

Frailty assessment and management using the frailty index: A narrative review

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Abstract

Objective: To provide a comprehensive overview of frailty assessment instruments and evaluate their clinical applicability and prognostic value across healthcare settings.

Methods: A structured literature search was conducted in PubMed/MEDLINE, Scopus, and Web of Science for studies published between January 2000 and January 2025. Keywords included “frailty,” “frailty index,” “frailty phenotype,” “Clinical Frailty Scale,” “electronic frailty index,” and related terms. Peer-reviewed studies evaluating frailty measurement tools and their associations with clinical outcomes in adult populations were included. Titles and abstracts were screened for relevance, followed by full-text review. Due to heterogeneity in study designs and outcome measures, findings were synthesized narratively.

Results: Frailty is operationalized using multiple conceptual models, primarily the phenotype-based approach and the cumulative deficit model. Additional instruments, including clinical bedside scales and claims- or electronic health record-based indices, have been developed to enhance feasibility and scalability. Across diverse populations and clinical settings, frailty consistently predicts adverse outcomes, including mortality, hospitalization, postoperative complications, prolonged length of stay, and healthcare expenditures. However, substantial heterogeneity exists in definitions, thresholds, and implementation strategies, limiting direct comparability across studies. No single instrument demonstrates universal superiority across all contexts.

Conclusion: Frailty assessment is a robust predictor of adverse clinical outcomes and represents an important tool for risk stratification. Nevertheless, variability in measurement approaches underscores the need for methodological standardization and prospective validation. Future research should determine whether frailty-guided interventions can translate prognostic identification into improved patient outcomes.

Key words: Frailty, frailty index, frailty phenotype, Clinical Frailty Scale, sarcopenia, cardiovascular-kidney-metabolic syndrome

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Abbreviations:

CHARLS - China Health and Retirement Longitudinal Study

CKD - chronic kidney disease

CKM – Cardiovascular-kidney-metabolic syndrome

CVD - cardiovascular disease

FI - Frailty Index

FP - Frailty Phenotype

Highlights

- **Frailty is a multidimensional geriatric syndrome that affects physical, cognitive, and psychological functions**
- **Frailty assessment improves risk stratification and prognostic evaluation**
- **However, it should not guide yet individualized clinical decisions until validated and evidence-based interventions established**

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Graphical abstract



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Frailty assessment and management using the frailty index: A narrative review



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Frailty = multidimensional geriatric syndrome

↓ Physical reserve. ↓ Cognitive reserve. ↓ Physiological reserve. ↑ Vulnerability to stress in adults.

Domains affected: Physical, Cognitive, Psychological, Social.

Frailty and CKM Syndrome: Frailty is closely linked to **interconnected organ systems:**

Cardiovascular disease (CVD), Chronic kidney disease (CKD), Metabolic dysfunction.

👉 Frailty both contributes to and results from CKM syndrome.

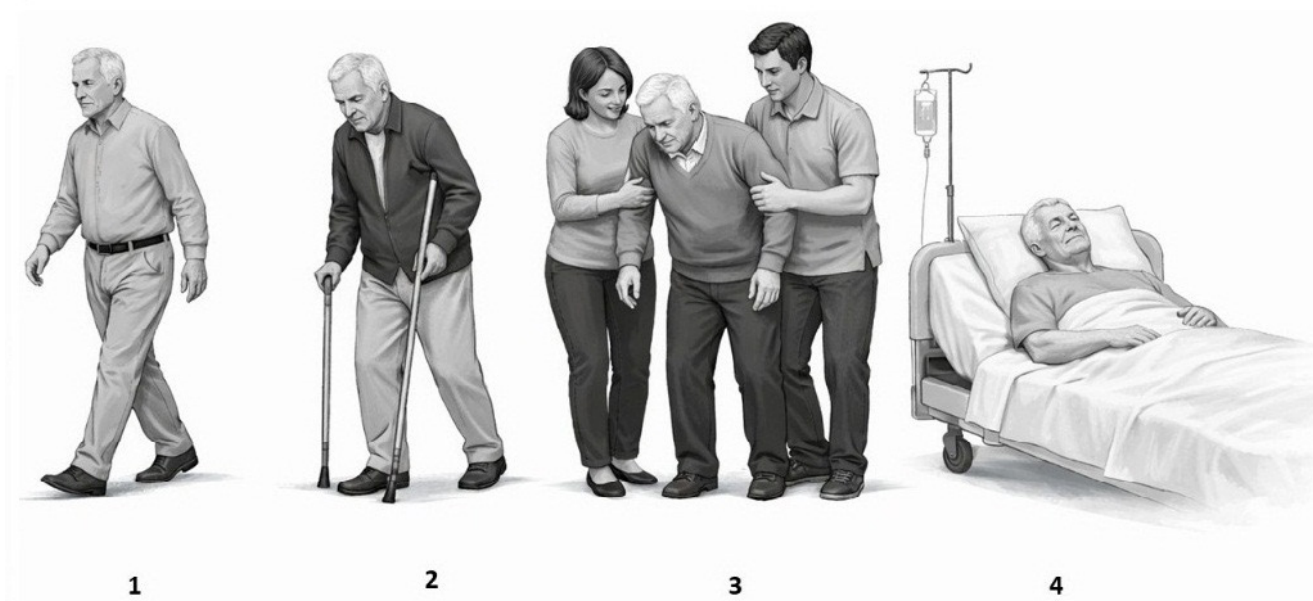
Frailty Assessment Tools: **1** **Frailty Index (FI).** Deficit accumulation model: 30 health deficits. $FI = \text{deficits} \div 30$.

Score range: **0–1**. **Domains included:** Cognitive & mental function; Chronic medical conditions; Mobility & physical performance; Sensory & communication abilities; Functional independence; Nutrition & weight loss. **Severity (30-item FI): 0–7:** Mild frailty; **8–14:** Moderate frailty; **≥15:** Severe frailty.

2 **Frailty Phenotype (Fried):** Based on five clinical criteria: Weakness, Slowness, Low physical activity, Exhaustion, Unintentional weight loss, **≥3 criteria → Frail.**

TAKE-HOME MESSAGE: Frailty assessment improves **risk stratification and prognostic evaluation.**

but should **not yet guide individualized clinical decisions** until **validated, evidence-based interventions** are established.



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Introduction Definition

Frailty is a complex, multidimensional condition characterized by increased vulnerability to stressors due to cumulative declines across multiple physiological systems. It is most

commonly observed in older adults and can manifest in physical, cognitive, social, and psychological domains (1, 2).

While these types of frailty may or may not coexist, they collectively contribute to an individual's overall frailty status. In recent years, researchers have developed integrated

conceptual models to capture frailty's multifactorial nature better, acknowledging that frailty is not solely a consequence of aging but rather the result of dynamic interactions among various systems (3, 9-62).

Prevalence: Prevalence varies by operational definition and age-

- 7% prevalence (3, 9),
- 25% prevalence reported by (4-5, 21, 22),
- 10-25% prevalence in individuals over 65 years old,
- 30-45% prevalence in individuals over 85 years old,
- 33% prevalence among in-hospital admissions (24).

Methods

A structured literature search was conducted in PubMed/MEDLINE, Scopus, and Web of Science to identify relevant studies on frailty measurement, frailty indices, and their clinical applications. The search covered publications from January 2000 to January 2025 (9-62).

Inclusion Criteria

Studies were included if they:

- Were published in peer-reviewed journals,
- Involved human adults (≥ 60 years),
- Evaluated frailty assessment tools,
- Examined clinical outcomes (mortality, hospitalization, surgery, costs),
- Were written in English.

Studies were excluded if they:

- Were conference abstracts without full text,
- Focused exclusively on pediatric populations,
- Were animal or laboratory-only studies.

Study Selection

Titles and abstracts were screened for relevance. Full-text articles were reviewed for eligibility based on the inclusion and exclusion criteria.

- Data Synthesis
- Given the heterogeneity of frailty instruments and study designs, findings were synthesized narratively rather than through meta-analysis.

Conceptual models of frailty (Phenotype vs. deficit accumulation)

The frailty phenotype model introduced by Linda Fried (9) conceptualizes frailty as a biological syndrome characterized by measurable physical components. It has strong predictive validity for mortality and disability.

The cumulative deficit model developed by Kenneth Rockwood (21, 22) operationalizes frailty as the proportion of accumulated health deficits. It demonstrates graded risk prediction across multiple outcomes and settings.

Both models:

- Predict mortality
- Predict hospitalization
- Demonstrate reproducibility across populations

Critical Appraisal

- The phenotype model may oversimplify frailty by emphasizing physical domains while underrepresenting cognitive and psychosocial dimensions.
- The deficit accumulation model is statistically robust but may lack biological specificity.
- Operational thresholds differ across studies, affecting prevalence estimates.

Knowledge Gaps

- Lack of consensus on a unifying biological framework.
- Limited mechanistic studies linking frailty indices to molecular pathways.
- Unclear whether one model performs superiorly in specific subspecialties (e.g., cardiology vs oncology).

Cardiovascular-kidney-metabolic syndrome (CKM)-related evidence: Outcome and risk studies

Evidence from Cardiovascular Outcome Studies: A growing body of observational and longitudinal studies demonstrates that frailty is independently associated with adverse cardiovascular outcomes across populations with metabolic dysfunction, early chronic kidney disease (CKD), and subclinical cardiovascular disease (CVD)—key components of CKM stages 1–3. In community-based cohorts, frailty and prefrailty have been linked to increased incidence of major adverse cardiovascular events, including myocardial infarction, stroke, heart failure hospitalization, and cardiovascular mortality, even after adjustment for traditional cardiometabolic risk factors such as hypertension, diabetes, and dyslipidemia (6,10,16–19).

- Importantly, several studies suggest that the prognostic impact of frailty is evident prior to overt cardiovascular disease, aligning with early CKM stages. In populations with metabolic syndrome or insulin resistance but no established CVD, frailty has been associated with accelerated progression to clinical cardiovascular endpoints, indicating that frailty may function as an early vulnerability marker rather than merely a consequence of advanced disease (17, 20, 21). Similarly, among individuals with mild to moderate CKD (stages 1–3), frailty has been shown to predict cardiovascular events and mortality independent of estimated glomerular filtration rate and albuminuria, underscoring its added prognostic value beyond traditional kidney measures (9, 22–24).

- Emerging evidence also suggests that frailty progression, rather than baseline frailty status alone, may be particularly relevant to cardiovascular outcomes. Longitudinal analyses have demonstrated that worsening frailty trajectories are associated with higher rates of incident CVD and heart failure, whereas frailty stability or improvement is linked to more favorable outcomes (18, 25).

These findings are especially pertinent within the CKM framework, where early identification of accelerating vulnerability could enable earlier preventive intervention.

Evidence from risk and prognostic studies

- Beyond hard cardiovascular endpoints, numerous studies have examined frailty as a predictor of cardiometabolic and renal risk states that precede overt CVD. Frailty has been associated with higher prevalence and incidence of hypertension, type 2 diabetes, central obesity, systemic inflammation, and insulin resistance—core drivers of CKM stage 1 and 2 progression (6,11,16,26). These associations persist even in younger and middle-aged populations, suggesting that frailty-related vulnerability is not confined to advanced age.

- Risk modeling studies indicate that frailty measures improve cardiovascular risk prediction when added to conventional risk scores, particularly in individuals with early CKD or metabolic dysfunction but without established CVD (10, 23). In CKD stage 1–3 populations, frailty has been linked to faster decline in kidney function, increased albuminuria, and heightened vascular stiffness, all of which contribute to elevated cardiovascular risk within the CKM continuum (9, 22, 27).

- Importantly, frailty appears to capture nontraditional risk pathways—including sarcopenia, autonomic dysfunction, chronic inflammation, and impaired stress response—that are not fully reflected in standard cardiometabolic biomarkers. This may explain why frailty is consistently associated with adverse outcomes even after extensive multivariable adjustment (6, 9, 10). Within early CKM stages, these subclinical mechanisms may represent a critical window during which frailty progression amplifies cardiovascular vulnerability before irreversible organ damage occurs.

Implications for early CKM stages (1–3)

Taken together, outcome and risk studies support the concept that frailty is both a marker and mediator of cardiovascular risk within the early phases of CKM syndrome. While much of the existing literature has focused on older adults or advanced disease states, accumulating evidence indicates that frailty-related risk emerges earlier in the CKM trajectory and may accelerate transitions from metabolic and renal dysfunction to overt cardiovascular disease.

- However, significant gaps remain. Most studies rely on single-time-point frailty assessments, limiting insight into how frailty progression or improvement modifies cardiovascular risk over time in CKM stages 1–3. Additionally, heterogeneity in frailty definitions and limited CKM-specific stratification complicate direct comparisons across studies. Addressing these gaps is

essential to clarify the prognostic role of frailty dynamics and to inform risk-stratification strategies in early CKM populations.

Sarcopenia overview

Sarcopenia is a progressive, age-related condition characterized by declines in skeletal muscle mass, muscular strength, and physical performance. Beginning in early adulthood, skeletal muscle mass decreases gradually at an estimated rate of several percent per decade, with the pace of decline accelerating after the sixth decade of life. When sarcopenia coexists with excess adiposity, the condition is often described as “fat-frail,” reflecting the combined burden of reduced muscle function and increased metabolic risk.

Clinically, sarcopenia contributes substantially to functional impairment, loss of independence, increased fall risk, and delayed recovery following acute or chronic illness.

Population-based estimates suggest that a significant proportion of adults aged 65 years and older are affected, underscoring its relevance as a public health concern. In addition to its clinical consequences, sarcopenia imposes a considerable economic burden on healthcare systems, with costs projected to rise in parallel with population aging.

Assessment of sarcopenia frequently relies on imaging-based measures of body composition, such as dual-energy X-ray absorptiometry, in conjunction with indices like the relative skeletal muscle index. Given the modifiable nature of muscle mass and function, effective management often requires interdisciplinary approaches that integrate nutritional optimization and structured physical activity interventions.

Assessment of Frailty

Frailty was quantified using the Frailty Index (FI), an established measure based on the cumulative accumulation of health deficits. This approach, originally developed by Rockwood and colleagues (21, 22), conceptualizes frailty as a continuum reflecting the proportion of age-related deficits present within an individual (2, 7). Subsequent studies have refined and validated this methodology across diverse populations (7, 8).

In the present analysis, the FI was constructed using 30 variables derived from the China Health and Retirement Longitudinal Study (CHARLS). These variables encompassed multiple health domains, including chronic conditions (excluding stroke and heart disease), functional limitations, physical performance, psychological symptoms, and cognitive status. Most items were coded dichotomously to indicate the presence or absence of a deficit, while cognitive function was represented as a graded variable ranging from 0 to 1.

The overall FI score was calculated by dividing the number of identified deficits by the total number of items, producing a continuous value between 0 and 1, with higher scores indicating greater frailty. Changes in frailty over time were evaluated using FI measurements obtained across successive follow-up waves. Based on established thresholds, participants were categorized as robust, pre-frail, or frail (2, 4, 7, 10).

30-Item Frailty Index checklist

The 30-item Frailty Index checklist assesses a broad range of health domains, including cognitive function, chronic medical conditions, mobility, sensory function, functional independence, and nutrition. Each item is scored as 0 (not present) or 1 (present), consistent with the deficit accumulation approach (2, 7). The total number of deficits accumulated by an individual determines their frailty score, with higher scores indicating greater frailty (2).

1. Cognitive & Mental Function
 1. Memory problems
 2. Difficulty concentrating
 3. Depression or low mood
 4. Anxiety or nervousness
 5. Diagnosed dementia or cognitive impairment
2. Chronic Medical Conditions
 6. History of myocardial infarction (heart attack)
 7. Congestive heart failure
 8. Diabetes mellitus
 9. Hypertension
 10. Chronic kidney disease or renal insufficiency
 11. Chronic obstructive pulmonary disease (COPD) or asthma
 12. Stroke or transient ischemic attack (TIA)
 13. Peripheral vascular disease
 14. Osteoporosis
 15. Cancer (active or history of)
3. Mobility & Physical Performance
 16. Difficulty walking (even with aid)
 17. Frequent falls (≥ 2 in past year)
 18. Use of walking aid (e.g., cane, walker)
 19. Difficulty rising from a chair or bed
 20. Slow gait speed (clinically assessed or perceived)
 21. Decreased grip strength or weakness
4. Sensory & Communication
 22. Uncorrected visual impairment
 23. Uncorrected hearing impairment
 24. Difficulty communicating (speech or comprehension)
5. Functional Independence
 25. Difficulty bathing
 26. Difficulty dressing
 27. Difficulty eating or feeding oneself
 28. Difficulty with toileting
 29. Difficulty managing medications or finances
6. General Health & Nutrition
 30. Unintentional weight loss ($>5\%$ in 6–12 months)

Scoring and interpretation (Table 1)

Table 1. Scoring and Interpretation of frailty index		
Total Deficits	Frailty Grade	Interpretation
0–7	Grade 1 – Mild	Mild frailty
8–14	Grade 2 – Moderate	Moderate frailty
≥ 15	Grade 3 – Severe	Severe frailty

Alternative assessment: Frailty Phenotype

An alternative to the Frailty Index, and one that is widely used in clinical and research settings, is the Frailty Phenotype (FP) introduced by Fried and colleagues (9). This model defines frailty as a distinct clinical syndrome diagnosed based on the presence of at least three of the following five criteria:

1. Weakness (measured by low grip strength)
2. Slowness (measured by slow walking speed)
3. Low physical activity level
4. Self-reported exhaustion
5. Unintentional weight loss

Individuals who meet one or two criteria are categorized as pre-frail, while those meeting three or more are classified as frail. This phenotype is particularly useful for identifying frailty in its early stages, with a primary focus on physical and functional health (1-3).

Scoring and interpretation

Frailty severity is commonly categorized based on the number of deficits present, allowing for stratification into mild, moderate, and severe frailty states (13, 14, 18-30). The Frailty Index score is calculated by dividing the total number of deficits by the number of items assessed, yielding a continuous value ranging from 0 (no frailty) to 1 (maximum frailty) (11). This quantitative approach provides a robust estimate of frailty severity and has been shown to correlate strongly with adverse outcomes, including mortality and hospitalization (2, 9).

Figure 1 illustrates the stages of frailty progression in older adults:

1. Independent walking (Fit)– low prevalence, low risk of adverse outcomes.
2. Cane-assisted walking (pre-Frailty)– Stage 2 (cane-assisted walking) was observed in 35% of the cohort, with a hazard ratio for mortality of 1.5 (95% CI: 1.2–1.8).
3. Caregiver support (Frailty)– high prevalence; high risk for hospitalization and mortality.
4. Bedridden / hospitalized (End-stage Frailty) – low prevalence; very high risk of adverse outcomes.



Figure 1. Diagram expressing grades of frailty
(prepared by AI)

The primary objective is to strengthen physiological reserve to enhance resilience, reduce susceptibility to stressors, and support recovery from physiological injury. Preventing or minimizing exposure to stressors is also essential. In individuals who are not frail, clinical management should focus on building physiological reserve through healthy lifestyle behaviors, effective control of chronic conditions, and appropriate preventive healthcare strategies.

Clinical Frailty Scale (22)

1. Very fit: Individuals who are robust, highly active, energetic, and motivated.
3. Managing well: Individuals with well-controlled medical conditions who may experience occasional symptoms and are generally not physically active beyond routine walking.
4. Living with very mild frailty: Represents the early shift away from full independence. Although individuals do not

- require daily assistance, symptoms often restrict activity levels.
5. Living with mild frailty: Characterized by noticeable slowing and the need for help with complex instrumental activities of daily living, such as financial management, transportation, and heavy household work.
6. Living with moderate frailty: Individuals require assistance with activities outside the home and with household responsibilities.
7. Living with severe frailty: Individuals are fully dependent on others for personal care due to physical or cognitive impairment.
8. Living with very severe frailty: Individuals are completely dependent for personal care and are typically nearing the end of life.
9. Terminally ill: Individuals with a life-limiting illness who are approaching the end of life.
10. Frailty Assessment in Individuals with Dementia (21).

The severity of frailty generally parallels the progression of dementia. In mild dementia, individuals may forget recent information while retaining awareness of the event itself, frequently repeat questions or stories, and exhibit reduced social engagement. Moderate dementia is characterized by marked impairment in recent memory, with relatively preserved recall of long-term autobiographical events. In severe dementia, individuals are unable to perform personal care activities independently. Those with very severe dementia are often bedridden and require complete assistance with all activities of daily living.

Feature	Frailty Index (FI)	Frailty Phenotype (FP)
Conceptual model	Deficit accumulation model	Biological/physical phenotype model
Original developers	Rockwood et al.	Fried et al.
Core principle	Frailty reflects the cumulative burden of health deficits	Frailty is a clinical syndrome characterized by specific physical features
Number of components	Variable (typically 30–70 deficits)	Fixed (5 criteria)
Components included	Symptoms, signs, diseases, disabilities, cognitive impairment, and laboratory abnormalities	Unintentional weight loss, exhaustion, weakness (grip strength), slowness (walking speed), low physical activity
Scoring method	Ratio of deficits present to total deficits assessed (score 0–1)	Categorical: robust (0), pre-frail (1–2), frail (≥3)
Frailty severity	Continuous scale allowing gradation of frailty severity	Ordinal categories only
Focus	Multidimensional (physical, cognitive, functional, comorbidities)	Primarily physical frailty
Ease of use	More time-consuming; requires comprehensive data	Simpler and faster to apply
Reproducibility across settings	May vary depending on the deficits included	Highly standardized
Sensitivity to change over time	High	Moderate

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Continued from page 60		
Predictive value	Strong predictor of mortality, hospitalization, and institutionalization	Strong predictor of disability, falls, and mortality
Use in population studies	Widely used	Widely used
Use in individual clinical decision-making	Informative but complex; not practical for routine bedside use alone	More feasible clinically but limited in scope
Main limitations	Complexity, lack of standardization in deficit selection	A narrow focus may miss cognitive and psychosocial frailty
Best application	Research, epidemiology, and comprehensive geriatric assessment	Clinical screening, physical frailty identification

The Edmonton Frail Scale

(The Edmonton Frail Scale (EFS) (30) is a brief, validated screening tool used to assess frailty in older adults, especially in clinical and preoperative settings. It is practical, easy to administer, and does not require specialized geriatric training.

Overview

- Developed at: University of Alberta
- Primary use: Identify frailty in older adults (typically age 65+)
- Administration time: ~5 minutes
- Who can administer it: Any trained healthcare provider (nurse, physician, allied health professional).

Domains Assessed (9 total)

The EFS evaluates multiple dimensions of health:

1. Cognition (clock-drawing test)
2. General health status
3. Functional independence
4. Social support
5. Medication use
6. Nutrition
7. Mood
8. Continence
9. Functional performance (Timed Up and Go test)

Scoring

- Score range: 0–17
- Higher scores indicate greater frailty.

Score	interpretation
0–4	Not frail
5–6	Apparently vulnerable
7–8	Mild frailty
9–10	Moderate frailty
11–17	Severe frailty

Strengths

- Multidimensional (not just physical frailty)
- Quick and practical
- Validated in acute care and surgical populations

- Includes objective (performance-based) and subjective components

Limitations

- Screening tool — not a comprehensive geriatric assessment
- May require patient participation (less suitable in severe cognitive impairment)
- Some subjectivity in self-reported domains

Management of frailty

Principles of frailty management are as follows:

1. Identification and management of reversible contributors to frailty

- Evaluate and treat acute illnesses, anemia, depression, infections, pain, sensory deficits, and endocrine disorders.

2. Encouragement of physical activity and exercise

- Promote regular aerobic, resistance, balance, and flexibility training to maintain strength, mobility, and reduce fall risk.

3. Nutritional evaluation and support

- Provide dietary counseling
- Ensure sufficient protein and caloric intake
- Supplement vitamins and minerals when clinically indicated (e.g., vitamin D, calcium, vitamin B12)

4. Rehabilitation interventions

- Utilize physical, occupational, and speech therapy as needed
- Emphasize functional independence and quality of life

5. Comprehensive medication assessment

- Identify and reduce polypharmacy
- Avoid potentially inappropriate medications
- Adjust dosages based on renal and hepatic function
- Simplify treatment regimens to enhance adherence

6. Preventive healthcare measures

- Administer recommended vaccinations (e.g., influenza, pneumococcal, herpes zoster, COVID-19)

- Implement fall prevention strategies, including assistive devices when necessary
- Screen for and manage osteoporosis

7. Cancer screening

- Tailor screening decisions to life expectancy, functional status, comorbidities, and patient preferences

8. Psychosocial and cognitive support

- Screen for depression, delirium, and dementia
- Address social support needs, caregiver stress, and risks of elder abuse

9. Advance care planning

- Discuss goals of care, advance directives, and end-of-life wishes.

Discussion

This review specifically examined the two most established and methodologically robust approaches to frailty assessment: the Frailty Index and the Frailty Phenotype. These models represent the dominant conceptual frameworks underpinning contemporary frailty research and clinical application (32-62).

The FP defines frailty as a clinical syndrome characterized by measurable physical criteria reflecting diminished physiologic reserve. In contrast, the FI conceptualizes frailty as the cumulative accumulation of health deficits across multiple domains, generating a continuous risk score.

Although derived from different theoretical perspectives, both models converge on the same fundamental principle: frailty represents increased biological vulnerability to stressors.

The literature consistently demonstrates that both FI and FP independently predict mortality, hospitalization, postoperative complications, disability, and healthcare utilization across diverse populations. The apparent differences between the two instruments are methodological rather than conceptual. The FP offers simplicity, biological clarity, and suitability for clinical screening and interventional research. The FI provides graded risk stratification and multidimensional depth, making it particularly valuable for prognostic modeling and population-based analyses.

Our analysis clarifies that the ongoing debate in the literature does not reflect uncertainty about the existence or validity of frailty as a construct, but rather differences in operational emphasis between these two complementary models. When appropriately applied according to clinical or research objectives, both FI and FP provide coherent and reliable quantification of frailty.

Conclusions

Frailty is a definable, measurable, and clinically meaningful state of vulnerability. The Frailty Index and the Frailty Phenotype constitute the two principal and evidence-based frameworks for its assessment. Rather than representing competing

definitions, these models provide complementary approaches to measuring the same multidimensional construct. The FP is particularly suited to bedside clinical identification of frailty as a syndrome, whereas the FI enables refined risk stratification across broader healthcare settings.

This review establishes a structured interpretation of frailty assessment, explicitly grounded in these two validated models. Selection between FI and FP should therefore be guided by context and intended application, ensuring methodological alignment with clinical or research goals.

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Conflict of interest: None to declare

Authorship: S.R. wrote the paper, revised the grammar and plagiarism, added references, and submitted the paper; M.S. revised the paper and improved the data; A.S. revised the paper and improved the data; M.S.E. revised the paper and improved the data. All authors approved revised version for publication, thus equally contributed to preparation of the manuscript and fulfilled all authorship criteria

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