The Identification of Frailty: A Systematic Literature Review

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An operational definition of frailty is important for clinical care, research, and policy planning. The literature on the clinical definitions, screening tools, and severity measures of frailty were systematically reviewed as part of the Canadian Initiative on Frailty and Aging. Searches of MEDLINE from 1997 to 2009 were conducted, and reference lists of retrieved articles were pearled, to identify articles published in English and French on the identification of frailty in community-dwelling people aged 65 and older. Two independent reviewers extracted descriptive information on study populations, frailty criteria, and outcomes from the selected papers, and quality rankings were assigned. Of 4,334 articles retrieved from the searches and 70 articles retrieved from the pearling, 22 met study inclusion criteria. In the 22 articles, physical function, gait speed, and cognition were the most commonly used identifying components of frailty, and death, disability, and institutionalization were common outcomes. The prevalence of frailty ranged from 5% to 58%. Despite significant work over the past decade, a clear consensus definition of frailty does not emerge from the literature. The definition and outcomes that best suit the unique needs of the researchers, clinicians, or policy-makers conducting the screening determine the choice of a screening tool for frailty. Important areas for further research include whether disability should be considered a component or an outcome of frailty. In addition, the role of cognitive and mood elements in the frailty construct requires further clarification. J Am Geriatr Soc 59:2129–2138, 2011.

Key words: frailty; systematic review; clinical tool; operational definition

When asked to define frailty, the image of a thin, stooped, slow octogenarian quickly comes to mind. Despite an intuitive understanding by clinicians, consensus on a definition of frailty has been much slower and more difficult to reach.1 Frailty has variously been defined as physical disability, impairment in basic or instrumental activities of daily living, or simply an increased vulnerability to adverse outcomes.2 The definition that Fried et al. proposed describes a wasting syndrome, with weight loss and negative energy balance as important elements.3 Other criteria have emphasized a life course approach, taking into account mid- and early-life influences on late-life frailty.2 Cognitive and social factors are a more-recent research focus.4–7

An operational definition of frailty is important for clinical care, research, and policy planning.8–10 Fried’s definition based on data from the Cardiovascular Health Study includes three or more of weight loss, weakness, exhaustion, low activity level, and slow gait speed.3 This syndrome of frailty, with its own underlying pathophysiology, is held to be a construct distinct from disability or comorbidity. This definition has been widely used for research purposes but has so far proven impractical in the clinical setting.4 An “accumulation of deficits” model of frailty, which posits that, simply put, the more things go awry, the more likely frailty is to develop, has been described.11 This mathematical model counts disabilities and comorbidities. Although well validated and investigated, this tool is more useful for policy planners than for clinicians.12 A clinically usable definition of frailty would help physicians screen their patients for frailty and allow for stratification according to risk level before cancer treatment, coronary angiography, or surgery.13–15

Just as clinicians need a uniform definition of frailty to screen and treat their patients appropriately, so too do researchers and policy-makers. Whether exploring the etiologies and predictors of frailty, or interventions to prevent and treat frailty, researchers need a clear definition to define their study populations and measure their results.3,9,16 Similarly, policy decisions regarding the distribution of scarce resources to help frail older adults and planning for future needs of an aging society are also
dependent on a consensus definition. Studies of comprehensive geriatric assessments (CGA) that use a multidisciplinary team approach to develop a treatment plan for frail older adults have shown that “targeted” populations, namely those who are not “too well” but not “too sick,” are the most likely to benefit from this intervention. A clear operational definition of frailty would thus enable the appropriate population to be targeted for interventions such as CGA that help to preserve functional status and prevent, delay, or decrease adverse outcomes such as recurrent hospitalization, death, or change in functional status. Only articles describing original tools were included, and not subsequent validation studies using the same tool.

Articles that focused on definitions, screening criteria or severity measures of disability that did not mention frailty were not included, because the conceptualization of frailty as a syndrome that may overlap with but is distinct from disability was of interest.

**Review Process**

The review process has been described elsewhere. Briefly, the abstracts of retrieved articles were blinded in terms of author and journal. Two of the authors of the current study (SS and AMC or AWS) then independently reviewed the abstracts for relevance. For abstracts that at least one of the authors selected as relevant, the full articles were retrieved. In a subsequent step, the authors read through the full articles, blinded in terms of author, journal, and acknowledgments, and selected original studies that met the inclusion criteria. Disagreements were resolved through discussion. The references in each of the selected articles were then peered to identify additional references of potential relevance. All original studies were then retained for quality assessment and data abstraction. Pertinent editorials and review articles that emerged from the literature search were retained as background papers.

Two assessors trained in the use of the quality assessment and data abstraction tool developed for this review independently assessed the methodological quality and abstracted data from all of the selected articles. Methodological criteria included appropriateness of the study population, inclusion and exclusion criteria, outcome definition and measurement, risk factor measurement, time frame of exposures, measurement of confounders, statistical analysis, and the follow-up of control and intervention groups. Each criterion was given a rating from 1 to 4, with 1 representing the poorest and 4 representing the highest quality. Assessors also ranked the overall methodological quality of the article from 1 to 4. A consensus ranking was then determined for all individual items and for the overall rating. Two authors performed a final review to ensure that each article was relevant to the study questions.

**RESULTS**

Four thousand three hundred forty-four abstracts were reviewed, from which 144 articles were chosen for further assessment. An additional 70 articles were identified by pearlring the bibliographies of the 144 aforementioned articles and by consulting with experts, for a total of 214
articles; 166 of these were eliminated for not being considered original research or not addressing the research question. This left 48 articles for quality assessment and data abstraction, of which a further 26 were eliminated for being of poor methodological quality or for being validation studies rather than presenting original tools, leaving 22 articles as the subject of the current article (Figure 2).

Table 1 describes the characteristics of these 22 articles. With respect to quality, six articles (27%) received a score of 4, 6, 7, 11, 27–29, 11 (50%) were given a score of 3, 3, 30–39 and five (23%) scored 2, 40–44. The reported prevalence of frailty ranged from 5% to 58%.

Definitions and Screening Criteria

The identifying components, such as activities of daily living (ADLs) or weight loss, mentioned in the frailty definitions or screening tools are displayed in Figure 3A. Physical function (17, 77%), gait speed or mobility (11, 50%), and cognition (11, 50%) were the most commonly mentioned categories. ADLs and IADLs were included as identifying components of frailty more frequently in the earlier years of this review, whereas gait speed and cognition have become more common in recent years.

The outcomes that the frailty criteria or screening tool predicted in 17 of the 22 articles were categorized, as displayed in Figure 3B. Four articles that appear in Table 1 were excluded from Figure 3B because they were cross-sectional analyses and lacked outcome measures41–44 and a fifth article because it presented a clinical global impression of change over time without specific outcome measures.36 The most common outcomes of frailty were death (13, 76%), disability (7, 41%), and institutionalization (6, 35%). A grouped outcome category of overall functional decline including disability, physical performance decline, and functional decline was present in 11 (65%) of the articles. The use of disability as an outcome measure of frailty was also more common in recent studies.

Severity of Frailty

Sixteen of 22 articles (73%) presented severity measures of frailty.3, 7, 11, 27–29, 33, 35–39, 41–44 These severity measures defined participants as fit, prefrail, or frail or graded frailty using a numerical score. Inclusion of a severity measure of frailty was more common in recent studies. Two innovative analyses addressed frailty as a dynamic state over time.27, 36 One developed a clinical judgment tool to measure change in frailty over time,36 whereas the other assessed the effect of static versus dynamic frailty on physical performance and functional decline.27

DISCUSSION

The current study has presented a systematic review of articles from 1997 to 2009 addressing the clinical operational definitions, screening criteria, and severity measures of frailty. The most-common identifying factors for frailty were physical functioning, gait speed, and cognition. Outcomes most commonly examined were death, disability, and institutionalization. A recent trend toward including gait speed and cognition as components of frailty, and disability as an outcome rather than a component of frailty, was evident.

The choice of components to be included in the frailty definition continues to be a contentious issue with important implications. For example, although some authors have included disability and functional decline as a component of frailty,11, 28, 30, 33–37, 39, 40, 43 others regard disability and functional decline as an outcome.3, 27, 29, 32, 34, 37, 39 When disability is left out of the measure of frailty, a tool emerges that aims to identify risk in a population that is functionally independent.6 Designing interventions to delay the onset of frailty in this population would be analogous to primary prevention (Figure 4). Because disability has itself been shown to be an important predictor of hospitalization and death, by combining it with other markers of
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<th>Recruitment Period</th>
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<th>Source Population</th>
<th>Analytical Sample Size, n</th>
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<tbody>
<tr>
<td>Brody⁴⁰</td>
<td>2</td>
<td>1990</td>
<td>1</td>
<td>1. Age</td>
<td>Social HMO</td>
<td>5,810</td>
<td>Nursing home certifiable or home care eligible or institutionalized</td>
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<tr>
<td>Strawbridge⁵¹</td>
<td>3</td>
<td>1965</td>
<td>Cross-sectional analysis in 1994</td>
<td>Four domains: 1. Physical functioning, 2. nutritive, 3. cognitive, 4. sensory Frail defined as problems or difficulties in ≥2 domains</td>
<td>Alameda County Study</td>
<td>574</td>
<td>Quality-of-life measures: activities, life satisfaction, mental health</td>
</tr>
<tr>
<td>Chin⁵²</td>
<td>3</td>
<td>1990</td>
<td>3</td>
<td>Three definitions of frailty: Physical inactivity plus either 1. decreased energy intake, 2. 5-year weight loss, or 3. low BMI</td>
<td>Zutphen Study, Holland</td>
<td>450</td>
<td>Death Disability Physical performance decline</td>
</tr>
<tr>
<td>Rockwood⁵³</td>
<td>3</td>
<td>1991–92</td>
<td>5</td>
<td>1. Mobility 2. ADL 3. Continence 4. Cognition Scoring: 0 = independent; 1 = incontinence only; 2 = assistance with ≥1 identifying factors; 3 = dependence in ≥2 identifying factors</td>
<td>Canadian Study of Health and Aging</td>
<td>9,008</td>
<td>Death Institutionalization</td>
</tr>
<tr>
<td>Brown⁴¹</td>
<td>2</td>
<td>Not reported</td>
<td>NA</td>
<td>Modified physical performance test Score: 32 to 36 = fit; 25–32 = mildly frail; 17–24 = moderate frailty</td>
<td>Community-dwelling older adults</td>
<td>107</td>
<td>Strength Range of motion Balance Gait parameters Coordination and reaction speed Sensation</td>
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<tbody>
<tr>
<td>Fried⁵</td>
<td>3</td>
<td>Cohort 1 1989-90</td>
<td>7</td>
<td>1. Weight loss&lt;br&gt;2. Grip strength&lt;br&gt;3. Exhaustion&lt;br&gt;4. Walking time&lt;br&gt;5. Physical activity&lt;br&gt;Frail = ≥3 criteria&lt;br&gt;Prefrail = 1 or 2 criteria</td>
<td>Cardiovascular Health Study</td>
<td>5,317 in cohort 1, 4, 735 in cohort 2</td>
<td>Incident falls, hospitalization, worsening mobility or ADL function, Death</td>
</tr>
<tr>
<td>Saliba⁴⁴</td>
<td>3</td>
<td>1993</td>
<td>2</td>
<td>Four models:&lt;br&gt;Age, self-rated health, and: 1. function; 2. function and medical conditions; 3. function and expanded diagnoses; 4. self-reported diagnoses and conditions</td>
<td>Medicare Current Beneficiary annual survey respondents</td>
<td>6,205</td>
<td>Functional decline, death</td>
</tr>
<tr>
<td>Brody⁵⁰</td>
<td>3</td>
<td>1990</td>
<td>1</td>
<td>Empirical method&lt;br&gt;Clinical judgment method</td>
<td>Social HMO</td>
<td>5,810</td>
<td>Nursing home certifiable or home care eligible or institutionalized</td>
</tr>
<tr>
<td>Mitnitski¹¹</td>
<td>4</td>
<td>1991–92</td>
<td>5</td>
<td>Frailty Index constructed statistically from self-report and observed data on 20 accumulated deficits</td>
<td>The Canadian Study of Health and Aging</td>
<td>2,914</td>
<td>Mortality</td>
</tr>
<tr>
<td>Jones⁵⁵</td>
<td>3</td>
<td>NA</td>
<td>1</td>
<td>Frailty Index-CGA impairment, disability, comorbidity&lt;br&gt;Number of problems and number of comorbidities/2&lt;br&gt;Mild 0 to 7, moderate 7 to 13, severe &gt;13</td>
<td>Mobile Geriatric Assessment Team trial</td>
<td>182</td>
<td>Mortality or institutionalization</td>
</tr>
<tr>
<td>Studenski⁶⁶</td>
<td>3</td>
<td>NA</td>
<td>NA</td>
<td>Clinical Global Impression of Change in Physical Frailty&lt;br&gt;Physical frailty—strength, balance, nutrition, stamina, neuromotor, mobility&lt;br&gt;Consequences of frailty—function, healthcare utilization&lt;br&gt;Global frailty—physical and consequences</td>
<td>Six expert panel members, 46 clinicians, 24 patients, and 12 caregivers based at an academic geriatric center</td>
<td>NA</td>
<td>NA</td>
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### Table 1. (Contd.)

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</table>
| Carrière37 | 3                    | 1992–94                   | 7                           | 1. Mobility  
2. Balance  
3. Strength  
4. Visual acuity  
5. Body composition  
6. Physical activity  
7. Educational level  
8. Perceived health  
9. Fear of falling  
Score: Statistical Epidemiology of Osteoporosis Study, France | 545 | Disability |
| Klein38    | 3                    | 1998–00                   | 3.5–4.5                     | 1. Gait speed  
2. Peak expiratory flow  
3. Grip strength  
4. Not being able to stand from a sitting position in one try  
5. Visual impairment  
Score: 0 (no frailty) to 5 (maximum frailty) Beaver Dam Eye Study | 2,515 | Cardiovascular disease, hypertension, cancer Mortality |
| Puts37     | 4                    | 1992–93                   | 6 years                     | 1. Static: BMI, peak expiratory flow, MMSE, vision, hearing, incontinence, mastery, depression, low physical activity  
2. Dynamic: weight loss, decline in peak flow, decline in cognition, loss of vision or hearing, new incontinence, decline in “mastery,” activity | Longitudinal Aging Study Amsterdam | 2,430 | Decline in physical performance tests or self-reported ADL |

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<th>Outcomes</th>
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</table>
| Rockwood28                  | 4                    | 1996               | 5                          | 1. Modified MMSE  
   2. Cumulative Illness Rating Scale  
   3. History of falls  
   4. Delirium  
   5. Cognitive impairment or dementia  
   6. Functional status  
   7. Urinary incontinence  
   8. ADL  
   9. Cognitive impairment, no dementia  
  10. Mobility Score: 1 (very fit) to 7 (severely frail) | Canadian Study of Health and Aging                           | 2,305                    | Death, institutionalization                                                             |
| Rolfson43                   | 2                    | July 2000—8 weeks  | NA                         | Cross-sectional  
   1. Cognitive impairment  
   2. Balance and mobility  
   3. Mood  
   4. Functional independence  
   5. Medication use  
   6. Social support  
   7. Nutrition  
   8. Health attitudes  
   9. Confinement  
  10. Burden of medical illness  
  11. Quality of life Score: 0 to 17 (maximum frailty) | Referral population for comprehensive geriatric assessment, Canada | 158                      | NA                                                                          |
| Amici42                     | 2                    | NA                 | NA                         | Neurological, cardiac, respiratory, renal, peripheral vascular, cancer, gastrointestinal, locomotive, sensory, metabolic and nutrition, MMSE | Italians aged ≥ 65                                          | 180                      | NA                                                                          |
| Ensrud29                    | 4                    | 1992–94            | 11.9                       | 1. Weight loss  
   2. Time to get up five times from a chair  
   3. Decreased energy level Score: 0 = robust; 1 = prefrail; 2+ = frail | Study of Osteoporotic Fractures                             | 6,701                     | Death Fractures  
   Falls Disability |

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<tbody>
<tr>
<td>Ávila-Funes 7</td>
<td>4</td>
<td>1999–00</td>
<td>4</td>
<td>Fried criteria+ 1. Cognitive impairment</td>
<td>Three-City Study, France</td>
<td>6,030</td>
<td>Incident disability, hospitalization, death dementia</td>
</tr>
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ADL = activity of daily living; BMI = body mass index; HMO = health maintenance organization; MMSE = Mini Mental State Examination; NA = not addressed; CGA = comprehensive geriatric assessment.
vulnerability in assessing frailty, the level of risk in a group that has already been identified as vulnerable by virtue of their disability is being examined. Interventions in this group to prevent further deterioration in frailty status would be analogous to secondary prevention trials (Figure 4).

The strengths of this study are its rigorous design and standardized systematic review protocol, including blinded review of abstracts and quality assessments, as part of the overarching CIFA. A recent report on the clinical assessment of frailty provided a review of the literature of definitions, clinical tools, and components of frailty combined with the expert opinion of an international panel of geriatricians.45 Although it was a comprehensive review and update, it did not provide any indication of the quality of the studies reviewed. A limitation of the current study is that the search was restricted to identifying factors of frailty, by necessity leaving out the rich literature on tools to identify disability.

Consensus does not yet exist regarding the component elements of frailty. The Fried “phenotype of frailty” has enjoyed the most attention from researchers because of its underlying physiological base and easily measurable components. Nonetheless, although lauding this approach, Ferrucci admitted “our gerontological souls are still bleeding”; the definition feels incomplete.46 Responding to this challenge, recent studies have examined the Fried components and added cognition and mood to the scale.6,7 Questions regarding the relationship between frailty, aging, disability, and chronic disease require clarification.16 The role of gait speed as a powerful predictor of adverse outcomes in nondisabled older people who are years away from entering the frailty cycle is an active area of research.16,47 Focus is also shifting to the dynamic nature of frailty over time rather than assessing frailty as a static condition.36

The definition and outcomes that best suit the needs of those doing the screening determine the choice of a screening tool for frailty.10 For example, clinicians looking to streamline their office practice to target complicated patients may prefer a screening tool that is short and simple to use, predicts a decline in functional status, and is linked to quality-of-care measures for “vulnerable” elders, such as the tool proposed by Saliba.34,48 Those more interested in researching the biology of frailty may prefer a definition based on a biologically plausible model, such as the Fried tool.3 An administrator involved in planning services for older adults may turn to a tool that predicts hospital admission and avoids the debate as to how to define frailty.49 Alternatively, the administrator may choose a frailty scale that can be derived from an administrative database such as the accumulated deficits approach of Mitnitski and Rockwood.11 The pressing clinical, research, and public policy implications of a consensus definition of frailty underscore the need for further investigation into models of identifying frailty.

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Figure 3. A. Prevalence of identifying factors for frailty in definitions and screening tools. B. Prevalence of outcomes of frailty predicted by definitions and screening tools. BMI = body mass index.

Figure 4. Opportunities for prevention of frailty.
Veilleissement, Canadian Institutes of Health Research, and Gustave Levensitch Foundation.

**Author Contributions:** All authors: Conception and design of the study and acquisition of data. Sternberg, Clarfield, and Wershof Schwartz: Analysis and interpretation of data. Sternberg and Wershof Schwartz: Drafting of the article. Bergman, Clarfield, and Karunananthan: Revision of the article for important intellectual content. All authors gave final approval of the current version of the article.

**Sponsor’s Role:** The sponsors had no role in the design, methods, data collection, analysis and preparation of paper.

**REFERENCES**