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Feature Article

Evaluation of fatigability measurement: Integrative review

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ABSTRACT

Fatigability is defined as the extent of fatigue in the context of activity and differs from the term used in exercise literature to describe muscle endurance characteristics. Many fatigability measures are available, but no studies have thoroughly evaluated them for adequate incorporation of fatigability concepts. This integrative review provides an overall assessment of existing fatigability measures and then evaluates each in depth. A database search and hand search produced 14 studies for review. Fatigability measurement took three forms: self-reported fatigability, perceived fatigability (self-reported fatigue following a defined performance test), and performance fatigability (performance deterioration). Of 17 measures identified, validity and/or reliability was reported for six (35.3%), and no measure was used in more than one study. Fatigability measures have been correlated with clinical measures, indicating that fatigability should be measured during routine clinical health screening. Refinement of measures and additional fatigability data collection will improve understanding and treatment of fatigue.

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Introduction

Fatigue refers to global self-reported tiredness, exhaustion, lack of energy, and weariness¹ and is a common complaint in older adults, although experienced by people of every age. Fatigue in older adults is associated with poor mobility, functional limitations, and mortality.^{2,3} Assessing fatigue and its impact on physical activity, however, is challenging given the propensity to modify activities to maintain feelings of fatigue within an acceptable range; referred to as self-pacing.¹ For example, different people may rate their fatigue at the same level, however, the impact of similarly-rated fatigue levels on physical activity likely differs from individual to individual. The concept of fatigability addresses this relationship between fatigue and physical activity. Eldadah (2010) defined fatigability as the degree of fatigue experienced during performance of a defined activity, which normalized fatigue to activity level. Understanding fatigability, therefore, can provide insight into the extent to which fatigue actually interferes with

physical activity and this is important for evaluating the impact of fatigue on physical activity and vice versa.

Fatigability, a relatively new concept in the geriatric literature, has generated a great deal of research interest. Because this work is still in its early stages, multiple definitions of fatigability exists leading to conceptual confusion and wide variations in measurement. For example, in some studies, fatigability was defined as fatigue in relation to a defined activity of a specific intensity and duration.^{4,5} Other studies defined fatigability as a change in performance, which included performance deterioration, or self-reported fatigue in response to physical activity, which included changes in perceived exertion.^{3,6} Two key points about fatigability have emerged from the literature: (1) fatigability is defined as a change in perceived fatigue in the context of activity, and (2) the activity or task must be standardized in terms of duration, intensity, and frequency. Arriving at a clear understanding of fatigability is important, as fatigue, physical inactivity, and the resulting fatigability likely play a role in the development of frailty, a common geriatric syndrome.⁷

Many measures are available for measuring fatigability, and these measures have been applied in various ways depending on the conceptual definition of fatigability used by researchers. Moreover, fatigability measurement is challenging because fatigue as a subjective symptom must be self-reported. Conversely,

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although physical activity may be self-reported, objective measurement of physical activity is preferred because it is more precise. In addition, there is no consensus about how to best measure fatigability, and there has been no systematic evaluation of how well each measure incorporates fatigability concepts.

Therefore, this review of fatigability instruments and measurement techniques was performed to help identify reliable and valid measures for use in future research. This integrative review was conducted in two phases. The purpose of phase one was to perform an overall assessment of fatigability measurement characteristics and research findings. Phase two was intended to provide an in-depth evaluation of individual fatigability measures in order to determine (1) how fatigue and activity were quantified; (2) how a fatigability score was calculated, including the type of scaling used; and (3) whether reliability and validity testing was reported.

Methods

Publications included in the integrative review were identified through literature searches of PubMed, CINAHL, and Embase using the combined terms “fatigability AND fatigue.” The option “Limit to terms indexed in article as major focus” was chosen for the Embase search in an effort to limit the articles to only those that primarily focused on fatigue and fatigability. The references of the studies obtained through computer indexing were examined to locate any additional articles not indexed in the literature databases. Only quantitative studies published between January 2010 and January 2016 were included in this review. The year 2010 was selected because fatigability was newly defined at that time in the fifth Bedside-to-Bench conference of the American Geriatrics Society.⁸ This conference defined fatigability as “a phenotype describing the change in fatigue level as a function of the change in intensity, duration, or frequency of activity” (p. 969). This definition contrasts with previous definitions of fatigability that relied mainly on the physiological phenomenon of skeletal muscle fatigability. Articles were included in the review if they met the following criteria: (1) quantitative research published in English, (2) research participants included adult patients or healthy controls, and (3) fatigability was conceptualized as perceived fatigue in the context of a defined activity level. Abstracts, unpublished studies, and review papers were not included in the review.

The search of the databases yielded the following results: 267 articles in PubMed, 74 articles in Embase, and 83 articles in CINAHL. The abstracts for all the articles were reviewed, and substantial overlapping of articles among the databases was found. After duplicates were removed, 284 articles were identified as potentially relevant. Three additional articles were identified by hand-searching the reference lists of the 284 identified articles. Of the 284 articles, 14 met the inclusion criteria and were included in this study (Fig. 1).

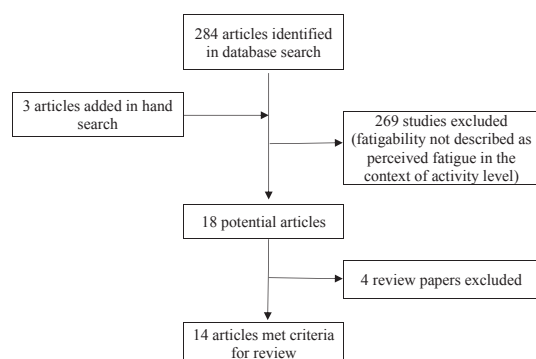


Fig. 1. Flowchart of search and selection strategy.

Results

General study characteristics

During an initial review of the 14 research articles, their methodological characteristics were assessed (Table 1). Most of the studies (85.7%) examined fatigability in an elderly population, but only two (14.3%) focused on fatigability in patients with chronic illness. The sample sizes varied considerably among the studies, with some enrolling as few as 17 subjects and some as many as 1,181; however, most studies (71%) enrolled fewer than 100 subjects. In terms of design, 10 of the studies (71.5%) used a cross-sectional design, three studies (21.4%) employed a retrospective research design, and only one measured fatigability at two time periods using a prospective design. Perceived fatigability, which is defined as self-reported fatigue following a defined performance test, was the measure most frequently used in the studies (71.4%); five studies (35.7%) measured fatigability as both perceived fatigability and performance fatigability (performance deterioration), and the other five (35.7%) measured only perceived fatigability in their research.

Phase one

Overall, 14 research articles met the criteria for inclusion in the review. They are described in detail in Table 2. The purpose of phase one was to characterize fatigability measurement in recent research, and such measurement was found to take one of three forms: (1) self-reported fatigability, (2) perceived fatigability (self-reported fatigue following a defined performance test), and (3) performance fatigability (performance deterioration). For both perceived and performance fatigability, measurements employed performance-based assessments.

Self-reported fatigability

Three studies used a self-reported measure of fatigability.^{4,9,10} One study developed a self-reported instrument specifically for fatigability.⁴ The other two studies used instruments originally developed to measure fatigue in specific activities of daily life.^{11,12} The numbers of items in the three instruments varied from two to 13.

Perceived fatigability (self-reported fatigue following a defined performance test)

In 10 of 14 studies (71.4%), perceived fatigability was measured using a self-reported fatigue score following a defined performance test. Self-reported fatigue was measured using several types of scales such as rating of perceived exertion (RPE) on the Borg scale

Table 1
General characteristics of fatigability studies.

Study characteristic	N	%
Sample Population		
Elderly	12	85.7
Chronic illness patients	2	14.3
Sample size		
≥100 subjects	4	28.5
<100 subjects	10	71.5
Research design		
Cross-sectional	10	71.5
Prospective	1	7.1
Retrospective	3	21.4
Fatigability measurement		
Self-reported fatigability (a)	2	14.3
Perceived fatigability–self-reported fatigue following a defined performance Test (b)	5	35.7
Performance fatigability–Performance deterioration (c)	1	7.1
(a) & (b)	1	7.1
(b) & (c)	5	35.7

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