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Test-Retest Reliability Of Activforce 2 Handheld Dynamometer For Measuring Knee Strength

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ABSTRACT

Assessing knee strength using a Handheld Dynamometer is critical for its application in clinical and research settings. The new ActivForce 2 Handheld Dynamometer, which is affordable and portable, is used easily to measure both force and range of motion. The objective of the present study was to determine the test-retest reliability of the ActivForce 2 Handheld Dynamometer to measure Knee strength.

An evaluative research design was conducted on 60 healthy participants through non-probability convenience sampling from Kerala. The researcher has done a maximal isometric knee extension and flexion strength and was assessed in two separate sessions. After the first session, the second session was evaluated 24 hours later. The data were recorded simultaneously and automatically in the ActivForce 2 software. Intra-class correlation coefficients (ICCs) on four pairs were calculated to determine the device's reliability.

The result showed that Intraclass Correlation Coefficients (ICCs) revealed moderately good reliability for right knee extension (ICC = 0.785) and left knee extension (ICC = 0.760), while right knee flexion (ICC = 0.644) and left knee flexion (ICC = 0.669) demonstrated moderate reliability. It indicates that the new Activforce2 Handheld Dynamometer provides a moderate level of reliability.

These findings suggest that the new ActivForce 2 Handheld Dynamometer is moderately reliable, user-friendly, and affordable for evaluating knee strength.

Keywords: *ActivForce 2, Hand Held Dynamometer, Isometric knee extension and flexion strength.*

1. INTRODUCTION

Handheld dynamometry is a portable and objective alternative for measuring muscle strength to traditional manual muscle testing [1]. It is used in a wide range of settings. It is a small portable device held by the examiner and placed against the patient's limb during a maximal isometric contraction to measure muscle force while simultaneously providing resistance and stabilization [2]. Handheld dynamometers are becoming popular for their use, portability, and affordability [3]. The device can be used to test both proximal and distal muscles in all extremities. Specific dynamometers are used to test grip strength. The testing positions are standardized to reduce the variance of serial measures. This strength measure is more sensitive to change than MMT and correlates well with fixed dynamometry up to 30 kg of force [4]. It uses a force-sensitive

strain gauge with the device that displays static force in kgf, Ib, or N. Consistent position and placement are essential for accurate results. This small device is placed in a precise location on the limb of the subject to measure the force generated by a muscle or a group of muscles. [5].

Handheld dynamometers (HHD) are employed to quantify the force production of knee and hip muscle groups. While HHD offers logistical and economic advantages over isokinetic dynamometers, particularly in assessing knee extension strength, establishing robust reliability requires further investigation [5]. Notably, research indicates HHD provides a more reliable assessment of muscle force compared to manual muscle testing [6]. However, the cost of the device can be a limiting factor in its widespread implementation. Accurate assessment of knee and hip muscle strength is essential for rehabilitation protocols and monitoring treatment efficacy [7].

The Activforce digital dynamometer offers a cost-effective and innovative approach to muscle force assessment, facilitating the collection of objectives, and evidence-based data that can potentially enhance client outcomes and improve client retention. Additionally, it enables the convenient measurement of both force and range of motion. While studies have demonstrated the Activforce dynamometer's reliability and validity in assessing shoulder muscle strength and cervical spine movements in chronic pain populations [8, 10], and its utility as a tool for exercise monitoring and muscle force testing [8], the generalizability of these findings remains to be established. The potential for electronic data storage and affordability may enhance the efficiency of muscle force assessments. Moreover, the importance of accurate isometric force measurement for optimizing sports performance, particularly in disciplines like volleyball where isometric muscle activation is crucial for force generation [9], underscores the need for validated measurement tools. Despite its potential benefits in clinical practice as low-cost handheld dynamometer (HHD) further research is warranted to fully characterize the Activforce dynamometer's psychometric properties across diverse populations and muscle groups [8].

Accurate and reliable assessment of muscle strength is crucial for rehabilitation, sports performance optimization, and clinical monitoring. Handheld dynamometers (HHDs) offer a practical and cost-effective alternative to isokinetic dynamometers, particularly for assessing muscle strength in various regions, including the hip, knee, and shoulder [8]. The reliability of HHDs has been demonstrated in numerous studies [11], highlighting their potential for widespread clinical and research applications. However, variability in reliability, particularly in knee extensors, and the importance of proper equipment positioning, indicate a need for further investigation to ensure consistent and accurate measurements. Specifically, the Activforce 2, a newer HHD with promising applications in sports training, requires further validation for knee strength assessments.

Thus, there is a paucity of research focused on Activforce 2's psychometric properties when used to evaluate knee strength, particularly in comparison to established HHD methods. Moreover, despite documented variability in knee extensor reliability using traditional HHDs, and the recognized importance of proper positioning for accurate measurements, the consistency and accuracy of ActivForce 2 in these assessments remain under-explored. Therefore, this study aims to address this gap by directly evaluating the reliability of the ActivForce 2 in measuring knee flexor and extensor strength, contributing to a more comprehensive understanding of its clinical and research utility.

2. METHODOLOGY

- **Aim**

The present study aimed to establish the test-retest reliability of the new ActivForce 2 Handheld Dynamometer for the measurement of knee strength, to determine its suitability for clinical and research applications.

- **Objective**

To determine the test-retest reliability of the ActivForce 2 Handheld Dynamometer to measure Knee strength.

- **Research Design**

Evaluative Research Design

This study utilized an evaluative research design. Evaluative research, in this context, serves to assess the psychometric properties, specifically the reliability and validity of the tool or the instrument. This study determines the psychometric properties of the ActivForce 2 digital dynamometer. Specifically, the study aimed to assess the instrument's reliability in measuring knee flexor and extensor muscle strength. Evaluative research, in this instance, is employed to systematically investigate the performance and quality of a measurement tool within a defined population. This approach allows for the collection of quantitative data to evaluate the consistency and accuracy of Activforce 2, providing crucial information regarding its suitability for clinical practice and research.

- **Sample and Sampling Method**

This study employed a **convenience sampling method, a non-probability sampling technique** wherein participants were selected based on their accessibility rather than random selection from the target population. A sample of 60 apparently

healthy individuals (males and females) was recruited. Data collection took place at Medical Trust Hospital and Medical Trust Sports Clinic, Ernakulam, Kerala.

- **Procedure of the Study**

Isometric knee extension torque was measured with an HHD with the participant sitting on a treatment table with their knee in 90° flexion and their thighs fixated to the treatment table with a strap. The strap used is activforce2 belt. Another strap was used around the leg of the treatment table and the HHD, which was placed on the anterior side of the participant's distal tibia. The participants were asked to extend their knees with maximal effort. Isometric knee flexion torque was tested with the participant laying on their stomach on a treatment table with their knee in 90° flexion. The examiner was sitting on the end of the table with a strap around the pelvis and around the HHD placed on the posterior side of the participant's distal tibia. The participants were asked to flex their knees with maximal effort.

When testing isometric extension and flexion torque with the HHD, each test was repeated 3 times for a preset 5 seconds duration for each repetition, so that average force can be evaluated.

All data were automatically recorded in activforce2 software. The researcher has done a maximal isometric knee extension and flexion strength and was assessed in two separate sessions. After the first session, the second session was evaluated 24 hours later. The data were recorded simultaneously and automatically in the ActivForce 2 software.

Figure 1 Isometric knee extension

Figure 2 Isometric knee flexion

- **Inclusion and Exclusion criteria**

Inclusion Criteria

- People who gave informed consent
- Healthy people between the age group of 18-40 years
- The samples were collected only from Ernakulam district

Exclusion Criteria

- Those who did not give consent
- Patients aged above 40 years
- Patients with Physical disability
- Patients undergoing any psychological treatments.

- **Method of Data Collection**

Quantitative Method

This study employed a quantitative data collection method. Quantitative research, in this context, involves the systematic collection and analysis of numerical data to examine the reliability of the ActivForce 2 digital dynamometer with the software. Isometric knee extension and flexion torque were measured across two sessions, 24 hours apart. Participants performed three 5-second maximal contractions for each movement. The ActivForce 2 unit was secured to the distal tibia, with specific positioning for extension and flexion. All data were automatically recorded in the software, and peak torque

values were extracted for statistical analysis, including means, standard deviations, and intraclass correlation coefficients (ICCs) to assess reliability.

- **Tools**

This study utilized one primary tool for the quantitative data collection:

- **Activforce 2:** As a digital handheld dynamometer, the ActivForce 2 provides a portable and convenient method for isometric muscle strength assessment in clinical and sports contexts. Its integrated force sensors detect and quantify muscle force, with Bluetooth functionality enabling seamless data transfer to a mobile application for efficient tracking and analysis

- **Data Analysis**

Intra- class correlation coefficient

The intraclass correlation coefficient (ICC) is a statistical measure used to assess the reliability and consistency of measurements, particularly when dealing with repeated measures. In this study, ICCs were calculated to determine Activforce 2's reliability in measuring isometric knee strength. Specifically, ICC values were computed for right and left knee extension and flexion, comparing measurements from the first and second sessions, 24 hours apart. Higher ICC values indicate greater reliability.

3. RESULTS AND DISCUSSION

1. Reliability Testing of Knee Strength Extension Right First and Second

To test the reliability of knee strength extension right first and second, the researcher used the intra-class correlation coefficient. The obtained result is given in below Table 1.

Table 1 Reliability Testing of Knee Strength Extension Right First and Second

Variable Pair	Cronbach's Alpha	Number of Items	Intraclass Correlation (Single measures)	95% CI (Lower-Upper)	F Test Value	p-value
Knee Extension right first and second	0.785	2	0.646	0.471 0.773	4.656	0.000

Table 1 shows the reliability test for knee strength extension right first and second. The result shows a good internal consistency with a Cronbach's Alpha of 0.785. The ICC of 0.646 (95% CI: 0.471 - 0.773) indicates moderate to good reliability. The F Test value of 4.656 is statistically significant (p = 0.000), confirming consistent measurements.

Consistent with the findings of the present study, previous research has demonstrated the reliability of handheld dynamometers (HHDs) for assessing knee extension strength. For example, one study involving 29 rehabilitation patients reported high reliability, with enhanced reliability observed when averaging two measurements [6]. Similarly, another investigation evaluated the reliability of HHDs in measuring knee extensor strength among patients undergoing rehabilitation following hip fracture [12]. In this study, 16 participants (14 women, mean age 79) were tested on both the fractured and unfractured limbs, revealing high retest reliability with minimal variation in both legs. Notably, knee extensor strength was significantly lower in the fractured limb compared to the unfractured limb. These findings collectively support HHDs as a reliable tool for assessing knee extensor strength in rehabilitation populations.

2. Reliability Testing of Knee Strength Flexion Right First and Second

To test the reliability of knee strength flexion right first and second, the researcher used the intra-class correlation coefficient. The obtained result is given in below Table 2.

Table 2 Reliability Testing of Knee Strength Flexion Right First and Second

Variable pair	Cronbach's alpha	Number of items	Intraclass correlation (single measures)	95% CI (lower-upper)	F test value	p-value
Knee strength flexion right first and second	0.644	2	0.475	0.253-0.649	2.809	0.000

Table 2 shows the reliability test for knee strength flexion right first and second. The result shows moderate internal consistency with a Cronbach's Alpha of 0.644. The ICC of 0.475 (95% CI: 0.253 - 0.649) indicates acceptable reliability. The F Test value of 2.809 is statistically significant (p = 0.000), confirming consistency in measurements.

Consistent with the present study's findings, the reliability of handheld dynamometers (HHDs) for knee extension strength assessment has been previously established in rehabilitation populations. For instance, a study involving 29 rehabilitation patients demonstrated high reliability, with further enhancement achieved through averaging two measurements [6]. Similarly, another investigation evaluated HHD reliability in measuring knee extensor strength among patients undergoing post-hip fracture rehabilitation [12]. This study, comprising 16 participants (14 female, mean age 79), assessed both fractured and unfractured limbs, revealing high retest reliability with minimal variability across both sides. Notably, knee extensor strength was significantly reduced in the fractured limb compared to the contralateral limb. These results collectively validate HHDs as a reliable instrument for evaluating knee extensor strength in rehabilitation settings.

3. Reliability Testing of Knee Strength Extension Left First and Second

To test the reliability of knee strength extension left first and second, the researcher used the intra-class correlation coefficient. The obtained result is given in below Table 3.

Table 3 Reliability Testing of Knee Strength Extension Left First and Second

Variable pair	Cronbach's alpha	Number of items	Intraclass correlation (single measures)	95% CI (lower-upper)	F Test Value	p-value
Knee strength extension left first and second	0.760	2	0.613	0.426-0.749	4.162	0.000

Table 3 shows the reliability test for knee strength extension left first and second. The result shows good internal consistency with a Cronbach's Alpha of 0.760. The ICC of 0.613 (95% CI: 0.426 - 0.749) indicates moderate to good reliability. The F Test value of 4.162 is statistically significant (p = 0.000), confirming consistent measurements.

Supporting the present study's findings, previous research has consistently demonstrated the reliability of handheld dynamometers (HHDs) for knee strength assessment. For example, a study evaluating knee extension strength in 24 patients with hematological malignancies reported high intra-observer reliability (ICC = 0.94), although inter-observer reliability was slightly lower [13]. Nevertheless, the overall findings indicated that HHDs are a reliable tool for assessing knee strength in this population. Similarly, another study investigated the reliability of HHDs for measuring isokinetic knee flexor strength in 30 high-level rugby players [14]. This research revealed good intertester reliability (ICC 0.80-0.87) with no significant differences observed between various fixation methods

4. Reliability Testing of Knee Strength Flexion Left First and Second

To test the reliability of knee strength flexion left first and second, the researcher used the intra-class correlation coefficient. The obtained result is given in below Table 4.

Table 4 Reliability Testing of Knee Strength Flexion Left First and Second

Variable fair	Cronbach's alpha	Number of items	Intraclass correlation (single measures)	95% CI (lower-upper)	F Test value	p-value
Knee strength flexion left first and second	0.669	2	0.503	0.287-0.670	3.023	0.000

Table 4 shows the reliability test for knee strength flexion left first and second. The result shows moderate internal consistency with a Cronbach's Alpha of 0.669. The ICC of 0.503 (95% CI: 0.287 - 0.670) indicates acceptable reliability. The F Test value of 3.023 is statistically significant (p = 0.000), confirming consistent measurements.

Consistent with the present study, previous research has affirmed the reliability of handheld dynamometers (HHDs) for assessing lower limb muscle strength. For instance, a study evaluating HHD reliability with belt fixation for hip and knee strength measurement in 21 athletes demonstrated excellent reliability (ICC = 0.76-0.95) across hip abduction, adduction, flexion, extension, and knee flexion, with negligible standard errors of measurement [11]. Similarly, another investigation explored the reliability and validity of HHDs for lower limb strength assessment in 28 older women with knee osteoarthritis, particularly when isokinetic dynamometers are unavailable [15]. This study revealed high test-retest reliability, although knee extension exhibited lower agreement compared to knee flexion. The authors concluded that HHDs are a reliable tool for monitoring strength changes in osteoarthritis patients and can be used to estimate true strength via regression equations.

4. CONCLUSION

The results of the study demonstrated that the Intraclass Correlation Coefficients (ICCs) indicated moderately good reliability for both right and left knee extension, while right and left knee flexion exhibited moderate reliability. These findings suggest that the new ActivForce 2 Handheld Dynamometer offers a reasonable level of consistency in measuring knee strength. Although the reliability levels were not excellent, the device still provides a practical and accessible tool for strength assessment. Additionally, its ease of use and affordability make it a viable option for clinical and rehabilitation settings where more advanced equipment, such as isokinetic dynamometers, may not be readily available. Therefore, the study concludes that the ActivForce 2 Handheld Dynamometer is a moderately reliable, user-friendly, and cost-effective device for evaluating knee strength.

5. IMPLICATIONS

ActivForce 2 is more affordable when compared to the isokinetic dynamometer and is a portable option for accessing knee strength. It tracks muscle recovery and progress. Its compact size allows to use them quickly in various settings like clinical settings, sports settings, and even home. By identifying the weakness of muscle, a proper intervention can be set by the trainer to reduce the risk of knee injuries. Furthermore, the device gives quantifiable muscle strength data, improving clinical decision-making for surgeries.

6. ETHICAL CONSIDERATION

The study on testing the reliability of the ActivForce 2 Handheld dynamometer for measuring knee strength was conducted with strict ethical considerations to protect participants' rights and well-being. All participants were provided informed consent after receiving a clear explanation of the study's objectives, procedures, potential risks, and benefits. Participation was entirely voluntary, with the option to withdraw at any time. Data confidentially was maintained through secure storage and anonymization. The study followed protocols to minimize any risk of harm and ensure fair treatment.

REFERENCES

[1] Bohannon RW. Hand-held dynamometry: A practicable alternative for obtaining objective measures of muscle strength. Isokinetics and Exercise Science. 2012 Jan 1;20(4):301-15.

[2] Dvir Z, Prushansky T. Cervical muscles strength testing: methods and clinical implications. Journal of manipulative and physiological therapeutics. 2008 Sep 1;31(7):518-24

[3] Aerts F, Sheets H, Anderson C, Bussie N, Hoskins R, Maninga A, Novak E. Reliability and Agreement of Hand-Held Dynamometry Using Three Standard Rater Test Positions. International Journal of Sports Physical Therapy. 2025 Feb 1;20(2):243.

[4] Mendoza M, Miller RG. Muscle Strength, Assessment of.

[5] Laguna L, Sarkar A, Chen J. Eating capability assessments in elderly populations. InNutrition and functional foods for healthy aging 2017 Jan 1 (pp. 83-98). Academic Press

[6] Pinto-Ramos J, Moreira T, Costa F, Tavares H, Cabral J, Costa-Santos C, Barroso J, Sousa-Pinto B. Handheld dynamometer reliability to measure knee extension strength in rehabilitation patients—A cross-sectional study. PLoS one. 2022 May 17;17(5):e0268254

[7] Martins J, Da Silva JR, Da Silva MR, Bevilaqua-Grossi D. Reliability and validity of the belt-stabilized handheld dynamometer in hip-and knee-strength tests. Journal of athletic training. 2017 Sep 1;52(9):809-19.

[8] Karagiannopoulos C, Griech S, Leggin B. Reliability and validity of the ActivForce digital dynamometer in assessing shoulder muscle force across different user experience levels. International journal of sports physical therapy. 2022 Jun 1;17(4):669.

[9] Kahraman Y. A new hand dynamometer activforce isometric muscle activation on single joint muscle force of volleyball players. Health Promotion & Physical Activity. 2023;25(4):22-30.

[10] Lazoura E, Savva C, Papacharalambous C, Ploutarchou G, Karagiannis C, Christofi I, Rentzias P. Intra-and inter-rater reliability of the ActivForce Digital Dynamometer for cervical range of motion in patients with chronic neck pain. Physical Therapy Reviews. 2025 Jan 29:1-0.

[11] Thorborg K, Bandholm T, Hölmich P. Hip-and knee-strength assessments using a hand-held dynamometer with external belt-fixation are inter-tester reliable. Knee Surgery, Sports Traumatology, Arthroscopy. 2013 Mar;21:550-5.

[12] Whiteley R, Jacobsen P, Prior S, Skazalski C, Otten R, Johnson A. Correlation of isokinetic and novel hand-held dynamometry measures of knee flexion and extension strength testing. Journal of science and medicine in sport. 2012 Sep 1;15(5):444-50.

[13] Roy MA, Doherty TJ. Reliability of hand-held dynamometry in assessment of knee extensor strength after hip fracture. American journal of physical medicine & rehabilitation. 2004 Nov 1;83(11):813-8.

[14] Van der Made AD, Paget LD, Altink JN, Reurink G, Six WR, Tol JL, Kerkhoffs GM. Assessment of isometric knee flexor strength using hand-held dynamometry in high-level rugby players is intertester reliable. Clinical Journal of Sport Medicine. 2021 Sep 1;31(5):e271-6.

[15] Hayes KW, Falconer J. Reliability of hand-held dynamometry and its relationship with manual muscle testing in patients with osteoarthritis in the knee. Journal of Orthopaedic & Sports Physical Therapy. 1992 Sep;16(3):145-9.