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RELIABILITY AND VALIDITY OF NEWLY DEVELOP SMART ELECTRONIC SCALE- PILOT STUDY

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Abstract :

BACKGROUND: Muscle strength is important factors in the prevention of injury. The muscle plays various roles in body function. In healthy elderly, muscle strength has been shown to be associated with the standing balance ability. A several types of functional performance tests are used for the assessment of patients with various lower extremity injuries. We designed a new functional performance test tool, which we named smart electronic scale to find out muscle strength.

AIM: To check reliability and validity of newly develop smart electronic scale.

OBJECTIVE: To assess the lower limb strength in old age subject, to determine the test-retest reliability and validity of smart electronic scale for strength measurement of the muscle in subject.

METHOD: Purposive sampling was used in the six-month physiotherapy OPD at VPMH Ahilyanagar. Male and female patients aged 50 and older who are healthy and free of injuries.

RESULT: Reliability testing Found that Intra rater reliability was Excellent (0.997 to 0.999) ICC and smart electronic scale is valid tool Validity of smart electronic scale also excellent due to almost perfect Correlation with MMT.

CONCLUSION: The study concluded that smart electronic scale is reliable and valid outcome to measure the muscle strength.

IndexTerms **- Smart Electronic Scale, Manual Muscle Testing, Muscle Strength**

Introduction

Muscular weakness, as a component of muscle function, is an impairment that is commonly observed in clinical populations and has been widely documented to impact upon physical function.[1] Physiologic changes associated with aging result in diminished muscle strength. Although there is individual variation, muscle strength significantly declines, on

average 1 to 2 % per year after the age of 50 years, with steeper declines observed after age 65 years. Decreased lower-extremity muscle strength is one of the stronger predictors of fall risk in older adults[2], but it is not clear if this is because of a relationship of strength to general functional mobility, specifically to balance, or because of the impact it has on activities such as walking.There are several methods of measuring muscle strength such as isokinetic dynamometers, manual muscle testing, and handheld dynamometry (HHD). Testing with an isometric action may be more clinically applicable for older adults because limited joint range of motion or the presence of joint pain may make concentric actions difficult.[3]

The human body's most important component for spatial mobility is the lower extremities.The lower extremities provide essential support for standing and walking motions.It has been demonstrated that standing balance ability and muscle strength are related in healthy older adults.Lower-extremity strength, particularly knee extension strength, has a moderate correlation with general mobility measures and some balance measures, like single-leg stance, but it does not always correlate with other balance measures, like functional reach (dynamic balance) or postural sway (balance in quiet stance). [3] Sufficient knee extensor strength improves performance of basic everyday activities, including walking, climbing stairs, and getting out of a chair.[4]

There are different muscles involved in elbow flexion which are superficially biceps brachii and brachioradialis as well as deeper brachialis.[5]

The most popular clinical method for evaluating strength is manual muscle testing.Every muscle group is examined bilaterally during manual muscle testing (MMT)[6]. The foundation of manual muscle testing is a technique developed by Lovett in 1912 that grades movement against examiner or gravitational resistance. This system is categorized as a semi-quantitative method of measurement due to a number of its features. A lot of the MMT grades depend on the examiner's discretion. For instance, the grading standards for strengths in the Good to Normal range inherently include an examiner's subjective evaluation of the degree of resistance applied.

Other devices that can be used to assess dynamic muscle power include linear position transducers, the Nottingham power rig, and force plates, however the cost, availability, time-consuming nature, and difficulty of implementation of such assessments may limit their use in clinical settings. Clinic-based assessment of muscle power is important to allow widespread access to testing and easily-interpreted results. The smart electronic scale is low-

cost and portable devices are an appropriate and convenient method to assess muscle strength in a clinical setting. Smart electronic scale requires little training to use, is easy to administer, is portable, and is less costly but it is not clear if Smart Electronic Scale is a reliable, valid tool to measure strength in lower-extremity muscles. So the aim of study to find the reliability and validity of smart electronic scale.

Methodology –

This is an observational pilot study. In VPMH physiotherapy OPD Ahilyanagar
in duration of 6 Months with purposive sampling of 10 .In healthy Persons both male and female with age ranges from 50 to 60 years above.

Procedure-

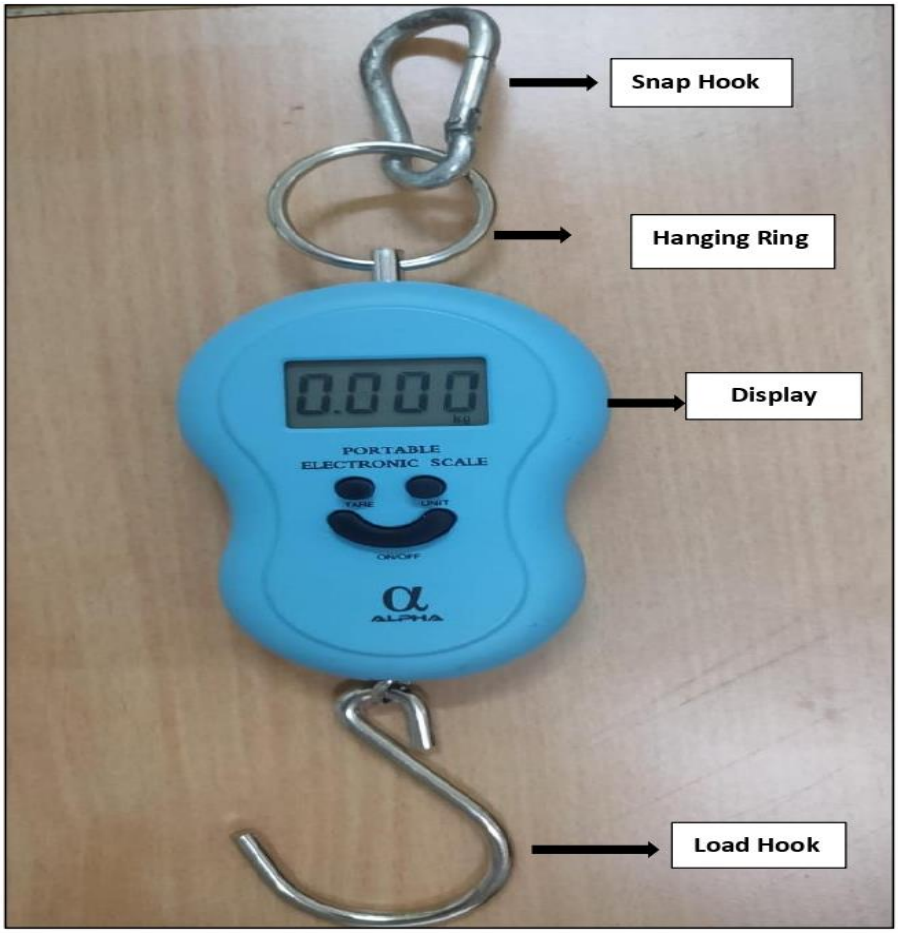
After obtaining permission from the Institutional Ethical committee, written and informed consent was obtained from the patient.

Before measuring lower-limb strength, all participants give instruction to that in the direction of movement and allow two trials with assistance. A measures closely stands to the participant to prevent compensatory movements during the test. All muscle strengths are measure at maximum strength within the pain-free range. The measurement procedure was also repeat on alternate day by same person on same patient.

1. KE strength: The participant was seat at the edge of a table with legs hanging down and the knee flex at 45° to test KE strength. The strap was tie to the ankle of each leg to be testing. Instruct the participant to back straight and immobilize the trunk, then extend the testing knee for 5 seconds.

Bicep Strength: Participants was comfortably seat in an upright posture with their right elbow flexed at 90° or extended. The right elbow of participants supported by a table. The

cuff was connected to the Smart Electronic strength scale, which was attached to a grounded weight kettlebell by belt.



Smart Electronic Scale

Manual muscle testing-

Manual muscle tests evaluate the ability of the nervous system to adapt the muscle to meet the changing pressure of the examiner's test. This requires that the examiner be trained in the anatomy, physiology, and neurology of muscle function. The action of the muscle being tested, as well as the role of synergistic muscles, must be understood. Manual muscle testing is both a science and an art. To achieve accurate results, muscle tests must be performed according to a precise testing protocol.

For Quadricep Muscles

Test position - Sitting upright with the knee fully extended to 0 degrees. Avoid knee hyperextension. Verbal instructions; "Straighten your knee". The hand giving resistance is contoured on top of the leg just proximal to the ankle. The other hand is placed under the

thigh above the knee. The examiner then states "Hold it. Don't let me bend it" and scores Grades 3, 4 or 5.[5]

For Bicep Muscle:

Test position - Forearm Supinated and flexed slightly more than 90 degrees. Verbal instructions: "Bend your elbow slightly more than 90 degrees". The hand giving resistance is contoured over the flexor surface of the forearm proximal to the wrist. The examiner's other hand applies counter force by cupping the palm over the anterior superior aspect of the shoulder. The examiner then states: "Hold it. Don't let me push it down" and scores Grades 3, 4, or 5.[5]

Manual Muscle Test

5	**Movement against gravity plus full resistance**
4	**Movement against gravity plus some resistance**
3	**Completes the available test range of motion against gravity, but tolerates no resistance**
2	**The patient completes full or partial range of motion with gravity eliminated**
1	**Slight contractility without any movement**
0	**No evidence of contractility (complete paralysis)**

Descriptive Statistics -

Using SPSS version 30 demographic descriptive statistics were generated. Intrarater reliability was determined by Interclass correlation coefficient (ICC ; two way, Mixed model, absolute agreement) ICC Interpretation 0–0.39 Poor reliability, 0.4–0.74 Modest reliability, 0.75–1 Excellent reliability Pearson's Correlation used between smart electronic scale and MMT .

Correlation value interpretation 0.01 – 0.09 Trivial or none,0.10 – 0.29 Low to medium ,0.30 – 0.49 Medium to essential,0.50 – 0.69 Essential to very strong ,0.70 – 0.89 Very strong ,0.90 – 0.99 Almost perfect .

Results :

Table 1.Demographic details of Individuals

Table shows demographic data of individuals included in the study .Total 10 Participants are participated in this study .In which 3are male and 7 are female with average age mean year .

Gender	Percentage
Male	30%(N= 3)
Female	70%(N= 7)

Table 2.Shows the mean values of Smart Electronic Scale first day

Sr.no	Smart electronic muscle strength measurement	MEAN+Std
1	RIGHT QUADRICEP MUSCLE	2.89±1.86
2	LEFT QUADRICEP MUSCLE	2.47±1.784532307
3	RIGHT BICEP MUSCL	2.73 ±2.128144732
4	LEFT BICEP MUSCLE	2.49±2.058289473

Table 3.Shows the mean values of Smart Electronic Scale 2nd day

Sr.no	Smart electronic muscle strength measurement	MEAN+Std
1	RIGHT QUADRICEP MUSCLE	3.02±1.85699
2	LEFT QUADRICEP MUSCLE	2.7±1.609002451
3	RIGHT BICEP MUSCL	2.71±2.101983191
4	LEFT BICEP MUSCLE	2.5±2.01574359

Table 4.Shows the mean values of Manual Muscle Testing Scale 2nd day

Sr.no	Manual muscle strength measurement	MEAN+Std
1	RIGHT QUADRICEP MUSCLE	4 ± 0.6
2	LEFT QUADRICEP MUSCLE	3.9±0.56
3	RIGHT BICEP MUSCL	3.8±0.421

Sr.no	Manual muscle strength measurement	MEAN+Std
4	LEFT BICEP MUSCLE	3.8± 0.421

Table 5.Shows the mean values of Manual Muscle Testing Scale 2nd day

Sr.no	Manual muscle strength measurement	MEAN+Std
1	RIGHT QUADRICEP MUSCLE	3.8±0.421
2	LEFT QUADRICEP MUSCLE	3.8±0.421
3	RIGHT BICEP MUSCL	3.8±0.421
4	LEFT BICEP MUSCLE	3.8±0.421

Table 6. Reliability-1 Quadriceps Smart Electronic Scale

Intraclass Correlation Coefficient-smart electronic scale quadricep

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures of Right Quadriceps	.999[a]	.995	1.000	1536.381	9	9	<.001
Average Measures of Right Quadriceps	.999[c]	.997	1.000	1536.381	9	9	<.001
Single Measures of Left Quadriceps	.967[a]	.874	.992	60.095	9	9	<.001
Average Measures of Left Quadriceps	.983[c]	.933	.996	60.095	9	9	<.001

Table7. Reliability- Bicep rt smart electronic scale

Intraclass Correlation Coefficient

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures of Right Bicep	.999[a]	.997	1.000	2874.929	9	9	<.001
Average Measures of Right Bicep	1.000[c]	.999	1.000	2874.929	9	9	<.001
Single Measures of Left Bicep	.651[a]	.081	.900	4.734	9	9	.015
Average Measures of Left Bicep	.789[c]	.150	.948	4.734	9	9	.015

DISCUSSION :

Elderly muscle weakness can be caused by a variety of factors, including aging itself, a general drop in typical activity, or disuse related to a local reason [7,8]. It could also be brought on by nutritional deficiencies or problems with the neurological or musculoskeletal systems.

Even after adjusting for area, older women's muscle strength is still lower than men's, suggesting that there are additional variables besides smaller muscles that contribute to this sex difference. Adjusting for body weight (power/weight ratio), which is crucial for walking [8].

Physical therapists require an accurate, reliable method for measuring muscle strength. They often use manual muscle testing or smart electronic scale muscle testing, but few studies document the reliability of MMT or compare the reliability of the two types of testing. We designed this study to determine the intrarater reliability of MMT and smart electronic scale. A physical therapist performed manual and smart electronic scale of the same two muscle groups on 10 patients and then repeated the tests one days later. Manual muscle testing and a variety of strength assessment devices are available. We measure strength in our study using a smart electronic scale, which is a low-cost, portable instrument that is a suitable and practical way to measure muscle strength in a clinical context. This investigation demonstrates the smart electronic scale's validity and dependability. It is a reliable tool for evaluating muscle strength and has a great intra-rater reliability (0.997 to 0.999).

ETHEL FRESE, MARYBETH BROWN, and BARBARA J. NORTON conduct one study Clinical Reliability of Manual Muscle Testing Middle Trapezius and Gluteus Medius Muscles. This study indicates that using manual muscle testing to make accurate clinical assessments of patient status is of questionable value.

Conclusion

This study demonstrates that smart electronic scale strength testing device is a safe (no adverse events reported), reliable means for measuring isometric muscle strength in healthy population. This study showed excellent reliability in isometric measurement of maximal strength in healthy elderly subjects using a smart electronic scale.

Conflict of interest:

There is no conflicts of interest

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