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Research Article

Evaluating the Inter-Rater reliability of VIMS strength testing device for the measurement of isometric cervical muscle strength in healthy population

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ABSTRACT

Assessing muscle strength is a fundamental part of patient care for physiotherapists. The value of a reliable tool to assess muscle strength has been emphasized, both to determine functional impairment and to develop appropriate therapeutic interventions. A review has shown a lack of neck-strength assessment protocols that evaluate side flexion and rotation along with flexion and extension.

The Aim of this study is to find the reliability, using the VIMS strength testing device for assessing isometric cervical muscle strength of neck flexors, extensors, left flexors and right flexors muscles. Therefore, the main objective of this study is to evaluate the inter-rater reliability of this new measurement modality for VIMS strength testing device.

Objective of this study is to evaluate the inter-rater reliability of this new measurement instrument of VIMS strength testing device.

A total of healthy participants between the ages of 18 and 30 years were recruited. Inclusion criteria required absence of current cervical pain or condition that would compromise performance of a maximal isometric contraction of the cervical musculature; pain-free active flexion, extension, and side bending; and a negative Spurling compression test. The ICC in the present study indicated high correlation using a VIMS strength testing device in measurement of isometric cervical muscle strength. The ICC ranged from 0.86-0.96, which indicates good to excellent correlation in all movement directions tested.

Their results demonstrated that inter-rated reliability was high for all tested positions of neck flexors (ICC=0.974), neck extensors (ICC=0.993), left side flexors (ICC=0.872), and right-side flexors (ICC=0.875). This study demonstrates that VIMS strength testing device is a safe (no adverse events reported), reliable means for measuring isometric cervical muscle strength in healthy population. this study showed excellent reliability in isometric measurement of maximal neck strength in healthy subjects using a VIMS strength testing device.

Keywords: Strength testing, Inter-rater reliability, VIMS strength testing device, Cervical muscles, Isometrics.

INTRODUCTION

Assessing muscle strength is a fundamental part of patient care for physiotherapists. The value of a reliable tool to assess muscle strength has been emphasized, both to determine functional impairment and to develop appropriate

therapeutic interventions. A review of the literature has shown a lack of neck-strength assessment protocols that evaluate side flexion and rotation along with flexion and extension and that are both portable and reliable ^[1].

Insufficient strength can lead to overloading of the muscle tendon bone joint system and possible consequent injury. The relationship between insufficient strength and injury is widely admitted for tasks such as manual materials handling and those requiring the use of hand tools. Knowledge of human muscular strengths thus is necessary in designing devices which are physically activated by humans and for preventing musculoskeletal injuries [2].

When diagnosing and treating patients with a range of neuromusculoskeletal diseases, clinical evaluation of muscle function yields valuable clinical information. Handheld dynamometers can be used in the clinical context to quantify muscle force output [3].

Isokinetic dynamometers, manual muscle testing, and hand-held dynamometry are the instruments that can be used to measure muscular strength. A handheld dynamometer is a very useful and effective equipment in clinical settings, and it can guarantee quantitative strength assessment. Additionally, it is regarded as a valid and trustworthy instrument for determining the strength of the muscles in the upper and lower limbs [4].

Because it takes less training to use, the handheld dynamometer (HDD) is a more affordable and portable tool for measuring muscle strength, which may make it more useful in clinical settings [5].

Cervical muscular strength is measured using non-standardized techniques. There have been several uses of different instrumentation, settings, constraints, push or pull techniques, and break or create tests. The objective strength values can be captured with reasonable ease and speed using HHD. A person can be tested with HHD while seated or while lying down on a table. If the individual is seated, the trunk can be placed against an immovable object, like a table, or secured with straps. There have been reports of both pushing and pulling techniques with device [6].

Although device is frequently employed in physical therapy, there are certain concerns with the "make" state. This means that the force applied to the device and the force produced by contracting muscles are equal and opposing. While it is advised that in healthy populations, utilizing this device is reliable.3. Thus, evaluating cervical muscular strength is helpful for both determining the effectiveness of conservative treatment programs and

identifying musculoskeletal abnormalities that might cause discomfort, disability, and neck disorders [7].

Our study therefore provides a standardized and functional isometric strength-testing protocol that allows assessment of strength in all planes of the neck, including rotation, using self-generated resistance and a hand-held device. The test inherently assesses the neck muscle to the strength limit of the upper kinetic chain. We believe that simultaneous functional assessment of strength about the neck could function as a useful clinical evaluation for people with neck pain and may have potential as a prognostic tool after neck injuries.

Thus, the purpose of this study is to find the reliability, using the VIMS strength testing device for assessing isometric cervical muscle strength of neck flexors, extensors, left flexors and right flexors muscles. Therefore, the main objective of this study is to evaluate the inter-rater reliability of this new measurement modality for VIMS strength testing device.

Participants

Total 80 participants were taken. Before they began the study procedures, all participants provided signed consent. A total 100 healthy participants between the ages of 18 and 30 years were recruited. Inclusion criteria required absence of current cervical pain or condition that would compromise performance of a maximal isometric contraction of the cervical musculature; pain-free active flexion, extension, and side bending; and a negative Spurling compression test. Participants were excluded if they had any current neck pain or a history of cervical injury or condition requiring medical care within the past years.

Instrumentation

Tests were conducted using VIMS strength testing device. Participants were in sitting positioned using standard chair without armrests. Device consist of head seat belt which stabilize the head and restrict excessive movement. Measurements will be shown in kgs (figure 2).

Procedure

Testing involved two 20-minute sessions separated by 1 week. Before testing, an examiner recorded. Participants underwent a screening evaluation consisting of active cervical flexion, extension, and lateral bending followed by a Spurling test. After participants warmed up with 10 repetitions each of cervical flexion, extension, and right and

left side bending, they performed a single 3-second isometric, submaximal hold for each of those motions.

Neck strength for cervical flexion, extension, right side bending, and left side bending was tested using methods: a seated pull test (Figure 1).

Participants used the same warm-up and testing order for sessions. The same examiner tested all participants

with “make tests,” which are isometric hold tests where the participant cannot move the resisting force. In these tests, the resisting force was the testing device held by the examiner.

The testing procedure consisted of 3 isometric contractions held for 3 seconds for the 4 cervical motions. A 30-second rest was given between each contraction [8].

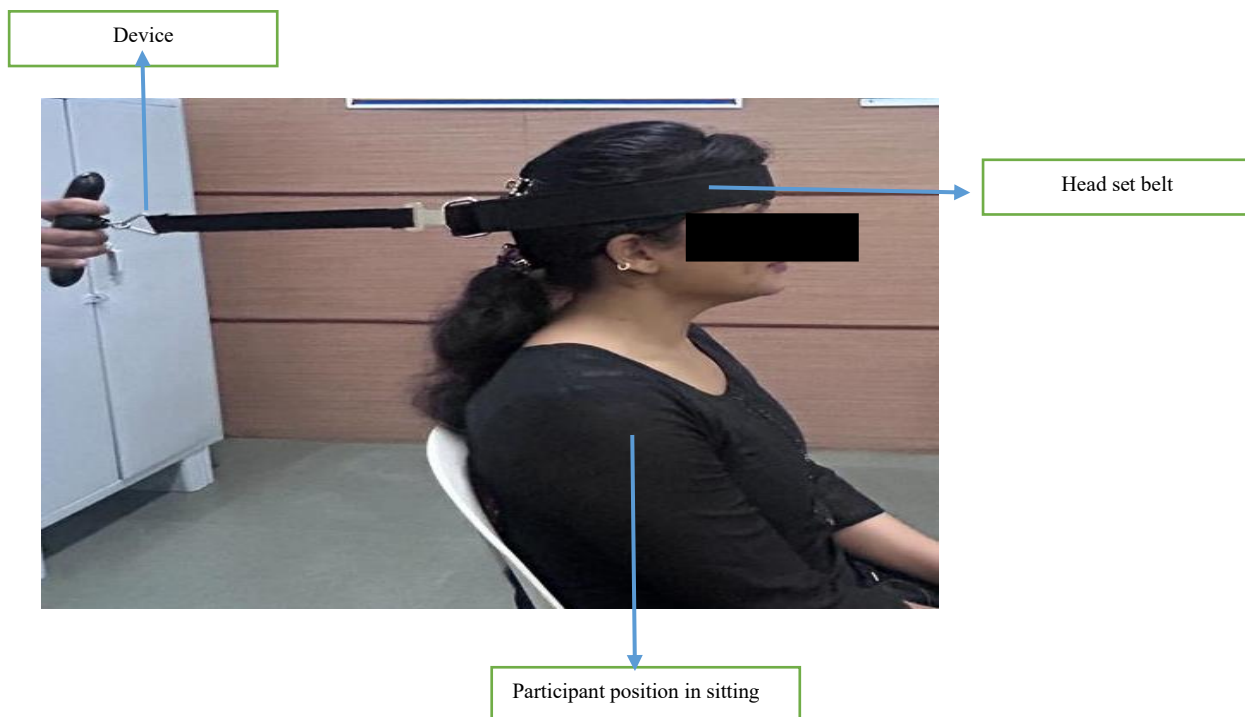


Figure1: A seated pull test for Cervical Muscles.

The figure demonstrates the setup for cervical flexor strength testing using the VIMS device, where the participant sits upright on a chair with a headset belt to stabilize the head. The participant performs a maximal isometric contraction. This “make test” protocol ensures proper isolation of cervical flexors and provides a standardized, safe, and reliable method for measuring isometric strength.



Figure 2: Device (Measurements will be shown in kgs)

Set up for the devices

The participants were in sitting position on chair. Shoulder and hand are in relaxed position. Consistent procedures were used for placing the device. The strap was centered on the forehead just superior to the eyebrows for

flexion tests. For extension, it was positioned slightly superior to the external occipital protuberance. To test right and left side bending, the pad or strap was placed on the lateral aspect of the head just superior to the ear.

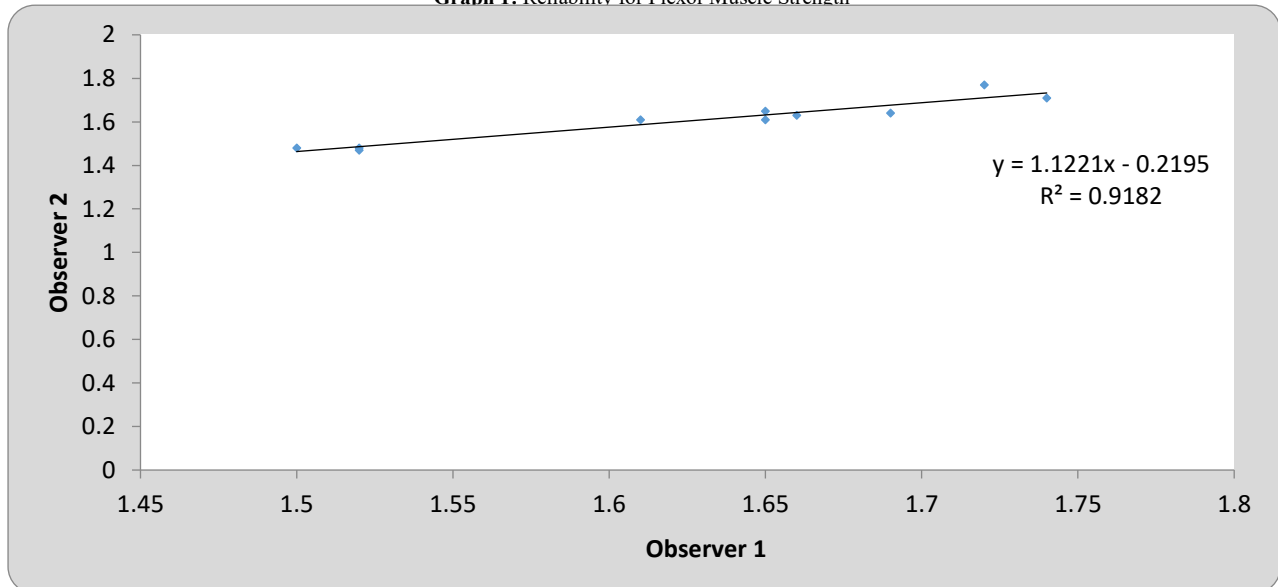
Statistical analysis

Statistical analysis was done by using descriptive and inferential statistics using Pearson's correlation

coefficient and Intra Class Correlation and software used in the analysis was SPSS 27.0 version and $p < 0.05$ is considered as level of significance.

RESULTS**Table 1:** Reliability for Flexor Muscle Strength

	Mean	SD	Correlation 'r'	Reliability
Observer 1	1.62	0.08	0.958 $P=0.0001, S$	0.974
Observer 2	1.60	0.10		

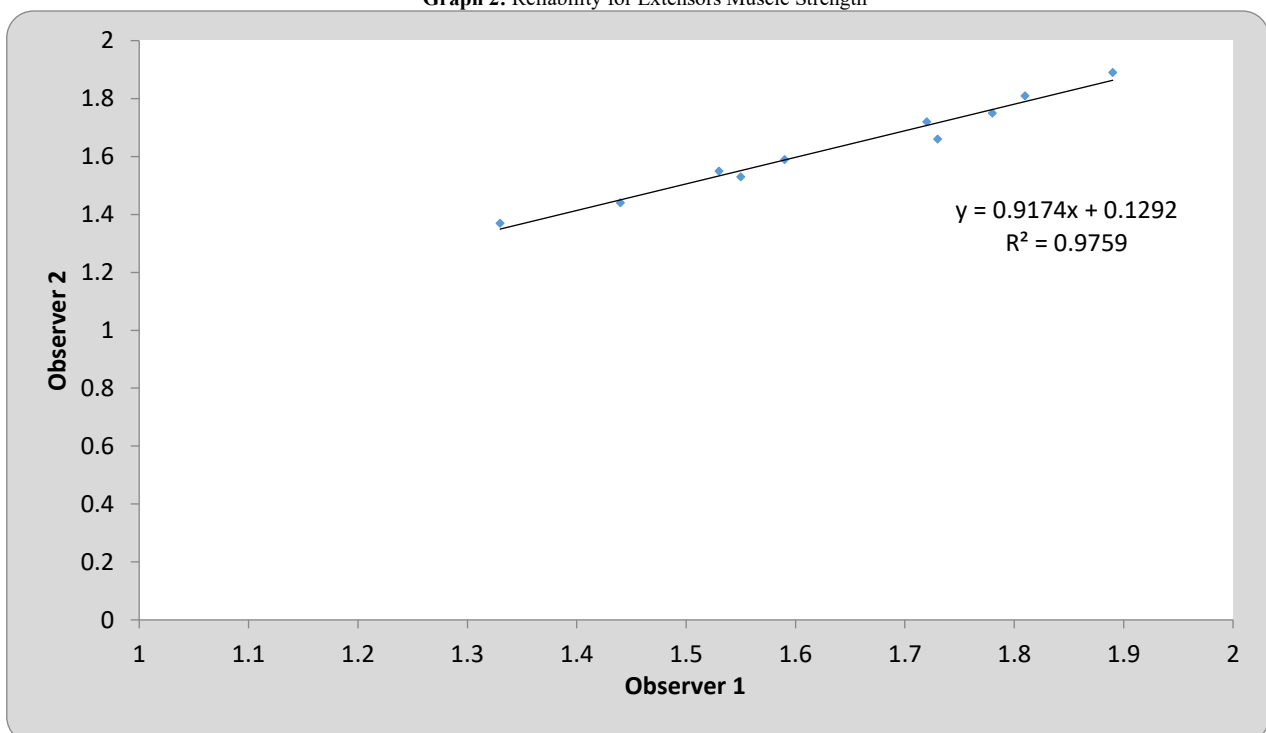
Graph 1: Reliability for Flexor Muscle Strength

Graph 1 visually demonstrates the close agreement between the two observers, showing very small variability

Interpretation: The VIMS device is highly reliable for measuring cervical **flexor muscle strength**.

Table 2: Reliability for Extensors Muscle Strength

	Mean	SD	Correlation 'r'	Reliability
Observer 1	1.63	0.17	0.989 $P=0.0001, S$	0.993
Observer 2	1.63	0.16		

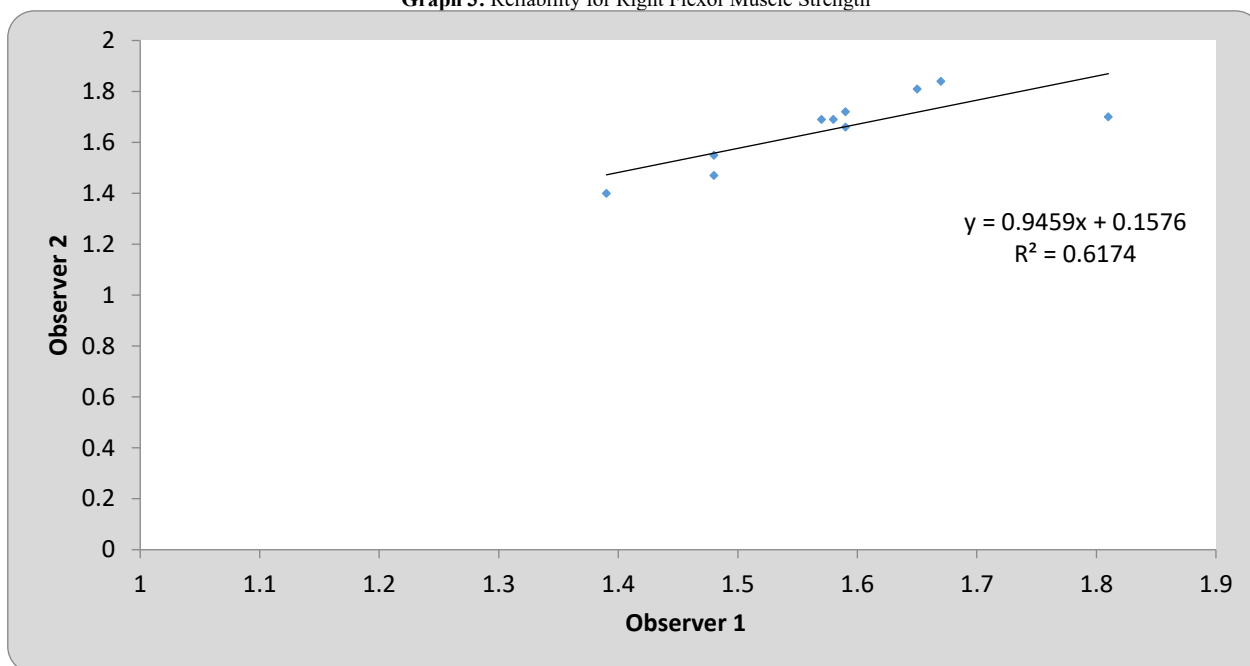
Graph 2: Reliability for Extensors Muscle Strength

Graph 2 shows almost identical readings between observers, with negligible variation.

Interpretation: Measurement of **extensor muscle strength** with the VIMS device is **most reliable**.

Table 3: Reliability for Right Flexor Muscle Strength

	Mean	SD	Correlation 'r'	Reliability
Observer 1	1.58	0.11	0.787 P=0.0001,S	0.872
Observer 2	1.65	0.14		

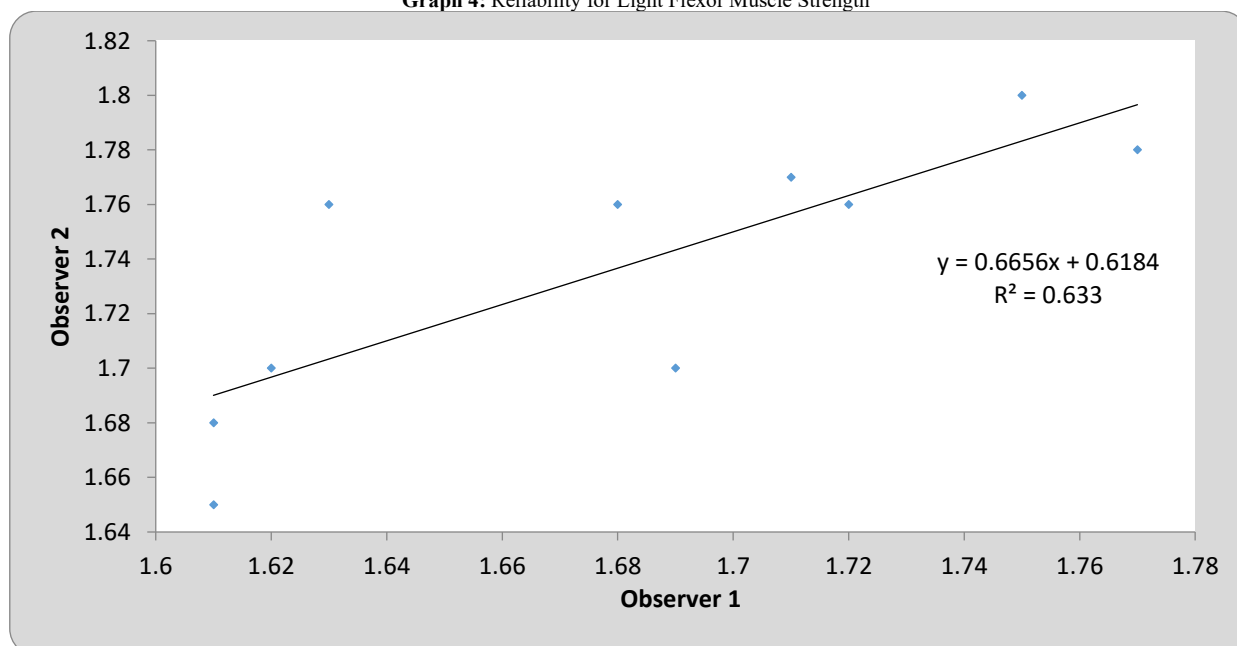
Graph 3: Reliability for Right Flexor Muscle Strength

Graph 3 shows a bit more spread between the two observers compared to flexors and extensors, explaining the slightly lower reliability.

Interpretation: The VIMS device demonstrates **good inter-rater reliability** for **right flexor muscles**, though there is slightly more variability compared to central flexion and extension.

Table 4: Reliability for Light Flexor Muscle Strength

	Mean	SD	Correlation 'r'	Reliability
Observer 1	1.67	0.05	0.789 P=0.0001,S	0.875
Observer 2	1.73	0.04		

Graph 4: Reliability for Light Flexor Muscle Strength

Graph 4 shows close alignment between observer scores, but with slightly more difference than central flexors and extensors.

Interpretation: VIMS device is **reliable for left flexor strength**, but variability is slightly higher compared to extension/flexion measures.

The present study evaluated the **inter-rater reliability** of the VIMS strength testing device for the measurement of **isometric cervical muscle strength** in healthy individuals. The statistical analysis, including Pearson's correlation coefficient and intra-class correlation coefficient (ICC), demonstrated good to excellent reliability across all muscle groups tested, with the highest reliability observed for **extensor muscles** and slightly lower values for **side flexor muscles**.

All participants completed the full test procedure; none reported experiencing any discomfort during or after testing. The ICC in the present study indicated high correlation using a VIMS strength testing device in measurement of isometric cervical muscle strength. The ICC ranged from 0.86-0.96, which indicates good to excellent correlation in all movement directions tested. Their results demonstrated that inter-rated reliability was high for all tested positions of neck flexors (ICC=0.974) shows in graph 1, neck extensors (ICC=0.993) show in graph 2, left side flexors (ICC=0.872) shows in graph 3, and right-side flexors (ICC=0.875) shows in graph 4. Pearson's correlation coefficients ($r = 0.787-0.989$) were significant ($p = 0.0001$) for all muscle groups.

DISCUSSION

This study has focused on exploring whether the VIMS strength testing device is a reliable tool for assessing the isometric cervical muscle strength of neck flexors, extensors, right flexors and left flexors.

Isokinetic is largely considered the criterion method to measure neck strength (Stark et al., 2011), though the cost, time and accessibility within a sport and clinical setting remain an issue. As such, there is a need for a portable and cost-effective measurement tool that is both reliable and valid. measurement tool that could potentially be used to objectively measure neck strength given its application when assessing upper and lower limbs. conducted a systematic review, concluding that both reliable and valid when compared to isokinetic dynamometry for measuring muscle strength in both upper and lower limbs [9].

A unique aspect of our study is that we chose to examine cervical retraction strength, a combined motion of upper cervical flexion and lower cervical extension. We found no other studies that examined the strength of this

motion. This may be of clinical importance as it is a common rehabilitation exercise used to counteract the deleterious effects of forward head posture and as part of the treatment for many cervical conditions, including cervical radiculopathy [10].

Study by A Ilyas et al measured reliability of device for assessing isometric shoulder flexor and abductor strength. The device showed excellent within day (ICC = 0.99-0.99) and between days (ICC = 0.99-0.99) intra-rater reliability for shoulder flexion and abduction of both sides. examined inter-rater and intra-rater reliability of for assessing isometric muscle strength of lower extremity. Thirty asymptomatic subjects were assessed on two sessions. Inter-rater and intra-rater reliability was moderate to excellent for hip and knee (ICCs ≥ 0.70), poor-good for ankle muscles (ICCs = 0.31–0.79) [11].

Cervical muscle strength is important for optimal functioning of the head-neck complex. Knowing that weaker neck muscle strength is characteristic of individuals with neck pain and that improvements in neck strength benefit both pain and disability indicates that this is an important measurement which warrants a valid and reliable test. The equipment and procedure used in this study are affordable, easy to administer, and clinically viable [12].

CONCLUSION

This study demonstrates that VIMS strength testing device is a safe (no adverse events reported), reliable means for measuring isometric cervical muscle strength in healthy population. this study showed excellent reliability in isometric measurement of maximal neck strength in healthy subjects using a VIMS strength testing device. This makes device a convenient measurement tool in both intervention studies and in clinical settings, where clinicians with training in the specific techniques can use the VIMS, strength testing device.

Conflict of interest

Authors declare no conflict of interest.

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