# Measuring frailty in heart failure: A community perspective

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**Background** Frailty, an important prognostic indicator in heart failure (HF), may be defined as a biological phenotype or an accumulation of deficits. Each method has strengths and limitations, but their utility has never been evaluated in the same community HF cohort.

**Methods** Southeastern Minnesota residents with HF were recruited from 2007 to 2011. Frailty according to the biological phenotype was defined as 3 or more of: weak grip strength, physical exhaustion, slowness, low activity and unintentional weight loss >10 lb in 1 year. Intermediate frailty was defined as 1 to 2. The deficit index was defined as the proportion of deficits present out of 32 deficits.

**Results** Among 223 patients (mean age 71 ± 14, 61% male), 21% were frail and 48% intermediate frail according to the biological phenotype. The deficit index ranged from 0.02-0.75, with a mean (SD) of 0.25 (0.13). Over a mean follow-up of 2.4 years, 63 patients died. After adjustment for age, sex and ejection fraction, patients categorized as frail by the biological phenotype had a 2-fold increased risk of death compared to those with no frailty, whereas a 0.1 unit increase in the deficit index was associated with a 44% increased risk of death. Both measures predicted death equally (C-statistics: 0.687 for biological phenotype and 0.700 for deficit index).

**Conclusion** The deficit index and the biological phenotype equally predict mortality. As the biological phenotype is not routinely assessed clinically, the deficit index, which can be ascertained from medical records, is a feasible alternative to ascertain frailty. (Am Heart J 2013;166:768-74.)

Frailty is increasingly recognized as an important prognostic indicator in heart failure (HF).[1-3] Frailty is more prevalent in HF than the general population[1,4,5] and increases the risk of death and hospitalizations.[1-3] However, methods to measure frailty vary widely throughout the literature.[6-14] Some have conceptualized frailty as a biologic syndrome, characterized by a decline in overall function and loss of resistance to stressors.[7] This biological frailty phenotype, referred to herein as the biological phenotype, is comprised of five physical indicators including low physical activity, weak grip strength, slow walking speed, exhaustion and unintentional weight loss. Alternatively, Rockwood and colleagues have defined frailty as the accumulation of deficits (impairments, disabilities and diseases).[8,15] Under this definition, frailty is measured by an index, termed the deficit index, which quantifies the cumulative burden of deficits.[8]

The biological phenotype has been shown to adversely impact outcomes.[7,16-19] However, despite its recognized prognostic value, it is not routinely assessed in clinical practice and cannot be obtained by review of the medical records. Conversely, the deficit index, which is also associated with adverse outcomes,[15,20] can be abstracted from the medical record and may be more feasible to ascertain frailty in large cohorts.

While each approach has conceptual strengths and limitations, few studies have evaluated them in the same cohort[11,15,20-22] and to the best of our knowledge, these two methods have never been evaluated in the same community-based HF cohort. Thus, we aimed to evaluate how the biological phenotype and the deficit index predict mortality in a community cohort of HF patients.

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# Methods

## Study setting

This study was conducted in southeastern Minnesota, an area relatively isolated from other urban centers. Thus, as previously described, only a few providers deliver nearly all health care to the local residents.[23] The medical records from each provider are indexed via the Rochester Epidemiology Project, resulting in the linkage of records from nearly all sources of care.[23]

## Identification of patients

Our HF case identification methods have been previously described.[24-26] In brief, patients residing in Olmsted, Dodge, and Fillmore County, Minnesota, with potential HF were identified by natural language processing of the electronic health record. The complete records of potential cases were reviewed to verify the HF diagnosis using the Framingham criteria.[27] We enrolled incident and prevalent HF cases, systolic and diastolic HF as well as inpatients and outpatients, capturing the complete spectrum of HF. Patients with HF were contacted about study participation. After consent, patients completed questionnaires and a hand grip test administered by a registered nurse at a median (25th-75th percentile) of 41 (26-58) days post the index HF date. All aspects of the study were approved by the appropriate institutional review boards.

## Biological phenotype

As described previously,[28] the biological frailty phenotype was ascertained using a modified version of the definition used in the Cardiovascular Health Study.[7] Patients were classified as frail if they met three or more of the following criteria: weak grip strength, physical exhaustion, slowness, low physical activity and unintentional weight loss. Intermediate frailty was defined as meeting one or two criteria.

Grip strength was measured using a Jamar dynamometer (kg) and was considered weak if the average of three tests was in the lowest 20% of the sex and body mass index (BMI)-adjusted community dwelling older adults.[7] Physical exhaustion was assessed with a question from the Patient Health Questionnaire (PHQ-9)[29]: "Over the past 2 weeks have you been bothered by feeling tired or having little energy?" Patients who answered "more than half the days" or "nearly every day" were classified as experiencing physical exhaustion.

The physical component score of the Short Form 12 (SF-12)[30] was used as an indicator of slowness and low physical activity, as was done in previous studies.[18,31] All study participants completed the SF-12, which includes a validated physical component scale.[30] The SF-12 physical component score ranges from 0 to 100 and higher scores indicate better physical health. A physical component score of 25 or less was used as an indicator of both low physical activity and slow walking speed. Unintentional weight loss was assessed with the following question: "In the past year, have you lost any weight unintentionally (without trying)?" A response of "10 pounds or more" was classified as unintentional weight loss.

## Deficit index

The deficit index was based on 32 deficits obtained from the medical record and defined as the proportion of deficits present for each patient (Table I). For example, if a patient exhibited 5 out of the 32 possible deficits, the frailty index for that patient would be 5/32 or 0.16. If a patient was missing less than 3 items, the patient was retained in the study and their denominator was adjusted accordingly. For example, the denominator for a patient that was missing 2 deficits would be 30. If that patient had 5 deficits, their index would be calculated as 5/30 or 0.17.

The first 14 items (activity of daily living questions) on the deficit index were collected from a patient-provided

**Table I.** Frailty definitions

| **Biological frailty phenotype** | |
|---|---|
| Unintentional weight loss >10 lb in 1 year | Self-reported |
| Physical exhaustion | Self-reported from Patient Health Questionnaire (PHQ-9) |
| Weak grip strength | Predefined cut-points |
| Slowness | Short Form 12 physical function score ≤25 |
| Weakness | Short Form 12 physical function score ≤25 |

| **Deficit Index** | **Cut-points** |
|---|---|
| 1. Need help preparing meals | Yes = 1, No = 0 |
| 2. Need help feeding yourself | Yes = 1, No = 0 |
| 3. Need help dressing yourself | Yes = 1, No = 0 |
| 4. Need help using the toilet | Yes = 1, No = 0 |
| 5. Need help with housekeeping | Yes = 1, No = 0 |
| 6. Need help climbing stairs | Yes = 1, No = 0 |
| 7. Need help bathing | Yes = 1, No = 0 |
| 8. Need help walking | Yes = 1, No = 0 |
| 9. Need help using transportation | Yes = 1, No = 0 |
| 10. Need help getting in and out of bed | Yes = 1, No = 0 |
| 11. Need help managing medications | Yes = 1, No = 0 |
| 12. Depend on assistive devices (walker, cane, etc) or other people to perform activities of daily life | Yes = 1, No = 0 |
| 13. Dependent on a device for normal breathing | Yes = 1, No = 0 |
| 14. Climb 2 flights of stairs without rest | No, can't do at all = 1<br>Yes, with difficulty = 0.5<br>Yes with no difficulty = 0 |
| 15. Myocardial infarction | Yes = 1, No = 0 |
| 16. Diabetes | Yes = 1, No = 0 |
| 17. Peripheral vascular disease | Yes = 1, No = 0 |
| 18. Cerebrovascular disease | Yes = 1, No = 0 |
| 19. Dementia | Yes = 1, No = 0 |
| 20. Chronic obstructive pulmonary disease | Yes = 1, No = 0 |
| 21. Peptic ulcer | Yes = 1, No = 0 |
| 22. Hemiplegia/paraplegia | Yes = 1, No = 0 |
| 23. Renal disease | Yes = 1, No = 0 |
| 24. Moderate/severe liver disease | Yes = 1, No = 0 |
| 25. Any malignancy | Yes = 1, No = 0 |
| 26. Metastatic solid tumor | Yes = 1, No = 0 |
| 27. Rheumatologic disease | Yes = 1, No = 0 |
| 28. Hypertension | Yes = 1, No = 0 |
| 29. Hyperlipidemia | Yes = 1, No = 0 |
| 30. Body mass index | Underweight or obese = 1,<br>overweight = 0.5<br>normal = 0 |
| 31. Depression | Yes = 1, No = 0 |
| 32. Anemia | Yes = 1, No = 0 |