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RESEARCH ARTICLE

VALIDITY OF ANEROID SPHYGMOMANOMETER CUFF TO ASSESS CORE MUSCLE STRENGTH OF LOW BACK IN YOUNG HEALTHY ADULTS

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ABSTRACT

Background of the study: Muscle strength measurement is a key component of physiotherapist's assessment and is frequently used as an outcome measure. The core muscle grading is generally done using a pressure biofeedback unit (PBU). However, the high cost of the device limits its availability in poorly resourced healthcare settings. The use of alternate measures such as the aneroid sphygmomanometer cuff (AS) to assess core strength needs to be investigated. **Objectives:** To study the validity of the aneroid sphygmomanometer cuff for assessing the core muscles strength of low back in young healthy adults. **Methodology:** This observational study included normal healthy young adults in the age group of 20-30yrs (N=100) were enrolled in the study, after taking their consent to participate in the study. Core muscle strength was measured by AS cuff and PBU, with the help of Richardson and Jull's core muscle grading method. **Results:** The Mean Age of the study group was 23.18yrs \pm 1.63 (95% CI, 22.86 – 23.50). The Core muscle strength was 2 (95% CI, 1.51 – 1.91) with PBU and 1 (95% CI, 1.2-1.56) with AS. High concurrent validity was found between AS and PBU ($\rho = 0.856$, $p = 0.000$). **Conclusion:** The aneroid sphygmomanometer cuff can be used instead of pressure biofeedback unit for assessing the strength of core muscles. The regression equation (PBU grading = 0.269+ (1.037) As grading) obtained will help the therapist to convert the grading using AS cuff to widely accepted, reliable and standardized grading using PBU which can be used for research purpose.

INTRODUCTION

The "core" has been described as a box with the abdominals in the front, Para spinals and gluteal in the back, the diaphragm as the roof, and the pelvic floor and hip girdle musculature as the bottom within this box are 29 pairs of muscles that help to stabilize the spine, pelvis, and kinetic chain during functional movements.¹ Without these muscles, the spine would become mechanically unstable with compressive forces as little as 90 N, a load much less than the weight of the upper body.² Core stability (or core strengthening) has become a well-known fitness trend that has started to transcend into the sports medicine world. Broad benefits of core stabilization have been touted, from improving athletic performance and preventing injuries, to alleviating low back pain. When the system works as it should, the result is proper force distribution and maximum force generation with minimal compressive, translational, or shearing forces at the joints of the kinetic chain³. The core is particularly important because it provides "proximal stability for distal mobility"⁴. If core instability and core weakness can be measured, outcomes can be followed and a proper emphasis can be placed upon core strengthening in certain individuals.

A delay in the onset of activation of the transversus abdominis (TrA) muscle has been observed in patients with recurrent low back pain compared to asymptomatic controls^{5,6}. In general, the gold-standard method used for measuring the activity of the deep abdominal wall muscles is fine-wire electromyography. However, some factors such as high cost, pain, discomfort and risk of infection make the use of this method less likely to be used in clinical practice. Ultrasound imaging and palpation tests are also used for measuring activity these muscles, however recent evidence have suggested that reproducibility studies are not acceptable for these evaluation tools^{7,8}. Several studies have used surface electromyography in measuring of TrA muscle activity⁹⁻¹². Accordingly, the pressure biofeedback unit (PBU) is an alternate approach to indirectly measure TrA muscle activity^{13,14}. The PBU is a simple pressure transducer consisting of a three-chamber air-filled pressure bag, a catheter and a sphygmomanometer gauge^{14,15}. The pressure bag has 16.7×24 cm in size and made from non-elastic material. The sphygmomanometer scale ranges from 0 mmHg to 200 mmHg, with 2 mmHg intervals on the scale. Movement or change in position causes volume changes in the pressure bag, which is registered by this device.

Validity is the degree to which the measure represents the phenomenon of interest, and refers to how much an instrument measures what it would be supposed to measure¹⁶. Thus, when an instrument undergoes a validation process, in fact is not the instrument itself that is being validated, but the purpose for which the instrument is being used¹⁷. Many valid and reliable instruments that are non-invasive and low cost could be useful to measure the TrA muscle activity favouring the clinical management of patients with chronic nonspecific low back pain^{18,19}. Although the PBU has reported to be the gold standard to assess the core muscle strength, the high costs of these devices limit the availability in poorly resourced healthcare settings. Alternate measures such as aneroid sphygmomanometer (AS) to assess the core muscle strength needs to be implemented. The AS is an instrument well known to be used for measuring blood pressure²⁰. However, this simple device has also been used to assess the strength of hand grip,²¹ elbow and hip extensors²², muscles of the shoulder²³ and neck²⁴. To the best of our knowledge, there are no studies that have used AS to assess the core muscle strength of low back. Hence the objective of this study was to establish the concurrent validity of aneroid sphygmomanometer cuff (AS) to assess core strength of low back in young healthy adults.

MATERIALS AND METHODS

This is Cross sectional comparative observational study with sample size of 100. Young healthy adults (Both males and females) of 20- 30 years age group were included. Individuals with Low back Pain, individuals participating in any fitness program, Females who are pregnant and menstruating during the tests, individuals who had abdominal wall or spinal surgery and with a body mass index (BMI) of 25 or over were excluded.



Fig 1. Aneroid sphygmomanometer and pressure biofeedback unit (Stabilizer)

The instruments used in the study were (1) a PBU (stabilizer PBU, Chattanooga Group Inc., Chattanooga, TN, USA) and (2) an AS with a pediatric cuff (Diamond, Pune, Maharashtra, India).²⁵ Modified versions of the sphygmomanometer have been used to measure CCFT in previous studies.²⁶ The PBU used in this study consisted of a combined gauge and pressure bulb connected to a pressure cell. The measuring range for this unit is from 0 to 200 mmHg. The pressure cuff of the PBU and AS was made of latex free rubber.

Procedure: Subjects coming to the OPD as well as the students in the college were screened. Ethical committee clearance was obtained from college ethical committee. Consent was obtained from all the participants enrolled in the study. Core muscle strength was measured by Stabilizer's pressure biofeedback unit as well as aneroid

sphygmomanometer with 30 minutes interval on the same day, with the help of Richardson and Jull's core muscle grading method. This grading method was used as it is reliable and valid method of testing core muscle strength²⁷. The subjects were instructed to be in supine lying position. The inflatable bag was placed in lumbar hollow and pressure was raised till 40mm of Hg. Subjects were instructed to flex both lower limbs. Two trial sessions were carried out prior to the grading of core muscle. 'Drawing in maneuver' i.e. core activation was taught to the subjects. Subjects were instructed to take their umbilicus upward and inward and maintaining this they were tested as per the following grades.

Richardson and Joule's grading of core muscle strength:

Grade 1:

1a: Single leg slide was performed with contralateral leg support; the test leg slides the heel down the surface of the examination surface. (Poor control)

1b: Unsupported leg slide was performed with the heel of the test leg held approximately 5 cm from the examination surface. (Below average control)

Grade 2

2a: Single leg slide with the contra lateral leg unsupported. The test leg slides the heel down the surface of the examination surface. (Good control)

2b: Unsupported leg slide with the contra lateral leg unsupported, and the test leg was held approximately 5cm from the examination surface. (Excellent control)

Subjects were allocated a grading at the point at which they were not maintaining the core muscle contraction⁴³.

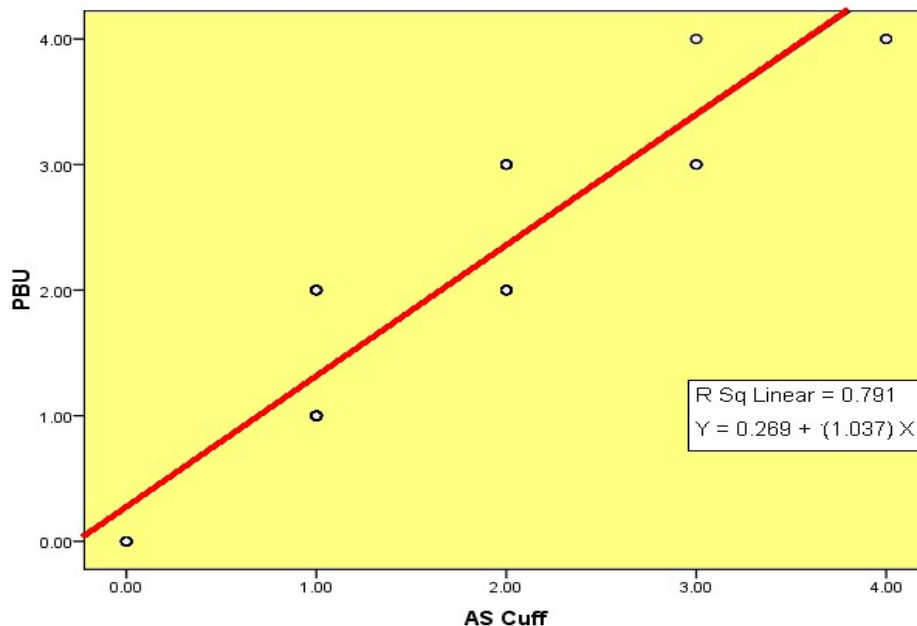


Fig. 2. Procedure to assess core muscle strength using Richardson and Joule's grading

Results and Tables

- The SPSS software 20 was used for data analysis.
- For Core Muscle Strength, grades 0, 1a, 1b, 2a & 2b were considered as 0, 1, 2, 3 & 4 respectively (Ordinal data).
- The Mean Age of the study group was 23.18yrs \pm 1.63 (95% CI, 22.86 – 23.50).
- The Core muscle strength was 2 (95% CI, 1.51 – 1.91) with PBU and 1 (95% CI, 1.2-1.56) with AS.
- High concurrent validity was found between AS and PBU ($\rho = 0.856$, $p = 0.000$).

Sample Size	Mean age	Mean strength with as cuff	Mean strength with pbu	Correlation coefficient(rho)
100	23.18yrs \pm 1.63 (95%CI,22.86-23.50)	1.38 \sim 1 (95% CI, 1.2-1.56)	1.71 \sim 2 (95%CI,1.51-1.91)	$r_s = 0.869$



DISCUSSION

This study was undertaken to determine the concurrent validity of the AS cuff compared with the PBU for assessing the strength of core muscles in young healthy individuals. Although the AS has been widely used for assessing peripheral muscle strength, there is limited literature wherein it is used for assessing the strength of the lower back muscles strength. This study has determined the high concurrent validity of AS cuff compared with PBU to assess the core muscle strength of low back in healthy individuals ($\rho = 0.869$, $p = 0.000$). In current healthcare environment, judicious use of resources remains vital. The PBU is more costly than the AS. In addition, the PBU is not easily available in India. In developing countries, the AS can be used to serve dual purposes, firstly to measure blood pressure and secondly to assess muscle strength. As it is easily available, it can be used in poorly resourced healthcare institutes. The regression equation obtained will help the therapist to convert the grading using AS cuff to widely accepted, reliable and standardized grading using PBU which can be used for research purpose. Future research needs to be carried to see if AS can be used in rehabilitation of muscle dysfunction. In summary, AS cuff is a simple, inexpensive and easily available device is a valid tool can be used as an alternative to assess the strength of the core muscles in healthy young individuals.

Limitations

- The possibility of observer error cannot be ruled out.
- The calibration of the device was not carried out, due to minimal resources.

CONCLUSION

The aneroid sphygmomanometer cuff can be used instead of pressure biofeedback unit for assessing the strength of core muscles.

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