

Ultrasound Assessment of Muscle Atrophy and Function in Critically Ill Patients: A Systematic Review

CHEN-CHUN LIN, Wei-Chun Hsu, Yi-Jia Lin

Citation

CHEN-CHUN LIN, Wei-Chun Hsu, Yi-Jia Lin. Ultrasound Assessment of Muscle Atrophy and Function in Critically Ill Patients: A Systematic Review. PROSPERO 2025 CRD420251052372. Available from <https://www.crd.york.ac.uk/PROSPERO/view/CRD420251052372>.

REVIEW TITLE AND BASIC DETAILS

Review title

Ultrasound Assessment of Muscle Atrophy and Function in Critically Ill Patients: A Systematic Review

Condition or domain being studied

Critical Illness; Adult Care; Ultrasound scan; Muscle Atrophy; Muscle Function Study; Muscle Weakness; Muscle Mass; Sarcopenia

This review focuses on critically ill adult patients in intensive care units (ICUs), particularly those at risk of or experiencing ICU-acquired weakness, muscle atrophy, and impaired muscle function. The condition is common in mechanically ventilated patients and those with prolonged immobilization. Ultrasound is increasingly used to assess skeletal muscle quantity and quality in this population due to its bedside feasibility and non-invasive nature.

Rationale for the review

Critically ill patients are at high risk of muscle atrophy and ICU-acquired weakness due to prolonged immobilization and systemic inflammation. Early detection of muscle wasting and functional decline is crucial for initiating timely interventions. Ultrasound has emerged as a feasible, non-invasive tool for assessing muscle quantity and quality at the bedside. While

several studies have used ultrasound in ICU settings, a comprehensive synthesis of its application for evaluating both muscle atrophy and function is lacking. This review aims to systematically summarize current evidence on ultrasound-based muscle assessment in critically ill patients, highlighting measurement protocols, target muscles, and clinical relevance, thereby informing future clinical practice and research.

Review objectives

Primary objective: to systematically review the literature on the use of ultrasound imaging to assess skeletal muscle atrophy and function in critically ill adult patients.

Secondary objectives: to describe the ultrasound parameters used for evaluating muscle quantity (e.g., muscle thickness, cross-sectional area) and muscle quality (e.g., echogenicity, fascicle length), identify the anatomical sites and muscles commonly assessed in ICU patients, explore the associations between ultrasound findings and clinical outcomes such as ICU-acquired weakness, mobility, and functional recovery.

Keywords

Critical illness; Ultrasound; Muscle atrophy; ICU acquired weakness; Physical function; Cross-sectional area; Muscle thickness; Pennation angle; echointensity

Country

Taiwan (R.O.C.)

ELIGIBILITY CRITERIA

Population

Included

Adults (≥ 18 years) in ICU, Use of ultrasound to assess skeletal muscle, Observational studies, Full-text, peer-reviewed articles in English

Excluded

Age < 18 years, Non-ICU settings, Case reports, reviews, abstracts only, Interventional studies, Animal or non-English studies

Intervention(s) or exposure(s)

Included

Ultrasound scan; Muscle Function Study; Intensive Care

Only studies in which ultrasound was used as an observational tool to assess muscle quantity or quality in critically ill patients will be included.

Excluded

Studies with any form of therapeutic intervention (e.g., exercise training, physical therapy, nutritional supplementation, or drug therapy) aimed at modifying muscle outcomes will be excluded.

Comparator(s) or control(s)

This review does not have any comparators

Study design

Only nonrandomized study types will be included.

Included

Observational studies, including prospective cohort studies, retrospective cohort studies, and cross-sectional studies

Studies that used ultrasound as an assessment tool for skeletal muscle quantity or quality in critically ill adult patients

Full-text, peer-reviewed articles in English

Excluded

Randomized controlled trials and interventional studies

Case reports, case series with fewer than 10 patients

Reviews, editorials, letters, and conference abstracts without full text

Animal studies and in vitro studies

Context

Studies must be conducted in adult intensive care units (ICUs), including medical, surgical, or mixed ICUs. Patients may be mechanically ventilated or not, but must be admitted for critical illness. Studies conducted in step-down units, general wards, outpatient settings, or rehabilitation centers will be excluded. There are no restrictions based on country, healthcare system, or income level.

TIMELINE OF THE REVIEW

Date of first submission to PROSPERO

14 May 2025

Review timeline

Start date: 1 March 2025. End date: 15 June 2025.

Date of registration in PROSPERO

19 May 2025

AVAILABILITY OF FULL PROTOCOL

Availability of full protocol

A full protocol has been written but is not available because:

The full protocol has been written for internal use and team coordination but has not yet been submitted for journal publication or public sharing. We plan to share the protocol upon completion of the review or in future publications.

SEARCHING AND SCREENING

Search for unpublished studies

Only published studies will be sought.

Main bibliographic databases that will be searched

The main database to be searched is *PubMed*.

Other important or specialist databases that will be searched
Web of Science (WoS)

Search language restrictions

The review will only include studies published in English.

Search date restrictions

Databases will be searched for articles published from 1 January 2000 and before by 30 April 2025.

Other methods of identifying studies

Other studies will be identified by: *contacting authors or experts, looking through all the articles that cite the papers included in the review ("snowballing"), reference list checking, searching conference proceedings, searching dissertation and thesis databases and searching trial or study registers.*

Link to search strategy

A full search strategy is available in the full protocol as described in the *Availability of full protocol* section

Selection process

Studies will be screened independently by at least two people (or person/machine combination) with a process to resolve differences.

Other relevant information about searching and screening

None

DATA COLLECTION PROCESS

Data extraction from published articles and reports

Data will be extracted independently by at least two people (or person/machine combination) with a process to resolve differences.

Authors will be asked to provide any required data not available in published reports.

Study risk of bias or quality assessment

Risk of bias will be assessed using: *Newcastle-Ottawa*

NIH Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies

Data will be assessed independently by at least two people (or person/machine combination) with a process to resolve differences.

Additional information will be sought from study investigators if required information is unclear or unavailable in the study publications/reports.

Reporting bias assessment

We will assess the risk of bias due to missing results by examining selective outcome reporting and comparing outcomes listed in study methods with those reported in the results. If applicable, we will also examine trial registries and protocols to identify discrepancies.

Certainty assessment

Certainty of findings will not be assessed

OUTCOMES TO BE ANALYSED

Main outcomes

Primary outcomes

1. Muscle quantity as measured by ultrasound, including: Muscle thickness, Cross-sectional area (CSA), Muscle fascicle length, Pennation angle (PA)
2. Muscle quality, including: Echogenicity (e.g., grayscale analysis, echo intensity), Muscle stiffness (e.g., shear wave elastography)
3. Functional outcomes related to muscle function or physical recovery, including: Medical Research Council (MRC) sum score for ICU-acquired weakness, Handgrip strength measured by dynamometer, Mobility or functional independence scores (e.g., ICU Mobility Scale, Functional Status Score for the ICU [FSS-ICU])

Time points:

- At ICU admission, serial assessments during ICU stay, or at discharge

Effect measures:

- Means and standard deviations for continuous variables
- Change from baseline (Δ) where applicable

-Proportions (e.g., % with ICU-AW), means/SDs for continuous scores, odds ratios or risk ratios if applicable

Additional outcomes

NA

PLANNED DATA SYNTHESIS

Strategy for data synthesis

No formal data synthesis is planned - data will be described but not combined.

CURRENT REVIEW STAGE

Stage of the review at this submission

Review stage	Started	Completed
Pilot work	✓	
Formal searching/study identification	✓	
Screening search results against inclusion criteria	✓	
Data extraction or receipt of IPD		
Risk of bias/quality assessment		
Data synthesis		

Review status

The review is currently planned or ongoing.

Publication of review results

Results of the review will be published in English.

REVIEW AFFILIATION, FUNDING AND PEER REVIEW

Review team members

Dr CHEN-CHUN LIN. Shin Kong Wu Ho-su Memorial Hospital. Taiwan (R.O.C).

No conflict of interest declared.

Professor Wei-Chun Hsu (review guarantor). Graduate Institute of Biomedical Engineering, National Taiwan University of Science and Technology. Taiwan (R.O.C).

No conflict of interest declared.

Assistant Professor Yi-Jia Lin. Graduate Institute of A.I. Cross-disciplinary Tech, National Taiwan University of Science and Technology. Taiwan (R.O.C).

No conflict of interest declared.

Named contact

Dr CHEN-CHUN LIN (m002186@ms.skh.org.tw). Shin Kong Wu Ho-su Memorial Hospital. Taiwan (R.O.C).

Review affiliation

Graduate Institute of Applied Science and Technology, National Taiwan University of Science and Technology,

Funding source

Review has no specific/external funding but is supported by guarantor/review team (non-commercial) institutions.

Peer review

There has been no peer review of this planned review.

ADDITIONAL INFORMATION

Review conflict of interest

Declared individual interests are recorded under team member details.. No additional interests are recorded for this review.

Medical Subject Headings

Adult; Critical Illness; Humans; Intensive Care Units; Muscle, Skeletal; Muscular Atrophy; Ultrasonography

SIMILAR REVIEWS

Check for similar records already in PROSPERO

PROSPERO identified a number of existing PROSPERO records that were similar to this one (last check made on 14 May 2025). These are shown below along with the reasons given by that the review team for the reviews being different and/or proceeding.

- Gender Differences in Associations between Ultrasound Measures of Skeletal Muscle Parameters and Muscle Strength/Physical Function among the Elderly: A Meta-Analysis [published 9 June 2024] [CRD42024552593]. **The authors did not check this review**
- Methodologies and clinical applications of lower limb muscle ultrasound in critically ill patients: a systematic review and meta-analysis [published 2 May 2023] [CRD42023420376]. The review was judged **not to be similar**
- Muscle wasting in critically ill patients: A systematic review and meta-analysis [published 13 January 2022] [CRD42022298954]. The review was judged **not to be similar**
- A systematic review on predictive utility of skeletal muscle ultrasonography for muscle

strength and physical function [published 10 January 2019] [CRD42019118453]. The review was acknowledged as **similar** but the authors opted to continue because *the review will be more up to date*

PROSPERO version history

- [Version 1.0, published 19 May 2025](#)

Disclaimer

The content of this record displays the information provided by the review team. PROSPERO does not peer review registration records or endorse their content.

PROSPERO accepts and posts the information provided in good faith; responsibility for record content rests with the review team. The guarantor for this record has affirmed that the information provided is truthful and that they understand that deliberate provision of inaccurate information may be construed as scientific misconduct.

PROSPERO does not accept any liability for the content provided in this record or for its use. Readers use the information provided in this record at their own risk.

Any enquiries about the record should be referred to the named review contact