



The burden of malnutrition & frailty in patients with coronary artery disease: An under-recognized problem

Samiullah Arshad¹ , Samina Khan², Adham Karim¹ and Vedant A. Gupta¹

Abstract

Elderly patients with coronary artery disease have a high prevalence of frailty and malnutrition. Frailty syndrome is associated with poor outcomes in patients with myocardial infarction. There is a known overlap between frailty and malnutrition, yet these are two different entities. Fried Frailty Phenotype, Frail Scale, timed up and go test, and gait speed are rapid screening tests that may identify patients with frailty in everyday clinical setting. Short Form MNA is a sensitive tool to screen for malnutrition. Despite the availability of several tools for screening for both these conditions, the screening rates remain low. We aim to create awareness about the impacts of frailty and malnutrition, provide a brief overview of tools available and highlight the importance of screening in this high-risk population.

Keywords

malnutrition, frailty, acute myocardial infarction < etiology < cardiology, secondary prevention < treatment < cardiology

Received 2 September 2021; Revised received 8 April 2022; accepted 8 May 2022

According to the World Health Organization (WHO), cardiovascular disease is the leading cause of death globally, with an estimated 17.9 million deaths in 2019, with approximately 32% of those deaths occurring in elderly patients.¹ Several individual risk factors including sarcopenia, anemia, polypharmacy, loss of activities of daily living (ADLs- toileting, dressing, feeding, transferring), mobility, delirium, and falls have been identified to negatively impact the health of elderly patients with cardiovascular disease.² While these factors may be viewed as individual markers of disease, they are more often found in a collective syndrome referred to as frailty.

Frailty is a heterogeneous condition characterized by increased vulnerability of the body to acute stressors due to decline in the functional reserve of organ systems.³ Many traits commonly found with aging are risk factors for frailty, such as a sedentary lifestyle, poor nutrition, social isolation and loneliness.^{4,5} The ability of the body to maintain functional homeostasis is compromised in frail individuals, and minor stressors may trigger rapid and dramatic deterioration.⁶ Frailty was defined by Fried et al. (Fried frailty Phenotype) by the presence of at least 3 out of these 5 phenotypic criteria indicating compromised

energetics: low grip strength, self-reported low energy, slow walking speed, low physical activity, and unintentional weight loss (>10 lbs or 4.5 kg in the last year).⁷ Fried frailty phenotype identifies individuals as non-frail (score 0), pre-frail (score 1–2) and frail (score 3–5). The phenotype scoring system can be effective in the initial screening; however it doesn't identify specific areas needing intervention and is not effective for follow up to assess the outcomes of intervention. Assessing walking speed and muscle strength may be challenging in an out-patient setting due to limitation in work space area.⁸ Further, conditions like stroke, dementia and Parkinson's were excluded from the initial study, and limit the utility of Fried frailty phenotype in conditions of compromised functionality of one or more organ systems.⁹ Rockwood

¹Department of Medicine, Gill Heart and Vascular Institute, University of Kentucky, Lexington Kentucky, USA

²Department of Medicine, Royal Alexandra Hospital, Alberta Health Services, Alberta, Canada

Corresponding author:

Samiullah Arshad, Address: 2151 Meeting Street, Apt 5208, Lexington KY.
Email: samiullaharshad@yahoo.com



and Mitnitski developed and validated the Frailty Index (FI), using the Canadian Study of Health and Aging which screened for 70 clinical deficits (including but not limited to comorbidities, locomotion, cognition, psychological and function/ADLs) and is calculated by dividing the number of deficits present from the total number of clinical deficits screened.¹⁰ The higher the burden of clinical deficits, the more likely the individual would have frailty. This scale helps identify areas of intervention, and can be used for longitudinal assessment especially utilizing electronically recorded data.¹¹ The Clinical Frailty Scale (CFS) developed by Rockwood et al. is dictated by clinical judgment and includes 7 degrees of fitness from very fit to severely frail.¹⁰ This tool has found use in clinical settings especially among elderly hospitalized patients due to its validity and easy assessment, yet the limitation is the inter-observer variability.¹² Edmonton frail scale (EFS) assesses 10 domains- cognition, health status with hospitalizations, functional independence, social support, medications, nutritional assessment, mood assessment and functional performance.¹³ It is unique as it can be administered by a staff member without formal medical training and considers social factors and timed get up and go test as part of assessment. Timed up and go test (TUG) evaluates the time taken by an individual to rise from the arm chair, walk 3 meters, turn, walk back, and sit down again.¹⁴ This test is easy to conduct in a daily clinical setting, and also provides useful information about falls risk in elderly. EFS was validated against Geriatrics Clinical Impression of Frailty (GCIF) which uses comprehensive geriatric assessment (CGA) for assessment of frailty.¹³ EFS is easier and faster to complete than GCIF in a clinical setting, with the latter requiring a CGA usually performed by a multidisciplinary team. The British geriatric society recommends gait speed <0.8 m/s (taking >5 s to walk 4 m); timed up and go test >10 s or PRISMA 7 questionnaire ≥ 3 are indicative of frailty and CGA as the gold standard for care of patients identified with frailty.¹⁵ CGA is a multidisciplinary team based assessment where elderly are evaluated by a core team of a geriatrician, nurse and social worker to identify medical, psychiatric, functional and social deficits followed by interventions, and when compared to usual care, patients have a higher likelihood of being alive at 3 to 12 months after discharge, and decreased need for nursing home stay.¹⁶ In CGA, interventions are initiated to target deficits and follow-ups are done to assess the impact of interventions. Specialist assistance is obtained when required from physiotherapists, nutritionists, pharmacists, psychologists, podiatrists and dentists to achieve the goal of rehabilitation.¹⁷

Short Physical Performance Battery (SPPB) includes timed short distance walk, time to rise from a chair five times, and a set of balance tests (side-by-side, semi-tandem, and full-tandem) and can be performed in a few minutes. SPPB has shown to identify frailty in both community setting¹⁸ and hospitalized elderly patients.¹⁹ Poor performance on SPPB also

predicts all-cause mortality²⁰ and is an early marker of a risk of future adverse cardiovascular event.²¹ FRAIL scale is a set of 5 questions (**F**atigue, **R**esistance, **A**mbulation, **I**llness and recent **L**oss of weight) which can be administered easily by both clinicians and non-clinicians in both inpatient and outpatient settings, and has shown to be effective in identifying frailty and its relation to mortality.²²

Hospital frailty risk score is based on the International Classification of Diseases 10th revision (ICD-10)²³ diagnosis codes that contribute to the burden of frailty and has been validated to identify frailty with the benefit of incorporating the score into electronic medical records for easy screening of patients at every health care encounter.²⁴ Tillburg Frailty Index assesses physical, psychological and social domains using a self-reported questionnaire. In daily clinical practice, Fried Frailty Phenotype, timed get up and go test, gait speed and Frail Scale are a few useful and quick tools that can be used to screen for frailty.

Despite the multiple instruments available, frailty screening is not actively pursued in clinical encounters.²⁵ Fawzy et al. reported among patients undergoing elective cardiovascular interventions, frailty screening was done only in 13% of patients, and improved to 75% after the team was educated by a geriatrician.²⁶ A quality improvement initiative undertaken by Orkaby et al. at Veterans Affairs (VA) hospital in Boston to include gait speed assessment into outpatient preventive cardiology clinics showed screening occurred in only 40% of visits initially but rose to 78% over 5 years, with adjoining clinics also adapting the screening.²⁷ Orkaby et al. described the transient fall in gait speed screening between 2017-18 due to low engagement rate of cardiology fellows, which improved after repeating engagement meetings and educational sessions. In a survey of 388 clinicians from UK, Italy and Germany by Bruyère et al., 38% assessed frailty 'sometimes', and 9% did not assess frailty at all. Reasons cited for no assessment of frailty were time constraints in daily health care setting, lack of provider comfort in diagnosing frailty, and lack of awareness of available instruments for screening.²⁸

There is a significant burden of frailty in patients with coronary artery disease ranging from 4% to 61%, with a pooled prevalence of frailty of 19% (95% CI 15–24%) in patients with ischemic heart disease, indicating every 5th patient with ischemic heart disease has frailty as reported in the meta-analysis by Liperoti et al.²⁹ Frailty has been demonstrated to have a significant association with poor outcomes in patients with acute myocardial infarction.^{30,31} Frail patients are less likely to receive revascularization with PCI or coronary artery bypass surgery, and have a higher in-hospital mortality rate, referral to hospice, as well as discharge to rehabilitation centers, when compared with non-frail patients.³² Frailty increased the all-cause mortality in patients with acute coronary syndrome by 2.6-fold and readmissions by 2.5-fold according to a meta-analysis

conducted by Duo et al.³³ The pathophysiology of frailty with cardiovascular disease is not very well understood, but the slowing of cellular metabolism and regeneration, with an increase in oxidative stress and markers of inflammation are suggested culprits.^{34,35}

Nutritional status influences the risk of developing sarcopenia, cachexia, frailty, and long-term disability.³⁶ Malnutrition has multiple definitions, with one being a state resulting from lack of intake or uptake of nutrition that leads to altered body composition (decreased fat free mass) and body cell mass leading to diminished physical and mental function and impaired clinical outcome from disease.^{37,38} This results in a loss of muscle mass, diminished grip strength, and increased fluid accumulation.³⁶ In malnutrition, amino acids and energy levels are depleted, with a reduction in myocardial mass and skeletal muscle mass if unaddressed over a longer period of time.³⁹ Whether assessed by the Geriatric Nutritional Risk Index (GNRI), Mini Nutritional Assessment (MNA), or Subjective Global Assessment (SGA), the prevalence of malnutrition in hospitalized patients is demonstrably increasing.⁴⁰ The MNA score in elderly patients with acute myocardial infarction (AMI) may be useful for prognostic stratification and identifying those who have malnutrition or are at risk of developing malnutrition. However, the MNA consists of 18 items: measurements of body mass index (BMI), calf and mid-arm circumference, questions on food and beverages intake, weight loss, acute disease, mobility, psychological stress, depression, dementia, independent living, polypharmacy, pressure injuries, and self-view of nutritional and general clinical status, and as such, it would be resource and time intensive for providers to perform this assessment on each elderly patient they encounter.⁴¹ Short Form MNA (MNA-SF) was created by picking 6 high sensitivity questions from MNA- screening for reduced oral intake, weight loss, mobility, psychological stress, neuropsychological problems, BMI and calf circumference⁴² with a score <7 indicating malnutrition.⁴³

Malnutrition continues to be underdiagnosed in a high proportion of patients admitted to the hospital, and more so in patients with cardiovascular disease. A study of the Korean Acute Myocardial Infarction Registry (KAMIR) found the prevalence of malnutrition was 18% in patients hospitalized with AMI using the GNRI score and they reported that this independently influenced the rates of in-hospital mortality and post myocardial infarction complications.⁴⁴ Research done using the National Inpatient Sample found that protein energy malnutrition was associated with several adverse outcomes including higher mortality, cardiogenic shock, need for intraortic balloon pump, discharge to a rehabilitation facility and increased length of stay.^{45,46,47} These studies also highlight that females, blacks, and the elderly were more likely to have protein energy malnutrition.^{45,46} The lower prevalence of

malnutrition seen in patients with myocardial infarction through survey of administrative databases stems from inadequate identification, documentation and use of the ICD codes for malnutrition indicating inadequate screening for malnutrition in daily clinical practise.⁴⁵

Malnutrition and frailty can co-exist in a patient, yet they are two different clinical syndromes.^{48,49} Malnutrition refers to a protein-calorie imbalance, which responds to nutritional interventions.^{48,49} Frailty stems from inactivity, increased cytokine activity with increased inflammation, muscle catabolism following reduced muscle loading and is further fueled by malnutrition.⁴⁹

Unfortunately, screening for frailty and malnutrition by both cardiologists and primary care providers is continually overlooked in everyday practice, and this needs to change. Quality improvement initiatives can be implemented at institutional levels to enhance screening. Electronic medical record instruments that alert clinicians using accumulated deficit models may also further aid clinicians in identifying patients at risk. Clinicians must consider the nutritional status and physical performance of patients as a part of their diagnostic and therapeutic decision making. As identification of frailty and malnutrition is improved, timely interventions are also required. Cardiologists and primary care physicians must work with multi-disciplinary partners including geriatricians, physical therapists, social workers, and nutritionists to improve the functional capacity, nutritional status and ultimately clinical outcomes of patients with the above syndromes.

Contributorship

SA, SK, and AK were responsible for drafting the manuscript. VG provided supervision, critical analysis and edited the manuscript. All authors interpreted the work and critically revised the manuscript. All authors approved the final manuscript as submitted.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

None.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Guarantor

SA is the guarantor for the manuscript.

ORCID iD

Samiullah Arshad  <https://orcid.org/0000-0003-0749-0367>

References

- Cardiovascular diseases (CVDs) [Internet]. Who.int. 2021 [cited 2021 Sep 1]; Available from: [https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)).
- Wleklik M, Uchmanowicz I, Jankowska EA, et al. Multidimensional approach to frailty. *Front Psychol* 2020; 11: 64. PMID: 32273868; PMCID: PMC7115252.
- Xue QL. The frailty syndrome: definition and natural history. *Clin Geriatr Med* 2011; 27: 1–15. PMID: 21093718; PMCID: PMC3028599.
- Mehrabi F and Béland F. Effects of social isolation, loneliness and frailty on health outcomes and their possible mediators and moderators in community-dwelling older adults: a scoping review. *Arch Gerontol Geriatr* 2020; 90: 104119. Epub 2020 Jun 6. PMID: 32562956.
- da Silva Coqueiro R, de Queiroz BM, Oliveira DS, et al. Cross-sectional relationships between sedentary behavior and frailty in older adults. *J Sports Med Phys Fitness* 2017; 57: 825–830. Epub 2016 Mar 9. PMID: 26959875.
- Clegg A, Young J, Iliffe S, et al. Frailty in elderly people. *Lancet* 2013 Mar 2; 381: 752–762. Epub 2013 Feb 8. Erratum in: *Lancet*. 2013 Oct 19;382(9901):1328. PMID: 23395245; PMCID: PMC4098658.
- Fried LP, Tangen CM, Walston J, et al. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001; 56: M146–M156. PMID: 11253156.
- Cesari M, Gambassi G, van Kan GA, et al. The frailty phenotype and the frailty index: different instruments for different purposes. *Age Ageing* 2014; 43: 10–12. Epub 2013 Oct 16. PMID: 24132852.
- Alves S, Teixeira L, Ribeiro O, et al. Examining frailty phenotype dimensions in the oldest old. *Front Psychol* 2020; 11: 34. PMID: 32273861; PMCID: PMC7113383.
- Rockwood K, Song X, MacKnight C, et al. A global clinical measure of fitness and frailty in elderly people. *CMAJ* 2005; 173: 489–495. PMID: 16129869; PMCID: PMC1188185.
- Goldstein JP, Andrew MK and Travers A. Frailty in older adults using pre-hospital care and the emergency department: a narrative review. *Can Geriatr J* 2012; 15: 16–22. Epub 2012 Mar 14. PMID: 23259013; PMCID: PMC3516240.
- Mendiratta P and Latif R. Clinical frailty scale. In: *Statpearls [internet]*. Treasure Island (FL): StatPearls Publishing, 2021 Jan. [Updated 2021 Jun 20]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK559009> (accessed 1 September 2021)
- Rolfson DB, Majumdar SR, Tsuyuki RT, et al. Validity and reliability of the edmonton frail scale. *Age Ageing* 2006; 35: 526–529. Epub 2006 Jun 6. PMID: 16757522; PMCID: PMC5955195.
- Podsiadlo D and Richardson S. The timed “up & go”: a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc* 1991 Feb; 39: 142–148. PMID: 1991946.
- Turner G and Clegg A. Best practice guidelines for the management of frailty: a British geriatrics society, age UK and royal college of general practitioners report. *Age Ageing* 2014; 43: 744–747. PMID: 25336440.
- Ellis G, Gardner M, Tsiachristas A, et al. Comprehensive geriatric assessment for older adults admitted to hospital. *Cochrane Database Syst Rev* 2017; 9: CD006211. PMID: 28898390; PMCID: PMC6484374.
- Pilotto A, Cella A, Pilotto A, et al. Three decades of comprehensive geriatric assessment: evidence coming from different healthcare settings and specific clinical conditions. *J Am Med Dir Assoc* 2017 Feb 1; 18: 192.e1–192.e11. Epub 2016 Dec 31. PMID: 28049616.
- Ramírez-Vélez R, López Sáez De Asteasu M, Morley JE, et al. Performance of the short physical performance battery in identifying the frailty phenotype and predicting geriatric syndromes in community-dwelling elderly. *J Nutr Health Aging* 2021; 25: 209–217.
- Fisher S, Ottenbacher KJ, Goodwin JS, et al. Short physical performance battery in hospitalized older adults. *Aging Clin Exp Res* 2009; 21: 445–452. PMID: 20154514; PMCID: PMC2822997.
- Pavasini R, Guralnik J, Brown JC, et al. Short physical performance battery and all-cause mortality: systematic review and meta-analysis. *BMC Med* 2016; 14: 15. PMID: 28003033; PMCID: PMC5178082.
- Belletiere J, Lamonte MJ, Unkari J, et al. Short physical performance battery and incident cardiovascular events among older women. *J Am Heart Assoc* 2020; 9: e016845. Epub 2020 Jul 14. PMID: 32662311; PMCID: PMC7660732.
- Kojima G. Frailty defined by FRAIL scale as a predictor of mortality: a systematic review and meta-analysis. *J Am Med Dir Assoc* 2018; 19: 480–483. PMID: 29793675.
- World Health Organization. *ICD-10 : international statistical classification of diseases and related health problems : tenth revision*. 2nd ed. Geneva, Switzerland: World Health Organization, 2004. <https://apps.who.int/iris/handle/10665/42980>
- Gilbert T, Neuburger J, Kraindler J, et al. Development and validation of a Hospital Frailty Risk Score focusing on older people in acute care settings using electronic hospital records: an observational study. *Lancet* 2018; 391: 1775–1782. Epub 2018 Apr 26. PMID: 29706364; PMCID: PMC5946808.
- Gobbens RJJ, van Assen MALM, Luijckx KG, et al. The Tilburg Frailty Indicator: psychometric properties. *J Am Med Dir Assoc* 2010; 11: 344–355.
- Fawzy AM, Lakhani H and Wyrko Z. 5Frailty Assessment in patients undergoing cardiovascular interventions: a quality improvement project. *Age Ageing* 2019; 48: i1–i15.
- Orkaby AR, James K, Leuchtenburg J, et al. Taking prevention to the next step: implementation of a brief, sustainable frailty assessment in a cardiology clinic. *BMJ Open Qual* 2021; 10: e001140. PMID: 33408100; PMCID: PMC7789440.
- Bruyère O, Buckinx F, Beaudart C, et al. How clinical practitioners assess frailty in their daily practice: an international survey. *Aging Clin Exp Res* 2017; 29: 905–912. Epub 2017 Aug 2. PMID: 28770478; PMCID: PMC5589778.
- Liperoti R, Vetrano DL, Palmer K, et al. Association between frailty and ischemic heart disease: a systematic review and meta-analysis. *BMC Geriatr* 2021; 21: 57. Epub ahead of print June 10, 2021.
- Ekerstad N, Swahn E, Janzon M, et al. Frailty is independently associated with 1-year mortality for elderly patients with non-ST-segment elevation myocardial infarction. *Eur J Prev Cardiol* 2014; 21: 1216–1224.
- Matsuzawa Y, Konishi M, Akiyama E, et al. Association between gait speed as a measure of frailty and risk of cardiovascular events after myocardial infarction. *J Am Coll Cardiol* 2013; 61: 1964–1972.

32. Damluji AA, Huang J, Bandeen-Roche K, et al. Frailty among older adults with acute myocardial infarction and outcomes from percutaneous coronary interventions. *J Am Heart Assoc* 2019; 8: e013686.
33. Dou Q, Wang W, Wang H, et al. Prognostic value of frailty in elderly patients with acute coronary syndrome: a systematic review and meta-analysis. *BMC Geriatr* 2019; 19: 22. PMID: 31416442; PMCID: PMC6694517.
34. Hubbard RE, O'Mahony MS, Savva GM, et al. Inflammation and frailty measures in older people. *J Cell Mol Med* 2009; 13: 3103–3109.
35. Uchmanowicz I. Oxidative stress, frailty and cardiovascular diseases: current evidence. *Adv Exp Med Biol* 2020; 1216: 65–77.
36. Gingrich A, Volkert D, Kiesswetter E, et al. Prevalence and overlap of sarcopenia, frailty, cachexia and malnutrition in older medical inpatients. *BMC Geriatr* 2019; 19: 20.
37. Elia M. Defining, recognizing, and reporting malnutrition. *Int J Low Extrem Wounds* 2017; 16: 230–237. Epub 2017 Nov 16. PMID: 29145755.
38. Cederholm T, Barazzoni R, Austin P, et al. ESPEN guidelines on definitions and terminology of clinical nutrition. *Clin Nutr* 2017; 36: 49–64. Epub 2016 Sep 14. PMID: 27642056.
39. Skipper A. Agreement on defining malnutrition. *JPEN J Parenter Enteral Nutr* 2012; 36: 261–262.
40. Webb JG, Kiess MC and Chan-Yan CC. Malnutrition and the heart. *CMAJ* 1986; 135: 753–758. PMID: 3093042; PMCID: PMC1491347.
41. Abd Aziz NAS, Teng NIMF, Abdul Hamid MR, et al. Assessing the nutritional status of hospitalized elderly. *Clin Interv Aging* 2017; 12: 1615–1625.
42. Rubenstein LZ, Harker JO, Salvà A, et al. Screening for undernutrition in geriatric practice: developing the short-form mini-nutritional assessment (MNA-SF). *J Gerontol A Biol Sci Med Sci* 2001; 56: M366–M372.
43. Soysal P, Veronese N, Arik F, et al. Mini nutritional assessment scale-short form can be useful for frailty screening in older adults. *Clin Interv Aging* 2019; 14: 693–699. PMID: 31118593; PMCID: PMC6475097.
44. Yoo SH, Kook HY, Hong YJ, et al. Influence of undernutrition at admission on clinical outcomes in patients with acute myocardial infarction. *J Cardiol* 2017; 69: 555–560.
45. Adejumo AC, Adejumo KL, Adegba OM, et al. Inferior outcomes of patients with acute myocardial infarction and comorbid protein-energy malnutrition. *JPEN J Parenter Enteral Nutr* 2020; 44: 454–462.
46. Karim A, Fry E and Gupta V. Separating the impact of frailty and malnutrition on in-hospital outcomes in patients with acute myocardial infarction. *J Am Coll Cardiol* 2021; 77: 15.
47. Karim AM, Panhwar M and Al-Kindi S. Malnutrition and in-hospital outcomes in patients admitted for acute myocardial infarction. *J Am Coll Cardiol* 2020; 75: 9.
48. Laur CV, McNicholl T, Valaitis R, et al. Malnutrition or frailty? Overlap and evidence gaps in the diagnosis and treatment of frailty and malnutrition. *Appl Physiol Nutr Metab* 2017; 42: 449–458. Epub 2017 Mar 21. PMID: 28322060.
49. Jeejeebhoy KN. Malnutrition, fatigue, frailty, vulnerability, sarcopenia and cachexia: overlap of clinical features. *Curr Opin Clin Nutr Metab Care* 2012; 15: 213–219.