Which frailty tool best predicts morbidity and mortality in ambulatory patients with heart failure? A prospective study.

Short Title: Prognostic value of frailty tools in heart failure

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Abbreviations: CHF = chronic heart failure, LVEF = left ventricular ejection fraction, NT-proBNP = N-terminal pro B-type natriuretic peptide, HFrEF= heart failure with reduced ejection fraction, HFnEF = heart failure with normal ejection fraction, DFI = Derby frailty index, AFN = the acute frailty network criteria, CFS = clinical frailty scale, EFS = Edmonton frailty scale, DI = the deficit index

Abstract:

Background:

Frailty is common in patients with heart failure (HF) and is associated with adverse outcome, but it is uncertain how frailty should best be measured.

Objectives:

To compare the prognostic value of commonly-used frailty tools in ambulatory patients with HF.

Methods:

We assessed, simultaneously, 3 screening tools (clinical frailty scale (CFS); Derby frailty index (DFI); acute frailty network (AFN) frailty criteria), 3 assessment tools (Fried criteria; Edmonton frailty score (EFS); deficit index (DI)) and 3 physical tests (handgrip strength, timed get-up-and-go test (TUGT), five-metre walk test (5MWT)) in consecutive patients with HF attending a routine follow-up visit.

Results:

467 patients (67% male, median age=76 years, median NT-proBNP=1156 ng/L) were enrolled. During a median follow-up of 554 days, 82 (18%) patients died and 201 (43%) patients were either hospitalised or died.

In models corrected for age, Charlson score, haemoglobin, renal function, sodium, NYHA, atrial fibrillation (AF) and body mass index, only log[NT-proBNP] and frailty were independently associated with all-cause death and/or hospitalisation.

A base model for predicting mortality at 1 year including NYHA, log[NT-proBNP], sodium and AF, had a C-statistic=0.75. Amongst screening tools: CFS (C-statistic=0.84); amongst assessment tools: DI (C-statistic=0.83) and amongst physical test: 5MWT (C-statistic=0.80), increased model performance most compared to base model ($p<0.05$ for all).

Conclusion:

Frailty is strongly associated with adverse outcomes in ambulatory patients with HF. When added to a base model for predicting mortality at 1 year including NYHA, NT-proBNP, sodium and AF, CFS provides comparable prognostic information to assessment tools taking longer to perform.

(250 words)

Introduction:

Heart failure (HF) is increasingly common. It is a leading cause of hospitalisation associated with poor outcome and high medical costs. [1,2] Frailty is a state of vulnerability to stressors due to accumulation of health deficits across different physiological systems. [3] There is particular interest in the relationship between frailty and HF for several reasons. First, up to 70% of patients with HF fulfil diagnostic criteria for frailty. [4] This has important consequences for morbidity and mortality. [5] The presence of HF may also accelerate the development of frailty. [6] Secondly, both HF and frailty are associated with aging and share common pathophysiological mechanisms such as chronic inflammation, hormonal and catabolic:anabolic imbalance and muscle dysfunction, resulting in poor physical functioning and a vicious cycle of decline.[7] Frailty may also be an "effect modifier", negatively impacting on the risk-benefit profile of both pharmacological and non-pharmacological interventions for HF, including device implantation, hence becoming a barrier to their use.[8,9]

Despite an increasing awareness of frailty in patients with HF, there is no consensus on how frailty should be measured. Many frailty tools have been proposed, [10] and each has its own advantages and disadvantages. Screening tools are easy to use and might be more suitable in a busy clinical setting. Assessment tools are time-consuming, but might give a more comprehensive frailty evaluation. Physical tests also require a large amount of time and resources, and might be challenging to perform in patients with reduced mobility. There is variability is the use of frailty tools among studies and confusion as to which tool is best to use in a specific population. Whether different tools have different prognostic value is also unknown. Pragmatic tools that could be used in busy clinical settings, or perhaps even during remote consultations, [11] to detect frailty accurately in patients with HF and determine those

at greater risk, would help identify patients who might benefit from a comprehensive geriatric assessment and individualised care. We therefore directly compared the prognostic value of several commonly-used frailty tools in a cohort of well-characterised ambulatory patients with HF.

Methods

Study population

Between September 2016 and March 2017, we enrolled consecutive ambulatory patients with HF who attended a community HF clinic for a routine follow-up appointment. All patients had a pre-existing (>1 year) clinical diagnosis of HF, confirmed by either evidence of left ventricular systolic dysfunction on echocardiography (left ventricular ejection fraction (LVEF) <40% or at least moderate left ventricular systolic dysfunction by visual inspection if LVEF was not calculated), defined as heart failure with reduced ejection fraction, -HFrEF; **or** normal left ventricular systolic function (LVEF ≥40%) and N-terminal pro-B-type natriuretic peptide (NT-proBNP) >400 ng/L, defined as heart failure with normal ejection fraction, -HFnEF. [12]

During the visit, all patients had a full medical history, physical examination, blood tests (full blood count, urea and electrolytes and NT-proBNP), an electrocardiogram and a consultation with a HF specialist.

Frailty tools

During the same clinical visit, all patients were screened and assessed by the same researcher (SS) for frailty (Appendix 1).

The screening tools used were:

1) *The Derby frailty index* (DFI; scores as frail vs non-frail)

   DFI is a quick pragmatic frailty identification tool initially developed in 2013. [13] A patient is classified as frail if one of the following criteria is met: 1) ≥65 years old and a care home resident; 2) ≥75 years old with confusion, falls or reduced mobility; 3) ≥85 years old with >4 co-morbidities (Appendix 1a).

2) *The acute frailty network criteria* (AFN; scores as frail vs non-frail)

   AFN defines frailty as present in (a) people aged ≥85 years or (b) people aged ≥65 years with one or more of the following presenting features: cognitive impairment; resident in a care home; history of fragility fractures; Parkinson's disease; recurrent falls (Appendix 1a). [14]

3) *The clinical frailty scale* (CFS; measures between 1 (very fit) and 9 (terminally ill))

   Subjects are scored according to their functional capacity, level of dependence and co-morbidities. For example, a patient with uncontrolled symptoms who is not frankly dependent is classified as vulnerable and scores 4 on the CFS; while an individual with limited dependence on others for instrumental activities of daily living including finances, transportation, heavy housework and medications will be classified as mildly frail and scores 5 on the CFS. Subjects with CFS 1-3, 4, 5, 6 and 7-9 are classified as non-frail, pre-frail, mildly, moderately and severely frail respectively. Subjects with a CFS >4 are classified as frail (Appendix 1a). [15]

The assessment tools used were:

1) *Fried frailty phenotype* (measures between 0 (normal) and 5 (very frail)):

The Fried Frailty phenotype [3] is commonly used to validate other frailty criteria. Frailty is considered as a clinical syndrome based on five criteria: unintentional weight loss (≥10 lbs [≥4.5 kg] in the past year); self-reported exhaustion; weakness (low grip strength); slow walking speed (time to walk 5 meters ≥ 6-7 seconds depending on sex and height); and low physical activity (low weekly total energy expenditure assessed using the short version of the Minnesota Leisure Time Activity questionnaire [16].) (Appendix 1b) Subjects with ≥ 3 points are classified as frail and those with 1-2 points and 0 points are classified as pre-frail and non-frail respectively.

2) *Edmonton frailty scale* (EFS; measures between 0-17)

EFS is a multi-dimensional frailty assessment tool which includes general health status, functional independence, social support, cognition, medication use, nutrition, continence and mood. [17] EFS has been validated against the comprehensive geriatric assessment (CGA), a multi-dimensional, multidisciplinary diagnostic process used to determine medical, functional and psychosocial problems in elderly patients. [12] Subjects with EFS 0-5 are classified as non-frail, those with EFS 6-7, 8-9, 10-11 and 12-17 are classified as vulnerable, mildly, moderately and severely frail respectively. Subjects with EFS ≥ 8 are classified as frail. (Appendix 1c)

3) *The deficit index* (DI; measures between 0.03-0.72)

Mitnitski and Rockwood consider frailty as a clinical state as a result of accumulation of deficits (symptoms, signs, co-morbidities and disabilities). [18] These deficits are

combined in a frailty index score to reflect the proportion of potential deficits present in a person. We selected 32 deficits according to previously published criteria [19] to construct the deficit index (Appendix 1d). If a subject exhibited 5 out of the 32 possible deficits, the frailty index for that patient would be 5/32 or 0.16. We stratified patients according to terciles (lower tercile: non-frail; middle tercile: pre-frail; upper tercile: frail) and quintiles of DI (lowest quintile: non-frail; subsequent quintiles: pre-frail, mildly, moderately and severely frail respectively).

Physical Tests:

a) Handgrip strength (HGS):

HGS was measured with a handgrip dynamometer (Es-100 Ekj107, Evernew, Japan). The subject was seated and instructed to hold the dynamometer upright and squeeze as hard as possible. Three trials in the right hand followed by three trials in the left hand were recorded and the highest reading of the 6 was taken as the final reading.

b) Gait analysis

1) Timed get up and go test (TUGT):

The area for TUGT was set up by measuring 3 meters from a chair. The subject was instructed to: "Sit on the chair. On the word `go,' stand upright, walk at your normal pace to the line on the floor, turn around, return to the chair, and sit down." Subjects who took >10 seconds to complete the test were classified as frail (Appendix 1c). Patients who were unable to complete TUGT due to limitation in mobility were also classified as frail (N=53).

2) Five metre walk test (5MWT):

The subject was instructed to walk at a normal pace for 5 meters according to their ability. Subjects who took >6-7 seconds (depending on sex and height) to complete the test were classified as frail (Appendix 1b). Patients who were unable to complete 5MWT due to limitation in mobility were classified as frail. We further stratified patients into 5 categories of 5MWT according to distribution of 5MWT in our cohort (5MWT≤ 7.0 sec: non-frail; 5MWT 7.0-9.5 sec, 10.0-14.5 sec, 15.0-28.0 sec: pre-frail, mildly and moderately frail respectively; those who were unable to complete 5MWT, we classified as severely frail (N=53).

Co-morbidities

Co-morbidities were measured using the Charlson co-morbidity index/score. [20] Hypertension was defined as blood pressure ≥140/90 mmHg or a previous clinical diagnosis. [21] Current haemoglobin (Hb) levels were used to define anaemia (Hb <13.0 g/dL in men and <12.0 g/dL in women). [22] Diabetes mellitus was defined according to the guideline from Diabetes UK. [23] Patients consented to the use of electronic medical records to identify previous clinical history of myocardial infarction (MI), peripheral vascular disease (PVD), cerebrovascular accidents (CVA), chronic obstructive pulmonary disease (COPD), dementia, liver or renal disease or malignancy.

End points and follow-up

All patients were followed for a minimum of 1 year. Patients were followed until 1st of August 2018. The primary end point was all-cause mortality and the secondary end point was the combination of all-cause hospitalisation and all-cause mortality.

Mortality was ascertained by using medical records (updated systematically using an NHS electronic database), autopsy reports and death certificates. Hospitalisation was ascertained by using electronic medical records and discharge letters. Hospitalisations refer to non-elective admissions to hospital with length of stay of at least 24 hours.

Statistical analysis

Continuous data are expressed as a median (25^{th} - 75^{th} percentiles) and categorical data are expressed as n (%). Independent t tests and Mann-Whitney U tests were used to compare two continuous variables for normally and non-normally distributed data. The chi-squared test was used to compare proportions between groups.

Time-to-event data are presented graphically using Kaplan-Meier curves. Log-rank-tests were used to compare survival between groups. The relation between a variable and outcome was explored using Cox regression analysis. The assumptions of Cox regression were tested. Univariable and multivariable analyses with Cox proportional hazard regression were used to determine significant predictors of events. Variables with $p< 0.1$ in univariable analysis were entered into a multivariable analysis with each frailty tool both as a continuous and binary variable. Further analyses were performed to study the relationship between the degree of frailty and outcome. We used the frailty tool from each category (single physical tests, screening and assessment tools) which best predicted all-cause mortality (highest χ^2). Log-transformation was applied when the data were very right-skewed.

In order to compare the prognostic performance of different frailty tools, we selected variables routinely available in clinical practice which were significant predictors of clinical

outcomes in univariable analysis (P<0.1) to create a base model for predicting mortality and the combined outcome at one year. The base model included NYHA (III/IV vs I/II), log [NT-proBNP], sodium and atrial fibrillation (AF). Age, BMI and co-morbidities (including Charlson score, haemoglobin and renal function) were excluded as some of the frailty tools include these variables. We then added each of the frailty tools in turn to the base model and used Harrell's C-statistic to evaluate model discrimination in survival analysis. Model performance refers to the ability to distinguish patients experiencing an event from those who did not and was quantified by the C-statistic. A C-statistic of 0.5 indicates no discriminative ability at all while a C-statistic of 1 indicates perfect discrimination.

To evaluate length of stay during hospitalisation, we only included patients with at least one hospitalisation and hospitalisations resulting in death were excluded.

All statistical analyses were performed using SPSS 26 (SPSS INc.,Chicago, IL, USA) and The Stata (14th Version, StataCorp, TX, USA) statistical computer package. A two-tailed P-value of <0.05 was considered significant in all analyses.

The study conformed to the principles outlined in the Declaration of Helsinki and was approved by relevant ethical bodies. All subjects gave their written informed consent for their data to be used for research.

Results

Baseline characteristics

A total of 467 consecutive ambulatory patients with HF was studied. Table 1 shows the baseline characteristics of the study population. The majority of patients were male and elderly; most patients had HFrEF (62%) with median NT-proBNP of 1156 (25^{th} - 75^{th} percentiles 496-2463) ng/L; around 20% had severe symptoms (NYHA class III/IV).

Compared to patients who were alive at 1 year, those who died were older, had more severe symptoms and were more likely to be frail at baseline. They also had higher NT-proBNP, lower BMI, more co-morbidities and were less likely to be treated with renin-angiotensin-aldosterone system inhibitors but more likely to be treated with a loop diuretic and digoxin (Table 1).

Relation between frailty and mortality

During a median follow-up of 554 days (25^{th} - 75^{th} percentiles 511-629 days), 18% of patients died. The influence of frailty measures considered as univariable predictors of mortality are shown in appendix 2a with appendix 2b showing the results for other clinical variables. The presence of frailty, as determined by any tool, was associated with increased risk of mortality. Clinical variables included in multivariable analysis for predicting mortality are shown in appendix 3. All the frailty tools, with the exceptions of grip strength, AFN, DFI and EFS (when used as a binary variable), were significant predictors of all-cause mortality when evaluated individually in multivariable analysis (Table 2).

A base model (including NYHA (III/IV vs I/II), log [NT-proBNP], sodium and the presence of AF) for predicting mortality at 1 year achieved a C-statistic of 0.75 (Table 3). Each frailty

tool, when added individually, improved the performance of the base model. Amongst the screening tools: CFS (C-statistic 0.84); amongst the frailty assessment tools: DI (C-statistic 0.83); and amongst the single physical tests: 5MWT (C-statistic 0.80) increased model performance most compared with the base model (all P <0.05).

The graphical abstract shows the Kaplan Meier curves illustrating the relation between frailty and all-cause mortality. Patients who were frail according to the 5MWT, DI and CFS had a 6-9 times greater mortality risk than those who were not frail.

The 3 month, 6 month and 12 month mortality according to frailty categories is shown in Figure 1, top panel. Worsening frailty was associated with higher mortality rates. Severely frail patients had a much higher 1-year mortality rate (33-74%) than non-frail (1-2%) or pre-frail patients (2-13%).

Relation between frailty and combined all-cause hospitalisation and mortality

During follow up, 43% of patients were either hospitalised or died. The influence of frailty measures considered as univariable predictors of the combined end-point are shown in appendix 2a with appendix 2b showing the results for other clinical variables. The presence of frailty, as determined by any frailty tools, was associated with increased risk of combined outcome. Clinical variables included in multivariable analysis for predicting combined outcome are shown in appendix 3. All frailty tools, with the exception of grip strength, 5MWT and CFS (when used as a binary variable), were significant predictors of the combined outcome when evaluated individually in multivariable analysis (Table 2).

A base model (including NYHA (III/IV vs I/II), log [NT-proBNP], sodium and the presence of AF) for predicting the combined outcome at 1 year achieved a C-statistic of 0.68 (Table 3). Each frailty tool, when added individually, improved the performance of the base model. Amongst the screening tools: CFS (C-statistic 0.73); amongst the frailty assessment tools: DI (C-statistic 0.74); and amongst the single physical tests: TUGT (C-statistic 0.73) increased model performance most compared with the base model (all $P < 0.05$).

Figure 2 shows the Kaplan Meier curves illustrating the relation between frailty and combined outcome. Patients who were frail according to the 5MWT, DI and CFS, had a 3-6 times greater risk of combined outcome than those who were not frail.

The 3 month, 6 month and 12 month combined event rates according to frailty categories is shown in Figure 1, bottom panel. Worsening frailty was associated with higher combined event rates. Severely frail patients had a much higher 3-month combined event rate (33-47%) than non-frail (1-5%) or pre-frail patients (1-13%). A similar trend was seen in 6 and 12 month combined event rates.

The relation between frailty and all-cause hospitalisation alone is shown in appendix 4 and 5.

Discussion

Our study is the first to make a comprehensive comparison of the prognostic value of several commonly-used frailty tools in a well-characterised cohort of ambulatory patients with

chronic HF. We found that the presence of frailty was a powerful predictor of morbidity and mortality, regardless of the frailty tool used, and independent of age, comorbidities, HF symptoms and severity. As frailty status worsens, the risk of hospital admissions and death also increases. Our results are consistent with results from other studies of HF cohorts which demonstrated frailty as a predictor of worse outcome.[4,10,24]

We have evaluated several commonly used frailty tools. The advantages and disadvantages of frailty tools are summarised in graphical abstract. Comprehensive assessment tools, such as Fried criteria, DI and EFS, cover multiple domains, including physical function, daily activities and comorbidities, and provide strong prognostic information. However, their assessment requires significant amount of time (15 minutes on average, depending on the mobility of patients) [25]. Slow walking speed and weak grip strength evaluate only the physical phenotype of frailty but are both significant predictors of poor outcome amongst elderly people. [26,27] Whilst the Fried criteria is the most commonly used frailty tool, it is complex to administer. [28] We have found that single physical tests such as the 5MWT, are as effective at predicting mortality as lengthy assessment tools. This suggests that that physical deconditioning and poor functional performance, amongst all the other components of frailty, play a key role in predicting a poorer outcome. In our cohort, physical tests can generally be completed within a minute, however, certain patients such as those with hemiplegia, advanced dementia or cognitive illness, might not be able to perform them.

Screening tools such as AFN, DFI and CFS, are much easier to perform and can generally be completed within a minute. [25] Amongst screening tools, we found that CFS has the highest prognostic value, comparable to that of complex assessment tools or physical tests. CFS

offers a quick head-to-toe assessment of the patient, and covers their physical functioning and dependence as well as comorbidities. Therefore, in busy clinical settings, screening tools such as CFS might be the preferred method for rapid evaluation of frailty. CFS might be a more appropriate initial evaluation tool especially in patients admitted to hospital acutely unwell who are unable to perform physical tests.

Frailty, ageing and HF are closely related and are not separate entities. A recent large-scale population study of 4 million individuals in the UK, has shown that from 2002 to 2014, prevention of HF, either through better healthcare provision or more vigilant management of comorbidities such as hypertension, diabetes, AF and ischaemic heart disease, has delayed the onset of HF to a more advanced age. [29] The consequence is an increased number of elderly patients with newly diagnosed HF. The profile of patients with HF is thus evolving over time with a trend towards older age and greater comorbidity burden, indicating the need to re-evaluate our current model of care for HF.

Frailty used to be thought of as a ‘geriatric syndrome’ to be solely managed by geriatricians. There is an extensive literature on frailty and its impact in the general geriatric population, but there are few well-conducted studies evaluating frailty in patients with HF using validated frailty assessment tools. [30,31] It is time for clinicians to rethink management strategies for HF. The vast majority of HF patients seen in daily practice have profiles very different to those enrolled in contemporary clinical trials. [32] They are mostly elderly, often socially isolated, have poor mobility and limited self-care ability; they are also more likely to be treated supportively, as they are less likely to tolerate optimal doses of HF medications, all of which contribute to repeated hospitalisations and poor outcome. [9] However, not all elderly

patients with HF are inevitably frail. In fact, one third of younger patients with HF are frail. [33] In our cohort, we found that the presence of frailty is associated with worse morbidity and mortality, regardless of the frailty tool used, and independent of age. Therefore, frailty should be evaluated in all patients with HF, irrespective of their chronological age, as recommended by the European Society of Cardiology. [34]

Traditional prognostic models for HF generally perform poorly in current populations because these models are mostly constructed using clinical variables; other important non-clinical variables such as frailty, social and functional status, are often not included. [35] Similar to our findings, in a recent study conducted in patients requiring HF hospitalisation, measures of frailty have been shown to improve prediction of hospitalisation and death compared to conventional clinical risk predictors. [36]

Whilst some might say that the symptoms of HF overlap with components of frailty, our study shows that frailty is associated with worse outcome independent of NYHA class and other variables such as NT-proBNP and comorbidities. We believe that incorporating frailty into prognostic models of HF would lead to a more holistic model that might improve identification of patients at greater risk.

Beyond simple prognostication, the clinical implications of identification of frailty in patients with HF are not clear. Early identification of frailty enables prompt referral of at-risk patients for detailed evaluation using the comprehensive geriatric assessment and facilitates the delivery of personalised care. Frail patients have high comorbidity burden and are at risk of

recurrent hospitalisations, of which non-cardiovascular admissions are particularly common.[9] Introduction of interventions such as cardiac rehabilitation, exercise training programmes, nutritional support and polypharmacy reduction, might delay disability, improve quality of life and prevent recurrent hospitalisations in frail individuals. [37] Identification of frailty, especially those with moderate or severe frailty, might help decide on potential ceilings for future care.

Study limitations

Firstly, this is a single-centre study with limited sample size, external validation of our results is needed. Our study is, however, the most comprehensive study which directly compares several commonly used frailty tools in consecutive, unselected, patients with CHF.

Secondly, we have only studied 9 frailty tools. A large number of frailty screening and assessment tools has been proposed and identified patients at risk of adverse outcome. [38]

Lastly, our study has limited follow up. We are unable to comment on long-term prognostic significance of frailty in the HF population. However, almost all patients identified as frail had had an end-point by the end of the study.

Conclusions

Frailty is a strong predictor of morbidity and mortality in ambulatory patients with chronic HF. When added to a base model for predicting mortality and the combined outcome at 1 year including NYHA class, NT-proBNP, sodium and AF, CFS provides comparable prognostic information to assessment tools taking much longer to complete. Frailty

evaluation should be routinely performed in clinical practice to identify patients with HF at high risk.

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The data underlying this article will be shared on reasonable request to the corresponding author.

Tables

Table 1: Baseline characteristics of patients with CHF (Died by 1 year vs alive at 1 year).

Table 2: Multivariable analysis of frailty tools predicting all-cause mortality and combined outcome. (Separate multivariable analysis was performed for each tool as both binary and continuous variable, with Appendix 3 showing clinical variables included in multivariable analysis for predicting all-cause mortality and combined outcome)

Table 3: Addition of frailty tools and its impact on performance of base model in predicting all-cause mortality and the combined outcome at 1 year.

Figure legends

Graphical abstract: A summary of pros and cons of different frailty tools and their prognostic value using Kaplan Meier curves to illustrate the relation between frailty tools and all-cause mortality.

Figure 1: 3-month, 6-month & 12-month mortality (top panel) and combined event rates (bottom panel) according to frailty categories of CFS, DI and 5MWT. *P<0.001,**P=0.002.

Figure 2: Kaplan Meier curves illustrating the relation between frailty tools and combined outcome.

Appendices

Appendix 1: Evaluation of frailty by different frailty tools.

Appendix 2a: Univariable analysis of frailty tools predicting all-cause mortality and combined outcome.

Appendix 2b: Univariable analysis of clinical variables predicting all-cause mortality and combined outcome.

Appendix 3: Clinical variables included in multivariable analyses for predicting mortality and combined outcome (using CFS as an example).

Appendix 4: Number of hospitalisations at 1-year follow-up and length of stay in frail vs non-frail patients according to CFS, DI & 5MWT.

Appendix 5: Number of hospitalisations at 1-year follow-up according to frailty categories of CFS, DI and 5MWT.

References

[1] Solomon SD, Dobson J, Pocock S, et al; Candesartan in Heart failure: Assessment of Reduction in Mortality and morbidity (CHARM) Investigators. Influence of nonfatal

hospitalization for heart failure on subsequent mortality in patients with chronic heart failure. *Circulation*. 2007;**116**:1482–87.

[2] Bueno H, Ross JS, Wang Y, et al. Trends in length of stay and short-term outcomes among Medicare patients hospitalized for heart failure, 1993–2006. *JAMA*. 2010; **303**:2141–47.

[3] Fried LP, Tangen CM, Walston J, et al; Cardiovascular Health Study Collaborative Research Group. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci*. 2001;**56**:M146–56.

[4] Vidán MT, Sánchez E, Fernández-Avilés F, Serra-Rexach JA, Ortiz J, Bueno H. FRAIL-HF, a study to evaluate the clinical complexity of heart failure in nondependent older patients: rationale, methods and baseline characteristics. *Clin Cardiol.* 2014; **37**:725-32.

[5] McDonagh TA, Metra M, Adamo M, et al; ESC Scientific Document Group. 2021 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure. Eur Heart J. 2021;42(36):3599-3726. doi: 10.1093/eurheartj/ehab368.

[6] Afilalo J. Frailty in patients with cardiovascular disease: why, when and how to measure. *Curr Cardiovasc Risk Rep* 2011;**5**:467-472.

[7] Afilalo J, Alexander KP, Mack MJ, et al. Frailty assessment in the cardiovascular care of older adults. *J Am Coll Cardiol*. 2014; 63::747-62.

[8] Kubala M, Guédon-Moreau L, Anselme F, et al. Utility of Frailty Assessment for Elderly Patients Undergoing Cardiac Resynchronization Therapy. *JACC Clin Electrophysiol.* 2017;**3**:1523-1533.

[9] Sze S, Pellicori P, Zhang J, Weston J, Squire IB, Clark AL. Effect of frailty on treatment, hospitalisation and death in patients with chronic heart failure. *Clin Res Cardiol.* 2021;**110**:1249-1258.

[10] McDonagh J, Martin L, Ferguson C, et al. Frailty assessment instruments in heart failure: a systematic review. *Eur J Cardiovasc Nurs.* 2018;**17**:23-35.

[11] Cleland JG, Clark RA, Pellicori P, Inglis SC. Caring for people with heart failure and many other medical problems through and beyond the COVID-19 pandemic: the advantages of universal access to home telemonitoring. *Eur J Heart Fail* 2020; **22**: 995-998

[12] National Institute for Health and Care Excellence (2018). Chronic heart failure in adults: diagnosis and management. [Accessed March 2020] available at: https://www.nice.org.uk/guidance/NG106

[13] Woodard J, Youde J, Sutton B & Bagshaw S. Frailty Identification in Acute Medical Admissions. *Age Ageing* 2014;**43**:i9.

[14] Acute frailty nework webpage. [Accessed April 2019]; available at: http://www.acutefrailtynetwork.org.uk/uploads/files/1/Resource/SILVER_BOOK_FINAL_MAIN.pdf

[15] Rockwood K, Song X, MacKnight C, et al. A global clinical measure of fitness and frailty in elderly people. *CMAJ* 2005;**173**:489–495.

[16] Taylor HL, Jacobs DR, Schucker B, Knudsen J, Leon AS, Debacker G. A questionnaire for the assessment of leisure time physical activities. *J Chronic Dis* 1978;**31:**741-55

[17] Rolfson DB, Majumdar SR, Tsuyuki RT, Tahir A, Rockwood K. Validity and reliability of the Edmonton Frail Scale. *Age and Ageing.* 2006;**35**:526-529.

[18] Mitnitski AB, Graham JE, Mogilner AJ, Rockwood K. Frailty, fitness and late-life mortality in relation to chronological and biological age. *BMC Geriatrics* 2002,**27**:1.

[19] Searle SD, Mitnitski A, Gahbauer EA, Gill TM, Rockwood K. A standard procedure for creating a frailty index. *BMC Geriatrics*.2008;**8**:24.

[20] Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis* 1987;**40**:373-383.

[21] Chobanian AV, Bakris GL, Black HR, et al; National Heart, Lung, and Blood Institute Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; National High Blood Pressure Education Program Coordinating Committee. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. *JAMA.* 2003;**289**:2560–72.

[22] Janz TG, Johnson RL, Rubenstein SD. Anemia in the emergency department: evaluation and treatment. *Emergency Medicine Practice*.2013;1**5**:1-15.

[23] Diagnostic criteria for diabetes. Diabetes UK. URL: https://www.diabetes.org.uk/Professionals/Position-statements-reports/Diagnosis-ongoing-management-monitoring/New_diagnostic_criteria_for_diabetes/ (Last accessed in June 2022)

[24] Sze S, Zhang J, Pellicori P, Morgan D, Hoye A, Clark AL. Prognostic value of simple frailty and malnutrition screening tools in patients with acute heart failure due to left ventricular systolic dysfunction. *Clin Res Cardiol*. 2017;**106**:533-541.

[25] Sze S, Pellicori P, Zhang J, Weston J, Clark AL. Identification of Frailty in Chronic Heart Failure. *JACC Heart Fail.* 2019;**7**:291-302.

[26] Studenski S, Perera S, Patel K, et al. Gait speed and survival in older adults. *JAMA* 2011;**305**:50–58.

[27] Chung CJ, Wu C, Jones M, et al. Reduced handgrip strength as a marker of frailty predicts clinical outcomes in patients with heart failure undergoing ventricular assist device placement. *J Card Fail.* 2014; **20**: 310–315

[28] Bouillon K, Sabia S, Jokela M, et al. Validating a widely used measure of frailty: Are all sub-components necessary? Evidence from the Whitehall II cohort study. *Age.* 2013; **35**: 1457–1465

[29] Conrad N, Judge A, Tran J, et al. Temporal trends and patterns in heart failure incidence: a population-based study of 4 million individuals. *Lancet*. 2018; **39**:572–80.

[30] Wang X, Zhou C, Li Y, Li H, Cao Q, Li F. Prognostic value of frailty for older patients with heart failure: a systematic review and meta-analysis of prospective studies. *Biomed Res Int* 2018. doi: 10.1155/2018/8739058

[31] Jha SR, Ha KSK, Hickman LD, et al. Frailty in advanced heart failure: a systematic review. *Heart Fail Rev* 2015;**20:**553-60

[32] Pellicori P, Urbinati A, Shah P, et al. What proportion of patients with chronic heart failure are eligible for sacubitril-valsartan? *Eur J Heart Fail.* 2017;**19**:768-778.

[33] Lupón J, González B, Santaeugenia S. Prognostic implication of frailty and depressive symptoms in an outpatient population with heart failure. *Rev Esp Cardiol.* 2008 ;**61**:835-42.

[34] Vitale C, Jankowska E, Hill L, et al. Heart Failure Association of the European Society of Cardiology position paper on frailty in patients with heart failure. *Eur J Heart Fail,* 2019; **21**: 1299-1305.

[35] Kansagara D, Englander H, Salanitro A, et al. Risk Prediction Models for Hospital Readmission: A Systematic Review. *JAMA.* 2011; **306**:1688–98.

[36] Sokoreli I, Cleland JG, Pauws SC, et al. Added value of frailty and social support in predicting risk of 30-day unplanned re-admission or death for patients with heart failure: An analysis from OPERA-HF. *Int J Cardiol.* 2019; **278**:167-72.

[37] Bakker FC, Robben SHM, Olde Rikkert MGM. Effects of hospital wide interventions to improve care for frail older inpatients: a systematic review. *BMJ Qual Saf*. 2011;**20**:680–91.

[38] Afilalo J, Lauck S, Kim DH, et al. Frailty in older adults undergoing aortic valve replacement: the FRAILTY- AVR Study. *JACC*. 2017;**70**:689-700.

Table 1: Baseline characteristics of patients with CHF (Died by 1 year vs alive at 1 year).

	HF patients N=467	Died by 1 year N=56	Alive at 1 year N=411	P (Died vs alive)	Missing
Demographics					
Age	76 (69-82)	82 (77-87)	75 (68-82)	<0.001	0
Sex (male), % (N)	67 (313)	68 (38)	67 (275)	0.88	0
HR (bpm)	70 (60-80)	70 (60-82)	70 (60-80)	0.84	0
Rhythm (AF), % (N)	46 (215)	66 (37)	43 (178)	0.001	0
BP systolic (mmHg)	139 (126-162)	136 (127-160)	140 (125-162)	0.89	0
BP diastolic (mmHg)	75 (66-83)	74 (66-83)	75 (66-83)	0.63	0
NYHA III/IV, % (N)	22 (103)	43 (24)	19 (79)	<0.001	0
HFrEF, % (N)	62 (291)	63 (35)	62 (256)	0.37	0
LVEF (%)	45 (35-54)	44 (34-51)	45 (35-54)	0.31	160
Height (m)	1.68 (1.61-1.75)	1.69 (1.60-1.75)	1.68 (1.61-1.75)	0.68	0
Weight (kg)	83 (69-99)	77 (66-89)	83 (69-100)	0.009	0
BMI (kg/m^2)	29 (25-33)	27 (23-30)	29 (26-33)	0.004	0
Comorbidities					
Charlson score	8 (6-10)	10 (9-12)	8 (6-10)	<0.001	0
MI, % (N)	42 (198)	38 (21)	43 (177)	0.43	0
PVD, % (N)	15 (72)	25 (14)	14 (58)	0.03	0
HTN, % (N)	67 (313)	66 (37)	67 (276)	0.87	0
CVA/TIA, % (N)	15 (71)	23 (13)	14 (58)	0.08	0
Diabetes, % (N)	35 (163)	39 (22)	34 (141)	0.46	0
Dementia, % (N)	10 (48)	36 (20)	7 (28)	<0.001	0
COPD, % (N)	30 (140)	41 (23)	29 (117)	0.05	0
Malignancy, % (N)	21 (100)	30 (17)	20 (83)	0.08	0
Depression, % (N)	20 (93)	29 (16)	19 (77)	0.08	0
Anaemia, % (N)	47 (218)	79 (44)	42 (174)	<0.001	0
Recurrent falls, % (N)	37 (173)	59 (33)	34 (140)	<0.001	0
Urinary incontinence, % (N)	7 (33)	14 (8)	6 (25)	0.03	0

Medications					
BB, % (N)	84 (392)	79 (44)	85 (348)	0.24	0
ACEi/ARB, % (N)	83 (389)	63 (35)	86 (354)	<0.001	0
MRA, % (N)	46 (214)	41 (23)	47 (191)	0.45	0
Digoxin, % (N)	21 (100)	32 (18)	20 (82)	0.04	0
Loop diuretic, % (N)	74 (347)	88 (49)	73 (298)	0.02	0
Thiazide, % (N)	4 (17)	4 (2)	4 (15)	0.98	0
≥ 5 medications, % (N)	87 (404)	95 (53)	85 (351)	0.06	0
Blood tests					
NT-proBNP (ng/L)	1156 (496-2463)	2507 (1434-5825)	1001 (428-2150)	<0.001	0
Hb (g/L)	131 (118-142)	117 (106-131)	132 (120-143)	<0.001	0
Na (mmol/L)	137 (135-138)	136 (133-138)	137 (135-138)	0.04	0
K (mmol/L)	4.4 (4.2-4.7)	4.4 (4.1-4.7)	4.4 (4.2-4.7)	0.40	0
eGFR (mL/min per 1.73m^2)	55 (40-73)	39 (28-58)	58 (42-74)	<0.001	0
Frailty tools					
DFI (frail), % (N)	48 (224)	77 (43)	44 (181)	<0.001	0
AFN (frail), % (N)	47 (217)	80 (45)	42 (172)	<0.001	0
CFS (frail), % (N)	44 (206)	82 (46)	39 (160)	<0.001	0
TUGT (frail), % (N)	69 (321)	95 (53)	65 (268)	<0.001	0
Grip strength (frail), % (N)	63 (292)	91 (51)	59 (241)	<0.001	0
5MWT (frail), % (N)	63 (294)	95 (53)	59 (241)	<0.001	0
Fried (frail), % (N)	52 (244)	88 (49)	47 (195)	<0.001	0
DI (frail), % (N)	35 (165)	73 (41)	30 (124)	<0.001	0
EFS (frail), % (N)	30 (140)	63 (35)	26 (105)	<0.001	0

HF= heart failure, HR= heart rate, AF= atrial fibrillation, BP= blood pressure, NYHA= new York heart association, HFrEF= heart failure with reduced ejection fraction, LVEF= left ventricular ejection fraction, BMI= body mass index, MI= myocardial infarction, PVD= peripheral vascular disease, HTN= hypertension, CVA/TIA= cerebrovascular accident/ transient ischaemic attack, COPD= chronic obstructive pulmonary disease, BB= beta-blocker, ACEi= angiotensin converting enzyme inhibitor, ARB= angiotensin receptor blocker, MRA= mineralocorticoid receptor antagonist, NT-proBNP= N-terminal pro-B-type natriuretic peptide, Hb= haemoglobin, Na= sodium, K= potassium, eGFR = estimated glomerular filtration rate, DFI= Derby frailty index, AFN= Acute frailty network frailty criteria, CFS= Clinical frailty scale, TUGT= Timed get up and go test, 5MWT= 5 meter walk test, DI= Deficit index, EFS= Edmonton frailty scale.

Table 2: Multivariable analysis of frailty tools predicting all-cause mortality and combined outcome. (Separate multivariable analysis was performed for each tool as both binary and continuous variable, with Appendix 3 showing clinical variables included in multivariable analysis for predicting all-cause mortality and combined outcome)

Worse outcome per unitary increase		**All-cause mortality [1]**			**Combined outcome [1]**		
		HR(95%CI)	Wald χ^2	P	HR(95%CI)	Wald χ^2	P
Physical tests	5MWT*	1.08 (1.01-1.15)	4.8	0.03	1.07 (1.03-1.12)	10.0	0.002
	5MWT (Frail vs non-frail)	3.10 (1.42-6.75)	8.1	0.004	1.36 (0.93-1.99)	2.6	0.11
	TUGT*	1.05 (1.01-1.09)	5.6	0.02	1.04 (1.01-1.06)	8.3	0.004
	TUGT (Frail vs non-frail)	2.50 (1.03-6.08)	4.1	0.04	1.95 (1.25-3.04)	8.8	0.003
	Grip strength **	0.99 (0.96-1.01)	1.2	0.28	0.99 (0.98-1.01)	0.6	0.44
	Grip strength (Frail vs non-frail)	1.61 (0.81-3.20)	1.8	0.18	1.32 (0.89-1.95)	2.0	0.16
Screening	CFS	1.79 (1.37-2.33)	18.22	<0.001	1.33 (1.12-1.56)	11.1	<0.001
	CFS (Frail vs non-frail)	1.92 (1.07-3.44)	4.8	0.03	1.26 (0.89-1.79)	1.6	0.20
	AFN (Frail vs non-frail) ***	1.78 (0.95-3.33)	3.2	0.07	1.60 (1.09-2.34)	5.9	0.02
	DFI (Frail vs non-frail) ***	0.77 (0.39-1.54)	0.5	0.46	1.60 (1.04-2.48)	4.5	0.03
Assessment	Fried criteria	1.36 (1.10-1.67)	8.3	0.004	1.21 (1.06-1.37)	8.5	0.004
	Fried criteria (Frail vs non-frail)	2.16 (1.14-4.08)	5.6	0.02	1.46 (1.01-2.09)	4.1	0.04
	DI (per 0.01 increase) ****	1.05 (1.03-1.07)	23.4	<0.001	1.03 (1.02-1.04)	22.4	<0.001
	DI (Frail vs non-frail)****	2.76 (1.62-4.70)	14.0	<0.001	1.67 (1.21-2.30)	9.8	0.002
	EFS	1.18 (1.08-1.30)	12.0	<0.001	1.14 (1.07-1.21)	18.8	<0.001
	EFS (Frail vs non-frail)	1.52 (0.91-2.56)	2.5	0.11	1.47 (1.06-2.03)	5.3	0.02

5 MWT= 5 meter walk test, TUGT= Timed get up and go test, CFS= Clinical frailty scale, AFN= Acute frailty network frailty criteria, DFI= Derby frailty index, DI= Deficit index, EFS= Edmonton frailty scale.

[1]Variables included in multivariable analyses predicting all-cause mortality and the combined outcome are: age, BMI, Cardiac rhythm (AF vs sinus rhythm), NYHA (III/IV vs I/II), Charlson score, recurrent falls, log[NT-proBNP], Hb, Na+, eGFR. Comorbidities including peripheral vascular disease, cerebrovascular accident/ transient ischemic stroke, diabetes, dementia, chronic obstructive pulmonary disease, malignancy are all variables with $p<0.1$ in univariable analyses predicting all-cause mortality or the combined outcome, however, these variables are not included separately in the multivariable analyses as they form part of the Charlson score. Recurrent falls is not part of Charlson score; therefore, it is included in the multivariable analyses. Anaemia is also not part of the Charlson score but is excluded as haemoglobin level is included in the multivariable analyses.

*53 patients were excluded as they were unable to perform 5m walk test or TUGT.

** Per unitary decrease.

*** Recurrent falls is excluded from multivariable analysis predicting all-cause mortality and the combined outcome as it is included in DFI and AFN frailty screening tools.

**** Charlson score is excluded from multivariable analysis predicting all-cause mortality and the combined outcome as the comorbidities taken into account for in Charlson score are also present in the DI.

Table 3: Addition of frailty tools and its impact on performance of base model in predicting all-cause mortality and the combined outcome at 1 year.[1]

Model	**All-cause mortality**		**Combined outcome**	
	C-statistics	Likelihood ratio test Compared to base model (P value)	C-statistics	Likelihood ratio test Compared to base model (P value)
Base model*	0.752	-	0.682	-
Screening tools				
Base* + CFS	0.835	<0.001	0.734	<0.001
Base* + AFN	0.788	<0.001	0.726	<0.001
Base* + DFI	0.780	0.004	0.719	<0.001
Assessment tools				
Base* + Fried criteria	0.812	<0.001	0.729	<0.001
Base* + DI	0.826	<0.001	0.739	<0.001
Base* + EFS	0.820	<0.001	0.747	<0.001
Single tests				
Base* + 5MWT	0.795	<0.001	0.703	<0.001
Base* + TUGT	0.787	<0.001	0.732	<0.001
Base* + Grip strength	0.783	<0.001	0.715	<0.001

*Base model: NYHA (III/IV vs I/II), Log [NT-proBNP], Rhythm (AF vs SR), Na

AF= atrial fibrillation, SR= sinus rhythm, NYHA= New York Heart Association, NT-proBNP= N-terminal pro-B-type natriuretic peptide, Na = sodium, CFS = clinical frailty scale, DFI= Derby frailty index, AFN= Acute frailty network frailty criteria, DI= Deficit index, EFS= Edmonton frailty scale, 5MWT 5 meter walk test, TUGT= Timed get up and go test.

[1]Harrell's C-statistic was used to evaluate model discrimination in survival analyses. The likelihood ratio test was used to determine if there was any significant difference in model fit between the base model and models including different frailty tools.

A) All-cause mortality rates

CFS

	Frailty					P
	Non 1-3 N=126	Pre 4 N=135	Mild 5 N=118	Mod 6 N=69	Sev ≥7 N=19	
3 m	0	0	2% (N=2)	4% (N=3)	16% (N=3)	*
6 m	0	3% (N=4)	7% (N=8)	12% (N=8)	26% (N=5)	*
12 m	1% (N=1)	7% (N=9)	13% (N=15)	25% (N=17)	74% (N=14)	*

DI

	Frailty					P
	Non 0.06-0.17 N=88	Pre 0.18-0.23 N=98	Mild 0.24-0.31 N=93	Mod 0.32-0.41 N=94	Sev 0.42-0.72 N=94	
3 m	0	0	0	2% (N=2)	6% (N=6)	**
6 m	0	1% (N=1)	7% (N=6)	5% (N=5)	14% (N=13)	*
12 m	2% (N=2)	2% (N=2)	9% (N=8)	14% (N=13)	33% (N=31)	*

5MWT

	Frailty					P
	Non ≤ 7 s N=195	Pre 7-9.5 s N=125	Mild 10-14.5 s N=67	Mod 15-28 s N=27	Sev unable to complete N=53	
3 m	1% (N=1)	0	0	7% (N=2)	9% (N=5)	*
6 m	1% (N=2)	6% (N=7)	5% (N=3)	7% (N=2)	21% (N=11)	*
12 m	2% (N=4)	13% (N=16)	13% (N=9)	19% (N=5)	42% (N=22)	*

B) Combined event rates

CFS

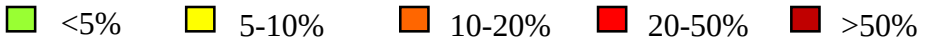
	Frailty					P
	Non 1-3 N=126	Pre 4 N=135	Mild 5 N=118	Mod 6 N=69	Sev ≥7 N=19	
3 m	1% (N=1)	13% (N=17)	12% (N=14)	33% (N=23)	47% (N=9)	*
6 m	5% (N=6)	23% (N=31)	22% (N=26)	51% (N=35)	79% (N=15)	*
12 m	10% (N=13)	33% (N=45)	40% (N=47)	67% (N=46)	95% (N=18)	*

DI

	Frailty					P
	Non 0.06-0.17 N=88	Pre 0.18-0.23 N=98	Mild 0.24-0.31 N=93	Mod 0.32-0.41 N=94	Sev 0.42-0.72 N=94	
3 m	2% (N=2)	1% (N=1)	15% (N=14)	17% (N=16)	33% (N=31)	*
6 m	7% (N=6)	8% (N=8)	24% (N=22)	30% (N=28)	52% (N=49)	*
12 m	10% (N=9)	16% (N=16)	37% (N=34)	49% (N=46)	68% (N=64)	*

5MWT

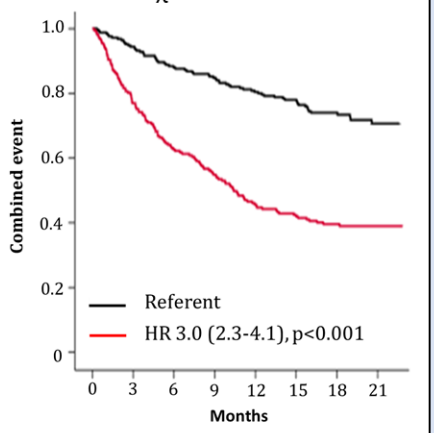
	Frailty					P
	Non ≤ 7 s N=195	Pre 7-9.5 s N=125	Mild 10-14.5 s N=67	Mod 15-28 s N=27	Sev unable to complete N=53	
3 m	5% (N=10)	12% (N=15)	16% (N=11)	30% (N=8)	38% (N=20)	*
6 m	11% (N=21)	22% (N=27)	27% (N=18)	52% (N=14)	62% (N=33)	*
12 m	18% (N=35)	36% (N=45)	43% (N=29)	74% (N=20)	76% (N=40)	*



Frailty Screening Tools

AFN

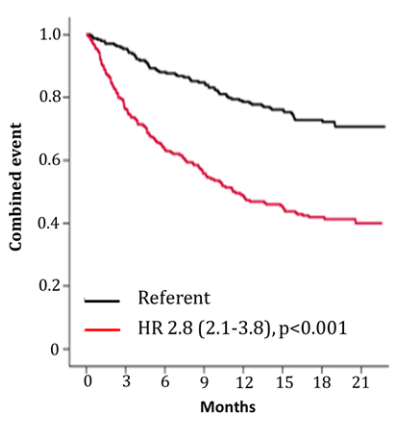
χ^2 =55.4



Non-Frail	250	220	201	184
Frail	217	136	97	86

DFI

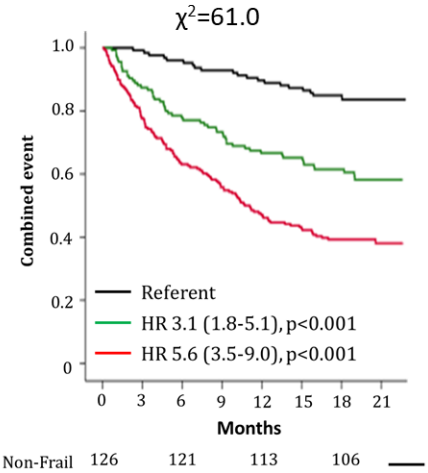
χ^2 =47.8



Non-Frail	243	214	191	176
Frail	224	142	107	94

CFS

χ^2=61.0

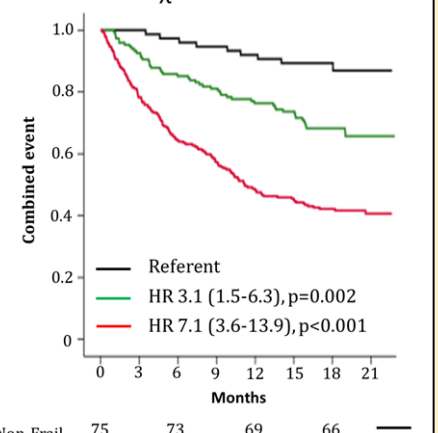


Non-Frail	126	121	113	106
Pre-Frail	135	105	90	83
Frail	206	130	95	81

Frailty Assessment Tools

FRIED

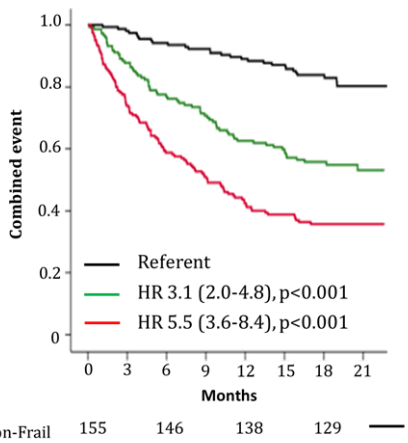
χ^2 =53.5



Non-Frail	75	73	69	66
Pre-Frail	148	126	113	101
Frail	244	157	116	103

DI

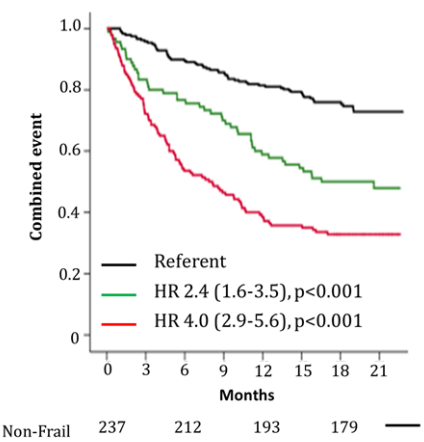
χ^2 =71.1



Non-Frail	155	146	138	129
Pre-Frail	147	113	92	82
Frail	165	97	68	59

EFS

χ^2=71.0

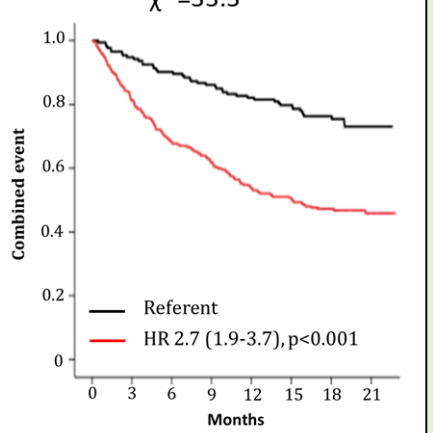


Non-Frail	237	212	193	179
Pre-Frail	90	69	53	45
Frail	140	75	52	46

Simple Physical Tests

5MWT

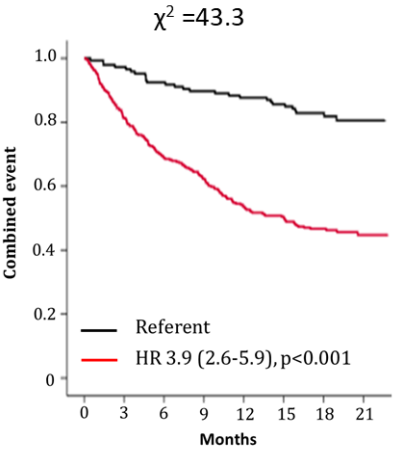
χ^2 =33.3



Non-Frail	173	156	142	131
Frail	294	200	156	139

TUGT

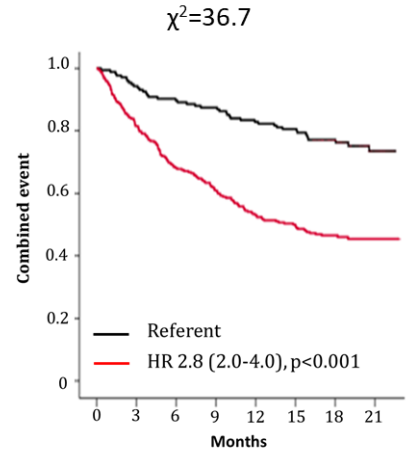
χ^2 =43.3



Non-Frail	146	135	128	120
Frail	321	221	170	150

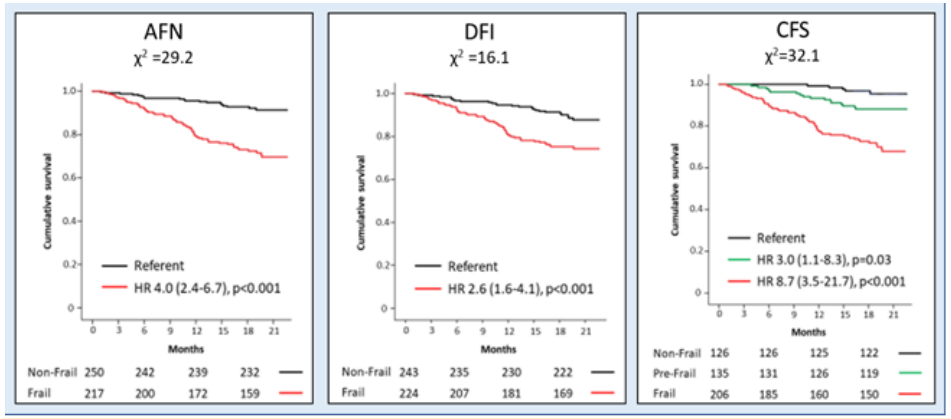
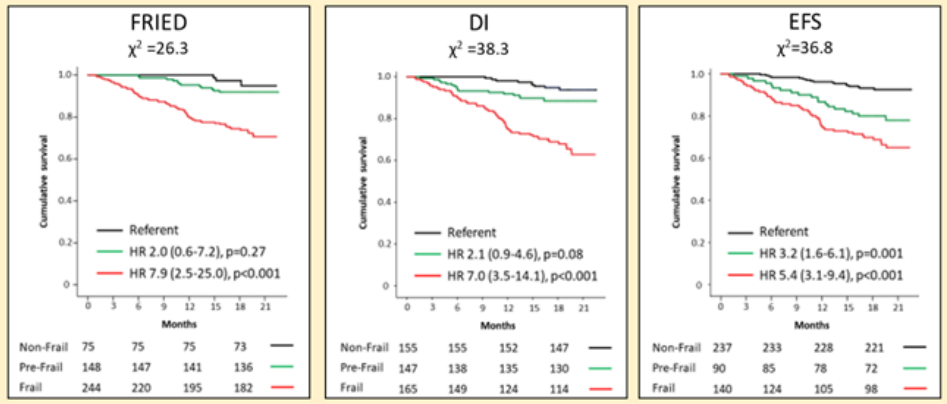
Grip Strength

χ^2=36.7



Non-Frail	175	157	145	134
Frail	292	199	153	136

How should we evaluate frailty in patients with heart failure?

Tools	Pros	Cons	Prognostic value
Screening • Acute Frailty Network criteria (AFN) • Derby frailty index (DFI) • Clinical frailty scale (CFS)	• Short • Easy to do • CFS has similar prognostic value to assessment tools	• Subjective • Not comprehensive	
Assessment • Fried criteria • Deficit index • Edmonton frailty scale	• Comprehensive • Cover multiple domains • Good prognostic value	• Complex to administer • Time consuming	
Physical Tests • 5 meter walk test (5MWT) • Timed get up and go test (TUGT) • Handgrip strength	• Simple • 5MWT has similar prognostic value to assessment tools	• Not suitable for patients with hemiplegia, poor mobility and advanced dementia