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Measurement properties of objective methods to assess shoulder muscle strength (a systematic review protocol)

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Introduction: Shoulder disorders cause significant impaired function and health-related quality of life. Treatment consists of either conservative or surgical treatment, and results in substantial health care utilization. Strengthening exercises of the rotator cuff muscles are often included in physiotherapy treatment of patients with shoulder disorders. Valid and reliable measurement methods to assess shoulder muscle strength are important to analyse the efficacy of treatment in both clinical practice and research. There is a need for an up to date systematic review that summarize the evidence of measurement properties of objective measurements of isometric and isokinetic shoulder muscle strength in individuals with and without shoulder symptoms.
Aim: The aim of this review is to investigate measurement properties of objective methods to assess shoulder muscle strength.
Methods: The following databases; Cochrane Central Register of Controlled Trials (CENTRAL), Pubmed, EMBASE, and PEDro will be searched for relevant studies reporting the assessment of measurement properties of objective methods used to assess shoulder muscle strength. The methodological quality will be assessed with the Consensus-based Standards for the selection of health Measurement Instruments (COSMIN) checklist. The overall evidence of the measurement properties of the included instruments will be summarized in a best evidence synthesis.

Keywords: Shoulder, Strength, Measurement properties, Reliability, Validity

Introduction

Shoulder disorders are the third most common musculoskeletal reason for seeking medical care and accounts for approximately 1% of all visits to the general practitioner and for up to 10% of all referrals to physiotherapists.[1,2] The prevalence of shoulder disorders has been reported to range from 7 to 26% with some indication that the prevalence increases with age.[2–4] Patients with shoulder disorders may present symptoms such as pain during activity and at night, loss of muscle strength, and stiffness.[1,5,6] Symptoms arising from the shoulder disorders hinder the performance of upper limb activities such as dressing, personal hygiene, eating and working by affecting the shoulder stability of the upper limb.[6] Shoulder disorders produce significant impairments in function and health-related quality of life (HR-QoL), and results in substantial health care utilization.[1,7]

Treatment of shoulder disorders, for example subacromial impingement syndrome, rotator cuff tendinopathy or rotator cuff tears, consists of either conservative or surgical treatment, and with the overall purpose of treatment to relieve pain and restore function of the shoulder.[1,5,6,8,9] Conservative interventions including physiotherapy are recommended as first choice of treatment, while surgical treatment such as subacromial decompression, bursectomy and rotator cuff repair can be considered for those who fail to respond to conservative treatment after 3–6 months.[1,10] Several studies have assessed the efficacy of surgery compared to conservative treatment, and found no significant differences in outcomes between treatment strategies.[1,5,9,11,12]

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Need of current review

In general, high quality measurement methods are important in order to evaluate the effect of an intervention on individual- and group level.[13,14]

Patients with shoulder disorders often present loss of muscle strength, and strengthening exercises of the rotator cuff muscles are frequently included in physiotherapy interventions.[1,5,6,11] Several systematic reviews have evaluated the measurement properties of muscle strength testing of the shoulder.[15–17] Schrama et al. summarized intraexaminer reliability of hand-held dynamometry in all joints of the upper extremity, and found conflicting results or unacceptable reliability for the assessment of shoulder strength.[15] Rabelo et al. investigated reliability of muscle strength assessment in patients with chronic post-stroke hemiparesis in five different joints and found reliability results varying from low to very high.[16] Edouard et al. examined the influence of position on the intersession reliability of the assessment of isokinetic muscle strength.[17] However, a large variety of instruments, joints, modalities and populations are included in these reviews.[15–17] Therefore, an updated systematic review that summarize the evidence of measurement properties of both isometric and isokinetic shoulder muscle strength in individuals with and without shoulder symptoms are needed. The quality of an instrument involves measurement properties that reflect validity, reliability, minimal detectable change and minimal clinically important difference.[13]

Aim of review

The aim of this systematic review is to summarize the evidence of measurement properties of objective methods used to assess shoulder muscle strength.

Methods

This systematic review follows the methodology of systematic reviews of measurement properties, based on ten steps, as described by *Terwee*.[18] The protocol follows the PRISMA-P guidelines.[19] The methodological quality of the included studies will be assessed with the Consensus-based Standards for the selection of health Measurement Instruments (COSMIN) checklist.[13,14]

The protocol has been registered in the International Prospective Register of Systematic Reviews (PROSPERO) (registration number CRD42017054027).

Search strategy

The following electronic databases will be searched from their inception up to present: Cochrane Central Register of Controlled Trials (CENTRAL), Pubmed, EMBASE and PEDro. We will develop the electronic search strategies with assistance of an information specialist, using MeSH (Pubmed), Thesaurus (EMBASE) and free text words. These terms will be combined with the sensitive methodological search filter to identify studies of measurement properties in Pubmed developed by *Terwee et al.* and a translation of this filter made for EMBASE.[20] Reference lists and citations of the included trials and relevant reviews will be handsearched for additional studies meeting the inclusion criteria. No publication period or language restrictions will be applied. Included studies should be published as a full text original article.

Selection criteria

Studies reporting on measurement properties of objective methods used to assess shoulder muscle strength will be included. Subjective measurement methods (pain, function, global improvement, HR-QoL) will not be included. Studies reporting on a combination of objective and subjective methods, will be included if the results of the objective methods are reported independently. Measurement properties are defined as: validity, reliability, measurement error, standard error of measurement, responsiveness, minimal detectable change and minimal clinically important difference. Individuals with and without shoulder symptoms, who are at least 18 years will be included. Studies evaluating measurement properties in patients with neurologic, neuromuscular, or systemic diseases or critically ill patients will be excluded.

Selection procedure

Two review authors (LS and either LGØ or MKP) will independently screen title and abstracts for relevance and possible inclusion. We will obtain full text of all potentially relevant studies to identify studies meeting the inclusion criteria. The reasons for exclusion of retrieved full text articles will be recorded. Disagreement will be discussed and a majority vote used to make decision.[18] If necessary, we will contact authors for clarification of study methods and characteristics to establish trial eligibility. The level of agreement between reviewers evaluating studies for inclusion will be assessed using kappa statistics.

Quality assessment

The methodological quality will be assessed using the COSMIN checklist. The COSMIN checklist is a validated critical appraisal tool designed for the systematic evaluation of the methodological quality of studies of the measurement properties of health measurement instruments. The COSMIN checklist was developed to evaluate the methodological quality of studies on PROM measurement properties. However, the COSMIN checklist can also be used to evaluate the methodological quality of studies focusing on other measurement instruments, such as performance-based and objective measurement instruments, because the same measurement properties are likely to be relevant.[13,14] The checklist will be adapted when necessary to suit objective measurement methods.

The checklist consists of nine boxes concerning measurement properties. Each box contains 5–18 items dealing with design aspects and statistical methods. Depending on the methodological quality each item will be scored on

a four-point rating scale as 'excellent', 'good', 'fair', or 'poor'. A methodological quality score per measurement property for each study will be determined by taking the lowest rating of any items in a box (worst score counts).[14] For each study, only boxes concerning the measurement properties evaluated in that study will be scored.

Two review authors (LS and either AKP or LGØ) will independently assess the methodological quality. We will resolve disagreements by consensus and, if needed, by consulting the third review author, who did not assess the quality of the relevant study (AKP or LGØ).[18]

Data extraction

Two review authors (LS and either AKP or LGØ) will independently extract data related to study characteristics and results using a data extraction form. This form will be based on the COSMIN boxes 'Interpretability' item 7–8 and 'Generalizability' item 1–7. This form will be pilot tested on one study before use.

The following information will be extracted from the studies:

- General characteristics of the instrument.
- Characteristics of the study population in which the measurement properties were assessed.
- Results of measurements properties.

Disagreements will be resolved through consensus. The third review author, who did not extract data of the relevant study (AKP or LGØ) will be consulted when necessary. We will attempt to contact authors when details of study methods or results are incomplete

Table 1. Levels of evidence for the quality of the measurement property

Level	Rating[a]	Criteria
Strong	+++ or –	Consistent findings in multiple studies of good methodological quality OR in one study of excellent methodological quality
Moderate	++ or –	Consistent findings in multiple studies of fair methodological quality OR in one study of good methodological quality
Limited	+ or –	One study of fair methodological quality
Conflicting	+/–	Conflicting findings
Unknown	?	Only studies of poor methodological quality

[a]+ = positive rating, ? = indeterminate rating, – = negative rating.

Best evidence synthesis

To determine the overall evidence of the measurement properties of the included instruments, a best evidence synthesis will be performed. The results of the different studies will be combined when the studies are sufficiently similar with regard to instrument, administration, study population and setting. Multiple reports of the same study involving the same participants but assessing different outcome variables will be collated and considered as one study. The level of evidence for the quality of each measurement property will be applied using the COSMIN checklist in a similar manner as proposed by the Cochrane Review Group (Table 1).[21]

The rating of the quality of a measurement property for each study will be recorded as 'positive', 'indeterminate' or 'negative' according to the pre-specified criteria list, adapted from Terwee et al. (Table 2).[22] Subsequently, the rating of all the included studies will be compared per measurement property, to determine the overall quality for each measurement property for each instrument.

Discussion

This systematic review will present an assessment of the evidence of measurement properties of objective instruments currently used to assess shoulder muscle strength.

Table 2. Quality criteria for measurement properties (based on Terwee et al.)

Property	Rating	Quality criteria
Reliability		
Reliability	+	ICC/weighted Kappa ≥0.70 OR Pearson's r ≥0.80
	?	Neither ICC/weighted Kappa, nor Pearson's r determined
	–	ICC/weighted Kappa <0.70 OR Pearson's r <0.80
Measurement error	+	MIC >SDC OR MIC outside the LOA
	?	MIC not defined
	–	MIC ≤SDC OR MIC equals or inside LOA
Validity		
Criterion validity	+	Convincing arguments that gold standard is 'gold' and correlation with gold standard ≥0.70
	?	No convincing arguments that gold standard is 'gold' or doubtful design method
	–	Correlation with gold standard <0.70, despite adequate design and method
Responsiveness		
Responsiveness	+	Correlation with changes on instruments measuring the same construct ≥0.50 OR at least 75% of the results are in accordance with the hypotheses OR AUC ≥0.70 AND correlations with changes in related constructs are higher than with unrelated constructs
	?	Solely correlations determined with unrelated constructs
	–	Correlations with changes on instruments measuring the same construct <0.50 OR <75% of the results are in accordance with the hypotheses OR AUC <0.70 OR correlations with changes in related constructs are lower than with unrelated constructs

+ = positive rating, ? = indeterminate rating, – = negative rating, ICC= intraclass correlation coefficient, MIC=minimal important difference, SDC=smallest detectable change, AUC = area under the curve; LoA = limits of agreement; MIC = minimally important change.

Knowledge of reliability and validity will illustrate whether the instrument is considered suitable for measuring muscle strength on group level or individual level. This information will be relevant in the selection of measurement instruments in research and clinical practice.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

Lotte Sørensen, PT, MSc, currently serves as a research assistant of the Department of Physiotherapy and Occupational Therapy at Aarhus University Hospital. She has great interest in rehabilitation, and her research focus includes the use of valid and reliable measurement instruments to analyse the efficacy of treatment in both clinical practice and research.

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