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CURRENT SITUATION OF FRAILTY SCREENING TOOLS FOR OLDER ADULTS

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Abstract: Frailty is a geriatric syndrome associated with adverse outcomes such as falls, disability, and mortality. Frailty is common and contributes to rising health care costs. Early screening and timely tailored intervention may effectively prevent or delay the adverse outcomes in older adults. Studies on frailty and its specific measurement tools are increasing in number, but the debate on the screening instruments remains. Currently, self-reported screening tools can identify frailty and predict the risk of adverse outcomes in older adults. Because they are easy to use and quickly provide information, self-reported frailty screening tools have significant implication in primary care settings and clinics. We reviewed the frailty screening instruments in older adults and proposed a two-step pathway for frailty identification, and to manage declines in intrinsic capacity as well as boost resilience.

Key words: Frailty, screening tool, older adults, intrinsic capacity.

Introduction

The number of older adults is increasing globally. Those aged 60 years or older are predicted to constitute 22% of the population by 2050 (1). As the mortality rate of older adults decreases, the aging population will require high-quality medical services, thereby increasing the cost of an aging society in health care (2). Frailty is a common geriatric syndrome, affecting 4% to 59% of older people according to different socio-economic conditions (3). The prevalence of frailty continues to increase, which contributes to the spiraling costs in geriatric health care.

The construct of frailty has emerged over the past decade and has become central to research on aging. So far, no frailty standards exist. In a recent systematic review, of the 79 frailty instruments, only 5 were linked to all the five International Classification of Functioning, Disability, and Health components, which highlights the heterogeneity in frailty operationalization (4). In particular, the evidence of outcome benefits for early screening and prevention of frailty is not well established, though exercise appears to be helpful (5). Frailty assessment may be able to identify frailty and predict patients' health outcomes and responses to therapies. Although the use of frailty measures and related outcomes in interventional studies is not well systematized, and is the subject of a future systematic review of randomized controlled trials (6), the predictive power of frailty criteria in various settings such as primary care (7), critical care (8), emergency care (9), cardiac diseases (10), renal diseases (11), surgery (12), and oncology (13) has been identified. Therefore, early screening and timely preventive management may effectively prevent or delay the adverse outcomes of frailty. As many reviews on frailty tools currently exist (14–19), the rigor of a meta-analysis or systematic review was beyond the scope of the article. We aimed to 1) review some of the widely-used performed frailty assessment tools; 2) summarize the validated self-reported frailty screening tools; and 3) propose a two-step approach for frailty assessment in older adults in this review.

Understanding of frailty

Frailty as a biological syndrome or cumulative deficits

Frailty is a geriatric syndrome resulting from a cumulative decrease in multiple physiological systems and a consequent reduction in the reserves and defense ability, with adverse outcomes such as falls, hospitalization, disability, and death (20–22). There are currently two major concepts of frailty: the frailty phenotype (20) and the cumulative deficits (23). The frailty phenotype is defined by the presence of three or more of five components (20): unintentional weight loss, slow gait speed, weak grip strength, complaints of fatigue, and inactivity, and it is the best-known instrument for defining and measuring the biological syndrome. The frailty index (FI) combines symptoms, disease, cognition, and disability (23), and is by far the best-known operationalization of the state of cumulative deficits.

Frailty as a multidimensional syndrome

The concept of frailty has been in development for much longer (24–26) than the above two proposed measures. Informed by past treatment of the issues and controversies (27), there is also growing consensus on a set of multidimensional core features including physical performance, nutritional status, mental health, and cognition (28). Social factors are

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associated with physical function and frailty (29, 30). A group in Europe considered frailty to be multi-dimensional, involving physical, psychological, and sociological aspects (31). This multidimensional syndrome aligns nicely with the term currently preferred by the World Health Organization, "intrinsic capacity", which focuses on five domains: locomotion, vitality, cognition, psychology, and sensory (32). Recently, a National Institute on Aging workshop on measures of physiologic resilience showed that the concept of resilience could be applied to "psychological, behavioral, physiologic, clinical, and social outcomes" (33), which implies the potential multidimensional nature of resilience. Therefore, both the construct of intrinsic capacity and resilience could be multidimensional, not only regarding the biological frailty phenotype, but also could be related to the comprehensive approach (32, 34). The frailty phenotype and FI dichotomy likely do represent a conceptual divide between frailty as a syndrome, and as a state, respectively. Frailty is a "state of increased vulnerability" (35) and manifests as a multidimensional syndrome, especially following conditions of stress, resulting in adverse outcomes.

Frailty is reversible

It is widely recognized that frailty is associated with an increased risk of adverse health outcomes, such as death (36–38), loss of autonomy (31), disability (39), falls (40), and hospitalization (41). Some frailty characteristics are also found in the normal aging process, such as a decrease in physiological reserves, organ functions, and functional reserves, as well as a loss of complexity. The concept of frailty does not overlap with that of diseases; frailty can increase the risk of developing a disease, which in turn may increase frailty risk (35). Although frailty triggers events that reduce body function, it is not an inevitable outcome of aging; the progression of frailty may be reversible if it is diagnosed and early intervention is instituted.

Frailty measurement instruments

Thus far, dozens of frailty assessment tools have been reported in the literature. The predictive effects of many frailty assessment tools on health outcomes and disease prognosis have been verified. Frailty assessment tools may be classified as applicable to community-dwelling population, inpatients, or both. This review describes some important assessment tools with regard to whether they are performed or self-reported.

Performed frailty tools

Given the large number of performed frailty instruments, we further subcategorized the tools into physical frailty tools, cumulative deficits tools, physical performance measure, multidimensional frailty tools, and judgment-based measure (14), and provided examples of each category (Fig.1).

Physical frailty tools

Cardiovascular Health Study criteria

Fried frailty phenotype is referred to as the Cardiovascular Health Study (CHS) index, which is based on the biological theory and can predict adverse clinical outcomes (20). It depicts frailty as a "geriatric syndrome" resulting from causal relationships among multiple factors leading to uniform clinical presentations through a common pathway, such as inflammation and testosterone deficiency leading to decreased muscle mass (42). It is based on an integrated biological perspective and overall state instead of focusing on the simple aspects of frailty. Due to this underlying physiological basis, it has been widely employed by many researchers (43–45). This assessment requires the use of special equipment such as a dynamometer as well as a complex questionnaire on energy consumption (Minnesota Leisure Time Activity); however, it remains the most evaluated and popular assessment tool available in clinical and research settings (15).

Study of Osteoporotic Fracture scale

The Study of Osteoporotic Fracture (SOF) scale has three components: involuntary weight loss, difficulty in performing the chair stand test, and fatigue, which indicates that frailty is a phenotype with potential biopathogenesis (46). Frailty is diagnosed when two or more components are present. It is easy to use and can independently predict adverse outcomes in community-dwelling residents (47). However, there might be safety issues with performing the chair stand test without supervision; thus, a supervisor/assessor is still needed. The SOF scale is suitable for population screening and clinical assessment of adverse prognostic outcomes correlated with the CHS and FI (46, 48).

Cumulative deficits tools

Frailty index of cumulative deficits

The FI was first defined by Rockwood and Mitnitski based on the deficit accumulation model of frailty (23). The FI comprises 70 multidimensional health deficits including physiology, psychology, and medical history. A higher number of health deficits indicates more severe frailty, with 0 representing the least frailty and 1 representing the most severe frailty. The FI of cumulative deficits (FI-CD) has been well-verified in aging and healthy research (49), and seems to be most suitable for use in outcome prediction. However, it is not easy to use because of its mathematical nature and time-consuming.

Claims-Based Frailty Index

A claims-based frailty index (CFI) was created using Medicare data based on the FI-CD, and was shown to be a good predictor of disability, mobility impairment, and falls. Conducting stratified analyses according to the different levels

of CFI is useful in individual prevention and intervention of frailty (50).

The Care Assessment Need Score

The Care Assessment Need (CAN) score is automatically generated from electronic health record data. It has been determined to be a predictor of hospitalization and mortality in veteran populations and provides acceptable diagnostic accuracy, which indicates that CAN might be a useful tool to detect frailty in primary care (51).

Physical performance measure

Physical performance measures such as gait speed, chair stands and grip strength can be used as single measures for frailty. Gait speed is associated with survival in older adults (52, 53). A gait speed of ≤ 0.8 m/s has a sensitivity of 0.99 for identifying frailty (18), and is inversely associated with FI (53); furthermore, it has been suggested as a new frailty screening test in older cancer patients to guide the implementation of a CGA in a recent systematic review (54). We previously found that self-reported inactivity could predict mortality in the older population (55). In all, although the measurement of a single function does not capture the complex nature of frailty, it could potentially be used by clinicians and researchers because it is quick and easy to perform.

Multidimensional frailty tools

Multidimensional Prognostic Index

The Multidimensional Prognostic Index (MPI), developed as a prognostic tool for elderly inpatients, is a multidimensional assessment tool for frailty and is simpler than the FI-CD56. The MPI is derived from eight domains and includs a total of 63 items from CGA: number of drugs, activities of daily living, instrumental activities of daily living, mental state, nutrition, risk of pressure score, comorbidity, and social network. Questions about each domain are classified as "major problem" (score of 1), "minor problem" (score of 0.5), or "none" (score of 0). The scores are then summed and divided by 8, with a score of ≥ 0.66 indicating frailty (56). The MPI has shown a greater ability to predict adverse prognoses in patients with a variety of clinical conditions (56, 57) and population-based cohort (58). It might be useful in making treatment decisions and monitoring the efficacy and safety of therapies in frail older patients (59).

Edmonton Frailty Scale

The Edmonton Frailty Scale (EFS) consists of nine components: cognition, general health status, functional independence, social support, medication use, nutrition, mood, continence, and functional performance (60). The degree of frailty can be determined based on the score: healthy (0–5), frailty (6–7), mild frailty (8–9), moderate frailty (10–11), and severe frailty (12–17) (60). EFS was associated with several geriatric conditions such independence, drugs assumption, mood, mental, functional and nutritional status (61). Since the EFS is easier to extract from comprehensive geriatric assessment (CGA) than the FI derived from CGA (FI-CGA), it is increasingly used to identify frailty in specific clinical conditions such as acute coronary syndrome (62). Modified versions of the EFS have been developed for assessing the prognoses of older adults with acute diseases overcoming the limitations associated with clock drawing (63, 64).

Frailty index derived from comprehensive geriatric assessment

The FI-CGA comprises multiple aspects such as cognition, emotion, motivation, strength, activity, balance, incontinence, social support, and complications. However, under strict time constraints, it is more frequently used than the FI-CD in inpatient clinical research and clinical judgement (65–67); its use in community research is limited (68, 69). The FI-CGA has been proven to be able to predict the prognosis in the general population and in patients with many types of diseases, such as cardiovascular disease (65, 70).

Judgment-based instruments

Clinical Frailty Scale

The Clinical Frailty Scale (CFS) is often used in older inpatients. It consists of four dimensions: mobility, energy, physical activity, and functioning (31). The CFS is a grading assessment tool in which abilities are classified into nine grades. A higher degree of frailty is assigned a higher grade; grade 1 indicates the patient is very fit, grade 5 indicates mildly frail, grade 7 indicates severely frail, and grade 9, the highest grade, indicates terminally ill (71). The CFS can be extracted from medical data or CGA data and has proven to be an indicator of adverse prognoses in older inpatients (71) and can reliably assess frailty in the intensive care unit (72).

Gérontopôle Frailty Screening Tool

The Gérontopôle Frailty Screening Tool (GFST) is a screening tool that can identify frailty early in elderly community-dwelling residents (73, 74). It requires two steps: first, a frailty questionnaire including six components (living alone, involuntary weight loss, fatigue, mobility, memory complaints, and slow walking speed) is administrated, followed by the identification of frailty status by physicians (74). The limitation is that it is largely based on the subjective clinical judgment of a clinician since it includes a question for clinical physicians: "do you think your patient is frail?"

Self-reported frailty screening tools

The above performed frailty assessments can be challenging in routine primary care because most of them are time-consuming, and some tools require special instruments such as dynamometer; furthermore, old persons' self-evaluated

frailty would decrease the burden of healthcare professionals and potentially anticipate possible preventive interventions against the disabling process (75). Thus, quick, simple, and feasible screening tools are needed for early detection and intervention for frailty. Several reliable and valid self-reported questionnaires have been effectively employed in primary care and clinical settings (37, 76–80). They vary by the number of items included, whether self-completed during a clinical encounter or delivered by mail. Clinicians would benefit from a self-reported tool that assists them in identifying older persons with frailty. As we have compared 12 self-reported frailty screening tools in our previous paper from the five aspects: population (origin and cross-culture), frailty components (physical function, cognition, and social function), simple to apply (time [<5 min], special equipment, assessor training, and CGA data), primary use (frailty risk factor, and frailty biomarker), and validity (large sample [>1000], agreement with a frailty criteria, and outcome prediction) (37), we provides examples of self-reported frailty screening tools in this review.

Self-reported physical frailty screening tools

Fatigue, resistance, ambulation, illness, and loss of weight index scale

The fatigue, resistance, ambulation, illness, and loss of weight (FRAIL) scale were proposed by the International Association of Nutrition and Aging and have five components: fatigue, resistance, ambulation, illness, and loss of weight. Frailty is diagnosed when three or more components are present (76). A recent study compared FRAIL items with the Fried phenotype criteria, and found an independent diagnostic property except for weight loss (81). Due to its time- and cost-effectiveness, the FRAIL has been widely adopted, and is valid and suitable for use in older adults in China and Australia (82, 83). FRAIL scale scores might demonstrate a closer relationship with dialysis-related complications (84).

Frailty Screening Questionnaire

The Frailty Screening Questionnaire (FSQ) scale is a self-reported questionnaire with a biological underpinning based on the Fried criteria: slowness (had difficulty walking 250 meters, score of 1), weakness (had difficulty in lifting or carrying something weighing 5 kilograms, score of 1), inactivity (weekly exercise <3 hours/week, score of 1), and exhaustion (responded yes to either “Everything I did required an effort” or “I could not get going” in the past week, score of 1). A score of ≥ 3 indicated frailty. FSQ frailty (HR = 3.94) and pre-frailty (HR = 1.89) were associated with a higher mortality rate, and slowness was the strongest predictor of mortality, while the combination of the four components provided the best risk prediction in a representative large Chinese population (37). This tool needs to be further validated in other populations.

Frail Non-Disabled Instrument

The Frail Non-Disabled (FiND) questionnaire is used to identify frail older persons without mobility disability. It consists of five questions, of which two questions related to physical disability (the ability to walk 400 m and climb a flight of stairs), and the other three questions aimed at identifying frailty (weight loss, exhaustion, and sedentary behavior). Those who meet the no mobility disability and no frailty criteria are considered as robust. It has a substantial agreement with the Fried phenotype and is the only assessment tool that can differentiate frailty from disability (75).

Self-reported multidimensional frailty screening instruments

Tilburg Frailty Index

The Tilburg Frailty Index (TFI) consists of 15 self-reported items in three dimensions: physiological factors (health, weight loss, walking difficulty, balance, hearing, visual acuity, grip strength, and fatigue), psychological factors (memory, sensory, anxiety, and coping capacity), and sociological factors (solitude, social relations, and social support). A score of ≥ 5 indicates frailty (77). The TFI is effective and reliable for community-dwelling older adults (77). Some studies have revealed that the physiological factors of the TFI demonstrate stronger predictive power than the sociological factors for adverse outcomes (85). Further studies on the application of the TFI for specific groups such as patients in the hospital or admitted to an emergency department are needed (86).

Groningen Frailty Indicator

The Groningen Frailty Indicator (GFI) consists of 15 binary-classification, self-reported items, including mobility, vision, hearing, nutrition, comorbidity, cognition, psychosocial and physical fitness. The total score is 0–15. Scores of ≥ 4 indicate frailty (87). The GFI has good feasibility and reliability and is widely used for older residents of assisted living facilities (88).

Sherbrooke Postal Questionnaire

The Sherbrooke Postal Questionnaire (SPQ) is a mail questionnaire consisting of six questions: solitude, ≥ 3 drugs, mobility, vision, hearing, and memory (89). Each question requires either a “yes” or “no” answer. A total score of ≥2 is considered to indicate frailty; the sensitivity is 75%, and the specificity is 52% (90). In comparison with the TFI and GFI, the SPQ is less efficient for the identification of frailty (90).

PRISMA-7 Questionnaire

The PRISMA-7 questionnaire identifies frailty via 7 self-reported items: age, gender, activity-limited, requires regular assistance, a health problem requiring the patient to stay at home, social support, and use of a wheelchair or walking aids. A total score of ≥ 3 indicates frailty (91). The PRISMA-7 questionnaire has high sensitivity for identifying frailtyin the community (92) and in the emergency department (93), and

as a case-finding tool to identify older adults with moderate to severe disabilities (91).

Is there a best measurement tool for frailty?

A two-step frailty measurement: First step - case finding in primary care, second step - assess

Frailty measures should be evaluated in line with the goal of the frailty tool in trying to understand the underpinning biology, to help with diagnosis and care planning, or to stratify risk for worse outcomes. Each frailty assessment instrument should be matched to the purpose and context of its use (19). With this perspective, all of the above frailty assessments can be categorized into two types of frailty measures: those for case-finding and those for assessment according to their different levels of complexity and the necessary sensitivity and specificity (94). Although the frailty phenotype and the FI are the most commonly used, to provide the best understanding of frailty, other assessments should also be considered (15). Furthermore, a recent study found that a stepped approach named "EASY-Care Two step Older people Screening" which aimed to help family physicians identify frail adults in primary care, could predict adverse outcomes efficiently (95, 96), but family physicians are involved in the entire process. As a better solution to quickly screen and provide intervention for a target population, we propose a two-step pathway. The first step is case-finding in primary care, using quick frailty screening tools, which can easily be implemented within a short time without equipment and special training, to detect frailty in all the individuals. The second step involves using a complex instrument to define the care demand at the individual level, only to the frail ones (97) (Fig 1).

Self-reported tools: much quicker and easier to apply in screening a target population

A better frailty case-finding tool in primary care and clinic settings should be quick and easy to supply, if possible, could be administered by phone, and not affected by different administrators. The FSQ is one such tools that could detect frailty and accurately predict the risk of long-term negative outcomes in the community-dwelling elders (37). Unlike the performed frailty instrument, self-reported tools do not require any equipment or professional training and can be managed by any multidisciplinary team in any location. Interestingly, self-reported function is found to be slightly more informative than frailty phenotype in predicting adverse postoperative course in older adults (37, 80), and has also been applied in community-dwelling elders (98), and in patients with chronic kidney disease and end-stage renal disease (99, 100). Thus, self-reported functional status may be more feasible for identifying high-risk older adults.

Limitation of the self-reported frailty screening tools

One major limitation of the self-reported questionnaires is that the validity of the self-reported data might be influenced by the cognition status of the participants (90). Participants with severe cognitive impairment may provide non-reliable information which leads to an underestimated frailty prevalence or misleads the intervention of frailty.

Future perspectives

Firstly, more work needs to be done to translate the current self-reported tools into subspecialized clinical work. Although the use of frailty assessment tools could identify older adults most vulnerable to a wide variety of adverse health outcomes, translation of frailty measures into clinical practice has lagged (21, 101). According to a systematic review, there is still a scarcity of frailty assessment for the purpose of clinical decision making and as an interventional target (19). Environmental and personal factors should also be considered in frailty assessment (4). Therefore, self-reported tools should be specific to individuals with different diseases. Secondly, a grade score will be more helpful for clinicians in care planning, outcome measurement, risk stratification, and therapy response evaluation; thus, further studies on a grade score are needed in clinical settings (94). Thirdly, a dynamic assessment is also necessary to better capture the change and complex nature of frailty which are important for planning interventions. Lastly, the validity and feasibility of these instruments need to be studied, and the inconsistency between performed and self-reported frailty tools should be considered. Though easy and quick screening tools are important in the clinical setting, the agreement in identifying frailty using different assessment tools are not good (102, 103). Johansen et al. proposed that patients who meet the self-report-based but not the performance-based definition of frailty may constitute an intermediate group between non-frail and frail groups (104). Clinicians may use frailty measure as a case-finding strategy to augment their assessment opportunistically. Alternatively, one can anticipate more systematic case-finding in the primary care setting based on pre-set criteria of risk.

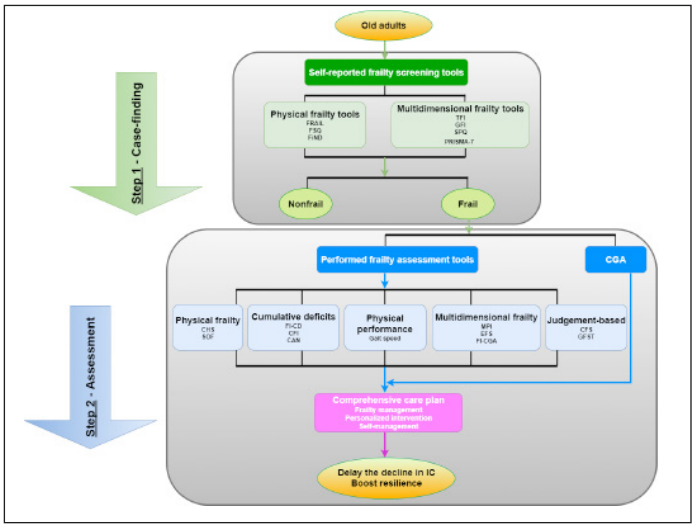
Conclusion

Frailty is a state of vulnerability to stressors that is prevalent in older adults and is associated with worse prognosis. Frailty screening and assessment is a fundamental issue in primary care for clinicians, researchers, and health care organizations. Multiple instruments are used to measure frailty; most are time-consuming, and may thus be modified or adapted to different conditions. Self-reported frailty screening tools, simple to answer by the participants, easy to implement, quick to use and interpret by non-specialist staff, may lead to earlier recognition of frailty and potentially improve healthcare outcomes in the older population. Several self-reported frailty

screening tools are available for older adults, and most of them have been verified as able to predict the prognosis. However, the reliability of many frailty assessment tools has not yet been verified. Thus far, no study has demonstrated an optimal assessment tool for guiding clinical management, and the selection of an assessment tool still relies on specific clinical conditions. Frailty screening should be tied to risk identification and personalized intervention. From this perspective, a two-step approach for frailty assessment might be a better solution. A simple self-reported screening questionnaire offers a simple and quick way of identifying frail older adults who would benefit from further complex assessment. Self-reported screening combined with clinical practices will provide clinical physicians with strategies for early identification and management of frailty in both community and clinical settings, and to further develop tailored interventions aimed at delaying the declines in intrinsic capacity and promoting resilience in the older population.

Figure 1

A schematic overview of a two-step pathway. The first step (case-finding) is performed by non-specialist staff or participants themselves, using self-reported screening tools. The second step (assessment) is conducted by trained professionals using complex, time-consuming or equipment required performed frailty assessment tools or CGA, which will be followed by comprehensive care planning, including personalized intervention for frailty to delay decline in intrinsic capacity and boost resilience



Abbreviations: FRAIL, the fatigue, resistance, ambulation, illness, and loss of weight scale; FSQ, Frailty Screening Questionnaire; FiND, the Frail Non-Disabled; TFI, Tilburg Frailty Index; GFI, Groningen Frailty Indicator; SPQ, Sherbrooke Postal Questionnaire; CGA, Comprehensive Geriatric Assessment; CHS, Cardiovascular Health Study; SOF, Study of Osteoporotic Fracture; CFI, Claimed-based Frailty Index; CAN, Care Assessment Need; MPI, Multidimensional Prognosis Index; EFS, Edmonton Frailty Scale; CFS, Clinical Frailty Scale; GFST, Gérontopôle Frailty Screening Tool; IC, intrinsic capacity.

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