The Power of Flexibility – Examination of Lower Limb Power In Relation to Flexibility

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Abstract

The static vertical jump is a performance-based test that measures an individual's ability to produce force from the legs to achieve maximal airtime. A less examined test is the standing broad jump, a test designed to measure similar outcomes but within a horizontal distance. Research regarding the effectiveness or accuracy of broad jump testing is limited when compared to vertical jump testing. Current research suggests that flexibility corresponds with an individual's ability to produce maximal, powerful movements as demonstrated from the tests previously mentioned. This study is designed to test 1. whether or not correlations exist between lower-limb flexibility and maximal power output as seen in the standing broad jump and Vertec tests 2. which of these tests are most closely correlated with lower limb flexibility as seen in the sit and reach test.

Significance

There are many different methods of assessment when examining lower extremity power from both general and athletic populations. Most common of these assessments is the vertical jump assessment, indicating the maximal vertical height an individual can achieve. The vertical jump test is meant to examine the lower extremity power from an individual; however this power is limited to a vertical component. This study aims to examine the standing broad jump, a less researched but effective test used when assessing lower extremity power within a longitudinal plane. Simultaneously, the study aims to examine possible correlations between lower limb flexibility and maximal power output as demonstrated in the standing broad jump test.

Peer-reviewed literature states that the standing broad jump is an effective measure of lower limb power but has yet to be directly compared to results seen in flexibility assessments such as the Sit-and-Reach test. This study aims to bridge the gap of previous research by reinforcing the concepts of lower limb flexibility and maximal power output that is to be demonstrated in the standing broad jump and Sit-and-Reach tests.

Results

Data was processed and analyzed with the use of Microsoft Excel spreadsheet software to produce the above visual representations of male and female participant scores. Average Sit-and-Reach scores equated to 17.5 cm for males and 40.4cm for females. The average Standing Broad Jump score for males is 86.25 inches and 61.3 inches for females. Average Static Vertical Jump scores are 25.25 inches for males and 21.7 inches for females. The provided Figures illustrate that a linear association between sit-and-reach scores and power testing scores (most notable in broad jump) exists within the collegiate-aged population.

Methods

Summary: All tests are to be performed within the immediate facilities of the FGCU Human Performance Laboratory. 120 participants, consisting of college-aged men and women were fit for the criteria of this study with appropriate considerations noted below.

Materials

Materials used for this project include necessary materials to effectively facilitate a sit-and-reach test, standing broad jump test, and vertical jump test.

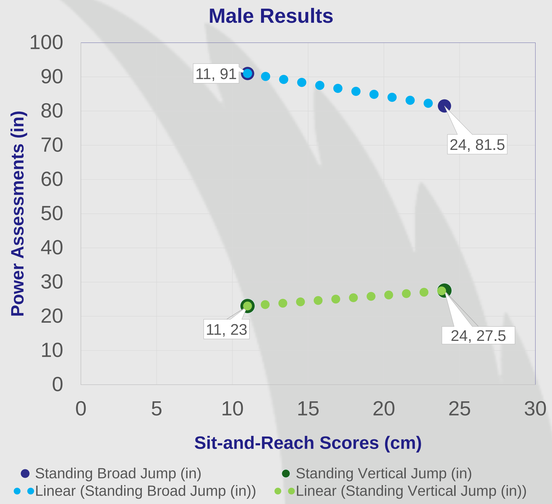
- **Sit-and-Reach Test:** Baseline™ Sit and Reach Box
- **Standing Vertical Jump:** Vertec™ Vertical Jump Tester
- **Standing Broad Jump:** A flat jumping area of at least 20 feet in length, a tape measure of at least 10 feet long, masking tape

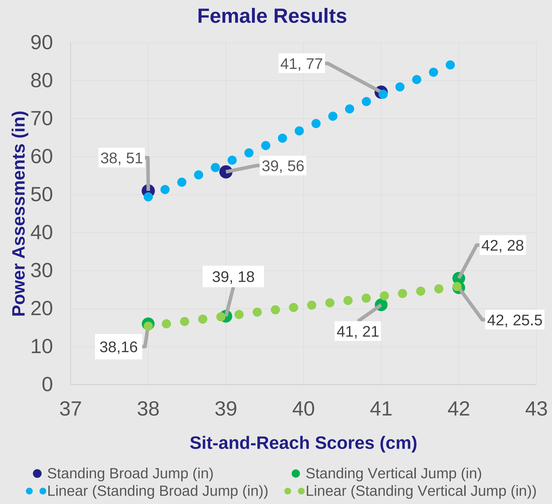
Subjects. The subjects for this project are recruited students within the Exercise Science classes of 2020 and 2021, that are currently or previously enrolled in the Methods of Resistance Training and Conditioning Lab (APK 4138L) course.

- ***Selection Criteria.*** Each subject must be above the age of 18 years old. Subjects must be healthy with no major health complications. Exclusion criteria includes any recent health status change, medication change, and/or injuries. At any time during the research, students had the opportunity to choose to withdraw from participating.
- ***Ethical Considerations.*** The institutional review board governing research on living matter of Florida Gulf Coast University has determined that the study protocol adheres to ethical principles.
- **Material and Subject Preparation.**
  - ***Consent Form:*** Consent Forms were provided to participants electronically and were to be documented before providing means of data collection by the research team

Protocols

- **Sit-and-Reach Protocol –** Sit and Reach protocols adhered to ACSM guidelines to ensure consistency and reliability of results. SnR scores are collected after power assessments to promote muscle stretch shortening cycles seen in power trials.
- **Standing Vertical Jump Protocol –** Using a Vertec™ Vertical Jump Tester, the testing apparatus was adjusted to the client's standing reach height with their dominant hand raised to the highest comfortable position. Protocol follows NSCA Vertical Jump guidelines.
- **Standing Broad Jump Protocol –** Randomized in performed order, SBJ trials were performed before or after completion of SVJ trials. SBJ trials are performed on turf or field to limit excessive joint impact during power assessment. Standing broad jump trials adhere to NSCA Standing Long Jump guidelines.





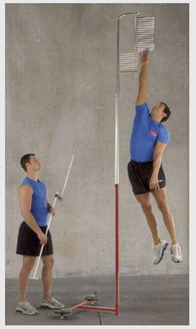
Figures 1 & 2 – The above figures provide visual representation of the best recorded trials. Men (Figure 1) and Women (Figure 2) scores are displayed independently. Power assessments (SBJ and SVJ) make up the Y-axis and the flexibility assessments (SnR) make up the X axis. SVJ values are indicated in green, SBJ values in blue.

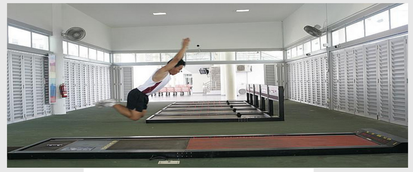
Discussion and Summary

The results drawn are limited in quantity whilst providing some possible reinforcement to the proposed hypothesis; reinforcing the possibility of a correlation between maximal lower limb flexibility and maximal power output demonstrated in the standing broad jump and static vertical jump tests. Testing protocols to achieve data were facilitated with ease as a result from lack of complexity in testing equipment. Standing broad jump and standing vertical jump were both examined to test the credibility of the two power assessments. Alternatives to traditional protocol exist where specialized equipment is not necessary. The testing apparatuses were used in this study to promote accuracy and repeatability.

It was unexpected to examine a negative trend in relationships seen in the standing broad jump from the male sample group. This same participant, referencing figure 1, performed as expected in the vertical jump but not to the same standard in the standing broad jump trials. The possible cause of this deviation in trend could be the accumulation of fatigue in lower limb musculature throughout the continuation of performed trials. Test selection between standing vertical jump and standing broad jump tests were randomized in order. It is to be noted that testing bias was possible as student practitioners facilitating student participants for data collection may effect results and relationships. The small sample size may be due to the remote collection methods used for data acquisition.

In conclusion, this study, although limited in sample size, reinforces the original hypothesis, confirming positive correlations in lower limb flexibility and maximal power output.





Images 1, 2, & 3. These images provide visual aid of the standing vertical jump (left) standing broad jump (top right) and sit-and-reach (bottom right).

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