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Systematic review

The assessment of abdominal and multifidus muscles and their role in physical function in older adults: a systematic review

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Abstract

Background Age-related changes in the trunk (abdominal and lumbar multifidus) muscles and their impact on physical function of older adults are not clearly understood.
Objectives To systematically summarise studies of these trunk muscles in older adults.
Data sources Cochrane Library, Pubmed, EMBASE and CINAHL were searched using terms for abdominal and MF muscles and measurement methods.
Study selection Two reviewers independently assessed studies and included those reporting measurements of abdominal muscles and/or MF by ultrasound, computed tomography, magnetic resonance imaging or electromyography of adults aged ≥50 years.
Data synthesis A best evidence synthesis was performed.
Results Best evidence synthesis revealed limited evidence for detrimental effects of ageing or spinal conditions on trunk muscles, and conflicting evidence for decreased physical activity or stroke having detrimental effects on trunk muscles. Thicknesses of rectus abdominis, internal oblique and external oblique muscles were 36% to 48% smaller for older than younger adults. Muscle quality was poorer among people with moderate-extreme low back pain and predicted physical function outcomes.
Limitations Study heterogeneity precluded meta-analysis.
Conclusion Overall, the evidence base in older people has significant limitations, so the role of physiotherapy interventions aimed at these muscles remains unclear. The results point to areas in which further research could lead to clinically useful outcomes. These include determining the role of the trunk muscles in the physical function of older adults and disease; developing and testing rehabilitation programmes for older people with spinal conditions and lower back pain; and identifying modifiable factors that could mitigate age-related changes.

Keywords: Systematic review; Older adults; Physical function; Trunk muscles; Abdominal muscles; Multifidus muscles

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Introduction

The muscles of the trunk are essential for normal functional activities such as walking and are involved in control of balance and posture [1]. Research on the influence of low back pain (LBP) on these muscles forms the basis of rehabilitation and motor control programmes used by physiotherapists to address alterations in function of these muscles [2]. Research has focused on the abdominal (internal oblique (IO), external oblique (EO), rectus abdominis (RA) and transversus abdominis (TrA)) and lumbar multifidus muscles (MF), but predominantly in younger adults. While physical capacity, skeletal muscle mass and strength [3] deteriorate with age (sarcopenia), the age-related changes of trunk muscles and the impact of such changes are poorly understood. A comprehensive summary of the current literature is critical to guide current clinical practice aimed at reducing age-related losses in physical function and to identify evidence gaps for future research.

Electromyography (EMG), ultrasound imaging (USI), computed tomography (CT) and magnetic resonance imaging (MRI) are commonly used to assess trunk muscle activation, morphology and function. EMG assesses muscle activation patterns which are associated with muscle function [4]. USI, CT and MRI assess muscle morphology, including thickness and cross-sectional area (CSA), which are associated with the amount of force an individual can develop [5]. CT and MRI can also evaluate muscle composition, which include muscle density or muscle attenuation (MA). Muscle attenuation is a radiological characteristic used to quantify macroscopic accumulation of intramuscular fat (muscle quality). The greater this accumulation, the lower the attenuation score in Hounsfield units (HU) [6].

The validity and reliability of trunk muscle measurements using EMG and imaging techniques have been reported for younger populations [7,8], a variety of factors may affect reliability for older adults. The presence of LBP, chronic disease, increases in water content and intramuscular fat accumulation as well as technical issues such as repositioning of the patient for scanning, muscle activation sequences and rate of imaging have the potential to affect reliability of imaging [9]. Concerns regarding the reliability of EMG measures due to problems with task standardisation, 'out-of-plane' movements and normalisation of EMG signals, have also been documented [8]. It is therefore important to determine the validity and reliability of these measures specifically for older adults.

The first aim of this systematic review was to provide a summary of the evidence for changes in function, composition and morphology of the abdominal and MF muscles and the effects of any changes on the physical function of older adults. The second aim was to document the validity and reliability of measurements of abdominal and MF muscles among older adults.

Methods

Literature search

A systematic literature search was conducted on PubMed, CINAHL, EMBASE and The Cochrane library databases as detailed in Supplementary File 2.

Inclusion/exclusion criteria

Studies were included if they:

- were an observational study or randomised controlled trial assessing abdominal or MF muscles;
- had at least 80% of participants ≥50 years old, or data for ≥50 year olds could be extracted from published results;
- used EMG, USI, CT, or MRI to assess abdominal (RA, EO, IO or TrA) or MF muscles;
- reported:
  - validity/reliability or descriptive data for any those muscles, and/or
  - associations of muscle measures with measures of physical function (excluding bodily functions such as micturition, coughing, sneezing and defecation), and/or
  - associations of muscle measures with other factors including but not limited to age, sex, serum vitamin D, medical conditions and medications.

Studies of post-acute abdominal or post-acute back surgery, animals and cadavers were excluded.

Data collection and analysis

Two reviewers (WAC and TMW) independently screened all titles, abstracts and if required full text articles for inclusion, with differences resolved by consensus. Two reviewers (WAC and AW) independently extracted data from included studies, with a third reviewer (TW) available to adjudicate any disagreements but this was not needed. Data extracted were participant characteristics (age, body mass index (BMI), gender, ethnicity) and study characteristics (number of participants, inclusion/exclusion criteria, study design, trunk muscles measured, assessment method, adjustment for confounders and study setting). Information on measures of validity/reliability and results of any associations tested between the muscles of interest and other factors were extracted as outcomes.

Assessment of methodological quality of studies

Methodological quality was assessed independently by two reviewers (WAC and AW) by an established approach for systematic reviews of observational studies on musculoskeletal topics [10] modified as appropriate for our topic. Twenty-three criteria assessed internal validity and informativeness of the studies (Supplementary File 3). Each criterion