as an assessment of anaerobic performance and as a means to analyze physiological responses to supramaximal exercise.[6] The test was designed to be simple to administer; non-invasive; intended to measure muscle performance;[6] safe to assume that peak power which is a reflection of the ability of either the arms or the legs to produce high amounts of mechanical power and mean power reflects the endurance of the muscle groups involved in the test, [3] but the major drawback of it is expensive method and require equipment which is not feasible for administration to a wide variety of population.

The most common field test which is used is the vertical jump test to evaluate anaerobic fitness improvements. It has been stated the vertical jump test is a more true power test used to measure both vertical jumping distance and power output.[3] The height that is achieved on the vertical jump has a direct correlation with the amount of force that is produced by muscle fibers.[7] During the vertical jump, total jump height and peak power can be measured and the mechanical work performed to accomplish the jump could be determined by using the distance that was measured. [5]Compare to wingate cycle ergometer test, this test is inexpensive, easy to aseess and equipment is also not needed, so we can easily use it as a field test.

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There exists conflicting opinions on the nature of contributions of various energy systems used in anaerobic power tests. [3] During a vertical jump test, power output required to attain maximal jump height and complete a single test is reached between one and two seconds which suggests that only the ATP-PC energy system is utilized since the test duration is so short.[8,9] However, the Wingate anaerobic cycle test requires contributions was estimated to be 84% from all of the three main energy systems.[3]

Despite the introduction of the previously mentioned anaerobic power tests, research in the area of anaerobic performance is still lacking. A prevailing lack of interest in anaerobic performance as a component of health and fitness has led to the development of anaerobic tests used today. [3] Even today, health professionals and fitness appraisers exclusively associate physical fitness and work capacity with only aerobic fitness. Reasons associated with a lack of interest in measuring anaerobic power to assess fitness levels can be the lack of motivation of subjects, use of suboptimal resistance when calculating power output, measuring mean power rather than peak power, and the limitation of exercise equipment. [10] Assessment of anaerobic power by various tests are frequent in the literatures, however, to date there has been no single test recognized as both a general indicator of anaerobic power as well as sport-specific in nature that has lead to the development of the present proposed investigation.

II. METHODOLOGY

Study design: Correlational study design

Sampling Technique: Simple Random Sampling

Sample collection: 100 high school basketball players between the age group of 14-18 years15.6000 ± 1.14286 (SD)) were included.

Study Setting: Various Sports academic institute of Rajkot.

Inclusion Criteria:

1. Age 14-20 years.
2. Healthy male and female high school basketball players.
3. Subjects with regular participation of more than 2 hours a day, 3 days per week.

Exclusion Criteria:

1. History of any cardiovascular, musculoskeletal, neurological problem.
2. History of smoking.
3. Subjects with regular participation in any athletic activity
4. Anemia.
5. History of metabolic disorders.
6. Uncooperative subjects

Materials used:

1. Monark Cycle (894 E)
2. Weighing machine
3. Wall
4. Chalk
5. Inch tape
6. Paper and Pen

III. TESTING PROCEDURE

The proposed title and procedure were being approved by ethical committee members. The potential risk and benefits, as well as the underlying rationale for the investigation, were explained to 100 high school Basketball players, written consent was taken from subjects who fulfilled the inclusion and exclusion criteria and they were randomly selected.

All the pariticipants had to undergo 2 days of study investigation. On the 1st day, participants were given overview of the study. All the participants then were given opportunity to ask the question about the test that they would be performing. Anthropometric data that includes weight (kg), height (cms) and BMI were taken and the Verticle Jump Test were asked to perform. On Day 2, Wingate cycle ergometer test were done on the participants.

The procedures of the Verticle Jump Test and Wingate Cycle Ergometer Test were performed as follows:

PROCEDURE:

Day 1: Vertical Jump Test: [9]

Prior to the vertical jump test, the subjects were lead through an 8-10 minute dynamic warm-up which consisted of squats, lunges, quad stretches and 20, 30, and 40 yard progressive jogging exercises. The player chalks the end of her finger tips and stands side onto the wall, keeping both feet remaining on the ground, reached up as high as possible with one hand and marked the wall with the tips of the fingers (M1) The player from a static position jumped as high as possible and marked the wall with the chalk on her fingers (M2). The therapist measured and record the distance between M1 and M2.The player repeated the test 3 times. The therapist recorded the best of the 3 distance and used this value to assess the player's performance.

Powerpeak (W) = [78.6 · VJ (cm)] + [60.3 · BM (kg)] –[15.3 · ht (cm)] -1,308

Poweravg (W) = [43.8 · VJ (cm)] + [32.7 · BM (kg)] –[16.8 · ht (cm)] + 431

Where: VJ = Vertical Jump BM = Body Mass (Weight) ht = Height

Day 2: Wingate cycle ergometer test: [3]

This test required the player cycle as fast as possible for 30 seconds. The therapist weighs the player (kg). The player warm up for 10 minutes. The therapist recorded the flywheel resistance required as follows:

- Player's weight x 0.08.

The therapist gave the command "GO" and starts the stopwatch and the player pedals as fast as possible with no flywheel resistance. After maximum rpm had reached, flywheel resistance was applied and the player continued to pedal as fast as possible until 30 seconds has elapsed.After 30 seconds the player was aked to stop pedalling. Peak power and mean power were calculated by using computarized softwear.

Outcome Measure:

1. Peak Anaerobic Power
2. Mean Anaerobiv Power

IV. DATA ANALYSIS

Data were analyzed by Pearson Correlation Coefficient to show the correlation between average power & peak power of vertical jump test and Wingate cycle test to measure the anerobic power in high school athletes at ≤ 0.05 with Cl of 95%

V. RESULTS

Table 1: Distribution of age groups

	Frequency	Percent	Cumulative Percent
14	10	20.0	20.0
15	14	28.0	48.0
16	14	28.0	76.0
17	10	20.0	96.0
18	2	4.0	100.0
Total	50	100.0	

Table 2: Gender Proposition

	Frequency	Percent
male	27	54.0
female	23	46.0
Total	50	100.0

Table 3: Correlation of average power of vertical jump test & wingate cycle test in high school basketball players.

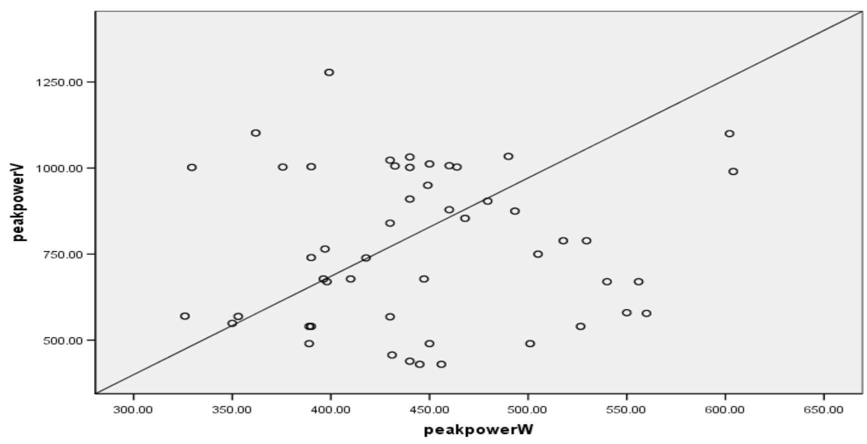
	Mean	SD	N	Verticle jump test mean power	Wingate cycle mean power
Pearson Correlation Sig (2-tailed)	668.0200	231.15314	50	1	0.031 0.833
Pearson Correlation Sig. (2-tailed)	394.7080	43.23900	50	0.031 0.833	1

Table 4: Correlation of peak power of vertical jump test & wingate cycle test in high school basketball players.

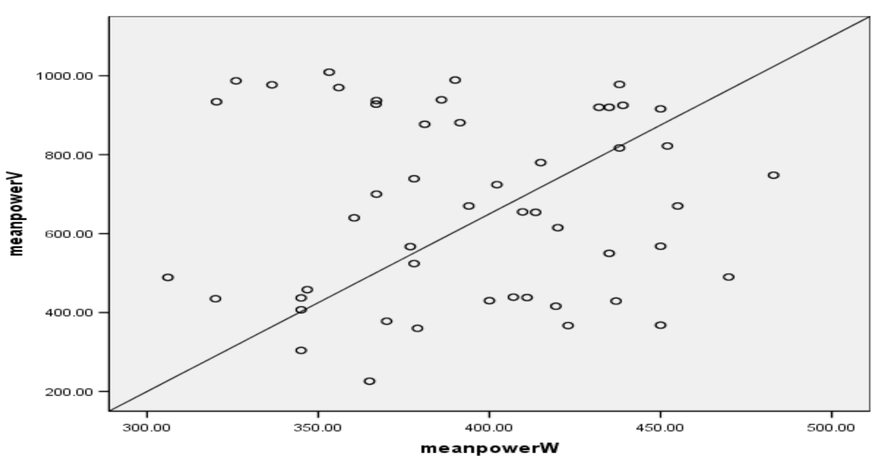
	Mean	SD	N	Verticle jump test mean power	Wingate cycle mean power
Pearson Correlation Sig (2-tailed)	773.7200	221.65951	50	1	0.044 0.759
Pearson Correlation Sig. (2-tailed)	447.5940	65.82322	50	0.044 0.759	1

The above table shows there was a positive correlation between the two variables i.e. average power ($r = 0.031$, $p > 0.05$) and & peak power ($r = 0.044$, $p > 0.05$) of vertical jump test and Wingate cycle test, demonstrating the validity of the vertical jump test as a field test of anaerobic power in high school athletes.

Graph 1: Correlation of average power of vertical jump test & wingate cycle test in high school basketball players.



Graph 2: Correlation of average power of vertical jump test & wingate cycle test in high school basketball players.



VI. DISCUSSION

The results of the present study indicated that there was a positive correlation between the average power ($r = 0.031$, $p > 0.05$) & peak power ($r = 0.044$, $p > 0.05$) of vertical jump test and Wingate cycle test, thereby supporting the experimental hypothesis.

Vertical Jump and Wingate anaerobic power tests rely heavily on ATP/PC energy system contributions to produce/sustain maximal anaerobic power. Also, weight had a considerable impact on performance on these two tests. The heavier subjects in the current investigation had higher anaerobic power outputs on both the Vertical Jump and Wingate tests. Previously, the vertical jump and Wingate power tests have been administered to athletes and recreationally active individuals to assess anaerobic contributions, and are considered relatively valid and reliable as suggested in the literatures.[3]

The results of this study appear consistent with other studies examining power performance in both a jump test and the WAnT. The moderate correlations observed ($r= 0.031$ and $r = 0.044$) in both peak and mean power, respectively between these 2 modes of anaerobic power assessments were greater than that recently reported by **Hoffman et al**., [11] but less than that previously reported by **Bosco et al..** [12] The differences between these studies are not easily explainable.However, in the study conducted by **Hoffman et al**., the subjects were elite-level basketball players. Considering that the jumping test is a more specific anaerobic power test for these athletes, their ability to generate power may be quite different when using other modes of assessment. Perhaps in a more diverse subject population, as seen in this present study and that of **Bosco et al**, the less specific the test is to the subject group the stronger the correlation between 2 different modes of assessment.

The differences between these modes of anaerobic power assessment (cycling vs. jumping) may also relate to the significant differences observed in power outputs between these tests. By recruiting a greater muscle mass (both legs acting simultaneously and the inclusion of upper-body musculature), the jump tests appears to result in a significantly greater power expression. This is consistent with several studies examining power performance using different modes of assessment.[11,12] In addition, the greater power outputs observed in the jumping test may also be related to a greater recovery of mechanical energy that is stored in the elastic elements of the body during the countermovement.

The present study used equations developed by Johnson and Bahamonde (1996) to predict vertical jump power in watts (W) from height, mass, and vertical jump height. When performing the tests, the subjects with greater heights and/or weights exhibited an ability to generate greater power outputs.This suggests that individuals taller and/or heavier would be predicted to a have higher anaerobic power output shows increased dependency of anthropometric variables (especially body weight) in the determination of anaerobic power in the tests.[9]

The limited ability to predict basketball performance from tests of anaerobic power is an indication that other variables are responsible for success on the basketball court. Basketball performance may be better predicted if the anaerobic tests mimic sport-specific movements and skills. Tests that incorporate jumping, sprinting speed, agility, muscular strength and endurance, and hand-eye coordination would provide a valuable tool to assess and monitor basketball performance.[3]

VII. CONCLUSION

The result suggested that vertical jump tests may be accept as a field measures of anaerobic power in high school female basketball players.

LIMITATION AND FURTHER RECOMMENDATION

The sample size was small for the study. Verbal encouragement can be administered by all people monitoring the testing procedures will give false positive result. Fatigue could have been limiting factors since test were performed. We can recreate the current investigation using a larger sample size with female athletic populations in Anaerobic Power tests. Comparison of anaerobic power test can be done with result of a similar age, gender, and anthropometric measurements can be done.

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