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Reliability of Dynamometric Measurements for Ankle Muscle Strength: A Systematic Review

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ADMINISTRATIVE INFORMATION

Support - None.

Review Stage at time of this submission - Preliminary searches.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 14 May 2024 and was last updated on 14 May 2024.

INTRODUCTION

Review question / Objective This systematic review aimed to (I) examine the reliability of dynamometric strength measurements for ankle muscles in healthy individuals and athletes, (II) identify the most valid and reliable positions for strength measurement, and (III) determine the most reliable velocities for assessing ankle muscle strength.

Rationale The ankle is among the most frequently injured orthopedic joints,5 with a reported incidence of ankle sprains being 1.00 per 1000 athletic hours in collegiate sports. The evaluation of ankle muscle strength can provide information on the functional capacity of an individual to perform activities of daily living and sports actions and reduce the risk of injury. Thus far, differences in test application, procedures used, specificity of protocols, variety in methodologies for test–retest studies, isolation of different muscle groups,14 equipment calibration, measurement parameters, stabilization procedures, isolation of muscle groups, and software adaptability have been shown to influence the reliability of the tests.

Condition being studied Dynamometric strength measurements for ankle muscles in healthy individuals and athletes.

METHODS

Search strategy A comprehensive search of four electronic databases (Web of Science, SCOPUS, EBSCO, and PubMed).

Participant or population Healthy individuals and athletes.

Intervention Reliability (test- retest) dynamometric strength measurements for ankle muscles in healthy individuals and athletes.

Comparator None.

Study designs to be included Reliability (test-retest) dynamometric strength measurements for ankle muscles in healthy individuals and athletes.

Eligibility criteria (a) the studies were in English or Spanish; (b) the subjects were healthy, physically

active adults and athletes; (c) the isokinetic, isometric, concentric, and eccentric ankle strength tests were evaluated; and (d) the mean ICC values, as well as the number of subjects and test (used for estimating variance), could be readily determined from the text of the manuscript. We identified articles that met the inclusion criteria and obtained their full-text versions. For studies in which multiple ICC results were presented, a typical value was sought for the quantitative analysis (i.e., 10–15 min duration, inter-session interval.1 day and 1-month, median result from multiple pipelines).

Information sources Quantitative studies were identified by searching the four principal electronic databases: Web of Science, SCOPUS, EBSCO, and PubMed. The bibliographic search was conducted by combining the different Medical Subject Headings (MeSH) terms with the following keywords: "Strength," "Dynamometer," "Ankle," "Reliability," and "Reproducibility".

Main outcome(s) A quantitative meta-analysis to estimate the reliability of the present tests for ankle muscles and a qualitative review of factors influencing reliability.

Data management To search for new studies, we examined the bibliographies of other previous related reviews and selected studies. Other possible scientific evidence related to the subject has been identified by contacting the authors of the published articles via email. Two authors examined the title/summary of articles found in the databases. After the initial selection, each study was analyzed according to the inclusion criteria. Each criterion is evaluated as yes or no. If discrepancies existed between the authors, the ratings of the articles were shared and discussed until a consensus was reached. The authors were familiar with the existing literature and did not have a bias different from any study selected for inclusion in this review.

Quality assessment / Risk of bias analysis The methodological quality of the selected studies was evaluated using a critical appraisal tool (CAT) and through the quality assessment of reliability studies (QAREL).

Strategy of data synthesis The methodological quality of the selected studies was evaluated using a critical appraisal tool (CAT)17 and through the quality assessment of reliability studies (QAREL).
R was used for all statistical analyses.19 Excel data were extracted using the read.xls function in gdata.20 The meta for package of R software was used to conduct the meta-analysis (Version3.4-0). A meta-analytic estimate of population ICC was computed using the rma.mv function with studies nested by the authors. Random effects were specified for the data set, and a salting model was fitted using restricted maximum likelihood estimation (RMLE). Noble et al., documented this procedure for the formal meta-analysis of ICC values. Therefore, the ICC-based meta-analysis was conducted with two assumptions.

Subgroup analysis A meta-analysis was performed using raw ICC values with the assumption of normal distribution. While not exact, this assumption is often made in a similar case of meta-analysis with Pearson's correlation coefficient and tends to be less skewed when values are far from one. Second, we assumed that each study's ICC variance could be approximated as Donner via Shoukri et al.

Sensitivity analysis We created forest plots of the studies included in the meta-analysis using the forest function. We created a funnel plot using the funnel function to show the relationship between the ICC coefficients and their estimated standard errors. Heterogeneity and publication bias were assessed using Cochrane's Q, and funnel plot asymmetry was estimated using the ranked regression test (rank test function).

Language restriction English.

Country(ies) involved Colombia, Chile.

Keywords Reproducibility, Muscle Strength Dynamometer, Ankle Joint, Muscle Contraction.

Contributions of each author

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