Review

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Global frailty screening tools: Review and application of frailty screening tools from 2001 to 2023

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SUMMARY As the aging population increases globally, health-related issues caused by frailty are gradually coming to light and have become a global health priority. Frailty leads to a significantly increased risk of falls, incapacitation, and death. Early screening leads to better prevention and management of frailty, increasing the possibility of reversing it. Developing assessment tools by incorporating disease states of older adults using effective interventions has become the most effective approach for preventing and controlling frailty. The most direct and effective tool for evaluating debilitating conditions is a frailty screening tool, but because there is no globally recognized gold standard, every country has its own scale for national use. The diversity and usefulness of the frailty screening tool has become a hot topic worldwide. In this article, we reviewed the frailty screening tool published worldwide from January 2001 to June 2023. We focused on several commonly used frailty screening tools. A systematic search was conducted using PubMed database, and the commonly used frailty screening tools were found to be translated and validated in many countries. Disease-specific scales were also selected to fit the disease. Each of the current frailty screening tools are used in different clinical situations, and therefore, the clinical practice applications of these frailty screening tools are summarized graphically to provide the most intuitive screening and reference for clinical practitioners. The frailty screening tools were categorized as (*i*) Global Frailty Screening Tools in Common; (*ii*) Frailty Screening Tools in various countries; (*iii*) Frailty Screening Tools for various diseases. As science and technology continue to advance, electronic frailty assessment tools have been developed and utilized. In the context of Coronavirus disease 2019 (COVID-19), electronic frailty assessment tools played an important role. This review compares the currently used frailty screenings tools, with a view to enable quick selection of the appropriate scale. However, further improvement and justification of each tool is needed to guide clinical practitioners to make better decisions.

Keywords frailty, screening tools, early screening, aging, electronic frailty assessment tool

1. Introduction

Frailty is a complex clinical syndrome with multiple causes and contributing factors. Frailty leads to increased vulnerability to minor stress triggers and increased risk for adverse outcomes, such as disability, hospitalization and mortality (*1,2*). It is often manifested by a maladaptive response to stress triggers, leading to a vicious cycle toward functional decline and other serious adverse health outcomes. Frailty is characterized by diminished strength, endurance and physiological reserve across the neuromuscular, metabolic and immune systems (*3*), becomes more prevalent with age, imposing substantial burdens on patients and caregivers (*4*). Notably, old age itself does not define frailty because some patients are active despite advanced age, whereas others can have a functional decline in the absence of apparent stress factors or failure to rebound following hospitalization or illness (*5*). As a dynamic and reversible geriatric syndrome, it has become one of the important public health problems emerging around the world (*6*).

Frailty can affect anyone during all stages of life, and has a prevalence rate from 4 to 59.1% based on various demographic or socioeconomic conditions (*7*). A meta-analysis from China showed the prevalence of frailty in adults aged ≥ 5 0 years was 12-24% worldwide. Its prevalence ranged from 6-25% in adults aged 65-74 years, and an average of 10% in adults aged ≥ 85 years. Using a common frailty assessment instrument, an estimated 15% of non-institutionalized adults in the

United States are frail (*8*), and global estimates of frailty range from 3.5-27.3% (*9*). In Canada, about 25% of the population aged over 65 years are frail, and over 50% of the population aged ≥ 85 years are frail (*10*). Research has approximated that 10% of community dwelling older adults are considered frail and over 41% considered pre-frail in Canada (*11*). In Australia, frailty is estimated to range between 4.9 to 27.3%, depending on the region and the measurement instrument used, and the prevalence of pre-frailty– a "clinically silent" intermediate stage between non-frail/robust and frail ranged from 34.6 and 50.9% (*12*). Like many countries, Australia's population of older adults is rapidly increasing. It has been estimated that by 2031, 3.9 million Australians aged ≥ 65 years will be either be frail or at-risk of becoming frail (*13*). In Spain, for the community-dwelling population aged ≥ 65 years, frailty prevalence has been estimated to be 11%, and that of pre-frailty is estimated to be 35-40%. Prevalence increases with age and can reach as high as 50% in the population aged > 80 years, and is slightly higher in women than in men (*14*). Another study using physical frailty models in adults aged ≥ 50 years old from 62 countries showed that the highest prevalence of physical frailty was found in Africa (22%) and the lowest prevalence was in Europe (8%), while the pre-frailty prevalence was highest in the Americas (50%) and lowest in Europe (42%). However, using deficit accumulation models, the prevalence of frailty was found to be highest in Oceania (31%) and lowest in Europe (22%), while pre-frailty prevalence was highest in Oceania (51%) and lowest in Europe and Asia (49%). The population-level frailty prevalence among community-dwelling adults varied by age, sex, and frailty classification (*15*). This shows that frailty-related debilitation is a global problem which cannot be ignored, and the prevalence of debility varies from one debilitating assessment tool to another. However, there is no international consensus for a common definition of frailty. For that reason, many tools have been developed over the years to identify, measure and assess frailty.

2. Common global frailty screening tools

In the past decade, numerous tools have been developed to screen or assess frailty. Since the release of the "Fried Frailty Phenotype" (FP) scale by Fried *et al*. (*16*) in 2001, nearly 70 frailty scales have been developed to identify frailty with various aspects of physical, psychological, or social components. Nonetheless, each screening scale has its advantages in the disease setting for which it was developed, and the differences in the selection and application of debilitating scales are apparent and cannot be ignored. However, there is no standard assessment instrument. The most widely used measures are the FP (*16*) and the frailty index (FI), but these cannot be easily implemented in large-scale population studies or busy clinics (*17*). To assess frailty in large populations, it is important to find short-term rapid instruments that give reliable results for the risk of a negative event and to stratify older adults according to their level of frailty. In this way the most appropriate strategies can be chosen and applied to delay the functional decline associated to frailty and its consequences, such as hospitalization, institutionalization, low quality of life, and death (*18*). The common debilitation assessment scales provided by national and international literature and consensus of relevant guidelines are presented in Table 1.

2.1. Fried's Frailty Phenotype

The Fried's Frailty Phenotype (FP) tool proposed by Fried *et al*. (*16*) includes five items: unintentional weight loss (4.5 kg or more over the past year), exhaustion (self-reported), low physical activity, weakness (low grip strength), and walking speed. Individuals with two deficits were considered pre-frail, and those with three or more deficits were classified as frail. This tool is based on the biological causative theory and it is predictive of adverse clinical outcomes. Although this tool should be able to identify frailty and to predict adverse outcomes and is widely used in clinical and research settings (*19*), it requires the measurement of grip strength, which is not usually done in medical activities.

2.2. Groningen Frailty Indicator

The Groningen Frailty Indicator (GFI) (*20*) is a 15-item screening instrument to determine the level of frailty, which is available as a specialized and self-reported version. It measures the loss of functions and resources in four domains: physical (mobility functions, multiple health problems, physical fatigue, vision, hearing), cognitive (cognitive dysfunction), social (emotional isolation), and psychological (depressed mood and feelings of anxiety). The range of the GFI score is 0 to 15. Geriatric experts agreed that a score of 4 or higher represented moderate to severe frailty. Major drawbacks of most of these instruments are that they (*i*) assess frailty in specific older adult populations only (*e.g*., home-dwelling), (*ii*) do not contain a specialized and a self-assessed version, (*iii*) do not comprise of items that assess disability that could predict poor outcome, and (*iv*) do not allow for grades of frailty to be identified (*21*). The GFI (*20*) is an instrument that includes all these domains and meets the drawbacks of other instruments. The GFI is widely used in clinical practice (*i.e.*, geriatric centers, nursing homes, emergency departments, traumatology, pulmonology, rheumatology, and surgical medicine), in outpatient settings, and in clinical studies (*21*).

2.3. Frailty Index

The Frailty Index (FI) by Mitnitski *et al*. (*22*) was

Table 1. Global frailty screening tools in common

Title/Year	Country	Publishers	Items	Components	Frailty classification
Frailty Phenotype (FP) / 2001	US	Fried *et al*. (*16*)	5	It assesses physical characteristics or phenotype, which include five domains: unintentional weight loss (4.5 kg or more in the last year), exhaustion (self-reported), low physical activity, weakness (low grip strength), and walking speed.	Frailty: ≥ 3 items; pre-frailty:1~2 items; robust:0 items
Groningen Frailty Indicator (GFI) / 2001	Netherlands	Steverink *et al*. (*20*)	15	Physical (9 items), Cognitive (1 item), Social (3 items), and Psychological (2 items), for a total of 4 dimensions.	Frailty: score ≥ 4
Frailty Index (FI) / 2001	Canadian	Mitnitski *et al*. (*22*)	30~70	all the 8 frailty items and all the 3 domains (physical, psychological and social) are assessed.	Frailty: score > 0.25; pre-frailty:0.12~0.25; robust: score < 0.12
Clinical Frailty Scale (CFS) / 2005	Canadian	Rockwood *et al*. (*28*)	9	Total 9 points: each point on its scale has a visual chart and a written description of frailty to assist the classification process.	Frailty: score ≥ 5
Edmonton Frail Scale (EFS) / 2006	Canadian	Rolfson *et al*. (*29*)	11	The EFS is an 11-item scale, of which 9 items are self-reported, It is assesses nine domains of frailty (cognition, general health status, functional independence, social support, medication usage, nutrition, mood, continence, functional performance).	The following cut-offs are used to classify frailty severity: not frailty (0-5), apparently vulnerable (6-7), mildly frailty (8-9), moderately frailty (10-11) and severely frailty
The Tilburg Frailty Indicator (TFI) / 2010	Netherlands	Gobbens *et al*. (*31*)	15	The TFI is composed of 2 parts: Part A about "determinants of frailty and diseases", and Part B about the "presence of frailty" that generates a final score. Part B includes three domains (physical, psychological, and social) and 15 items.	Frailty: score ≥ 5

developed using the Canadian Study of Health and Aging (CSHA) data. It is a continuous scoring system where eight frailty items and three domains (physical, psychological, and social) are assessed. This tool evaluates the presence of health deficits (*e.g*., comorbidities, symptoms, disabilities, and diseases). Although the Frailty Index can be used by clinicians in hospitals and in community settings and by researchers, it is not easy to use because it involves mathematical calculations (*19*). Hence, Sternberg *et al*. (*23*) had proposed this tool to plan health services.

2.4. Clinical Frailty Scale

The Clinical Frailty Scale (CFS) is a clinical judgement-based frailty tool developed for the Canadian Study of Health and Aging (*24*). The CFS evaluates specific domains including comorbidity, function, and cognition to generate a frailty score ranging from 1 (very fit) to 9 (terminally ill). Various reviews have been published on frailty using the CFS tool indicating it to be a promising frailty screening tool (*25-27*). The CFS has been used in a variety of contexts around the world. Although most administered in Canada and the United Kingdom, this frailty tool is also used in Asia, South America, and other parts of Europe. The CFS is most often used in hospital settings in several inpatient and outpatient populations, particularly in geriatric e and cardiology units. The increase of its use in a variety of settings shows that researchers and clinicians value the ease and efficiency this judgement-based tool. In research, the CFS is commonly used to predict health outcomes, mostly mortality, comorbidity, functional decline, mobility, and cognitive decline (*28*).

2.5. Edmonton Frail Scale

The Edmonton Frail Scale (EFS) (*29*) is an 11-item scale, of which nine items are self-reported. It assesses nine domains of frailty (cognition, general health status, functional independence, social support, medication usage, nutrition, mood, continence, functional performance). Test results can be from 0 to 17. The participants are classified conventionally into three categories, and a higher score represents a higher degree of fragility. Severe Frail and non-frail participants were defined according to the EFS score as "no frailty" (≤ 5 points), "apparently vulnerable" ($6 \leq n \geq 11$ points), and "severe frailty" ($12 \leq n \geq 17$ points). Of note, the EFS was validated by non-specialists who had no formal training in geriatric care. The administration of the EFS questionnaire requires 3-5 min. Thus, the EFS can be a practical and clinically meaningful measure of frailty in a variety of settings. Perna *et al*. (*30*) suggested that EFS is a helpful tool to stratify the state of frailty in a group of institutionalized older individuals. As matter of fact, the EFS has been shown to be associated with several

geriatric conditions such independence, drugs assumption, mood, mental, functional and nutritional status.

2.6. Tilburg Frailty Indicator

The Tilburg Frailty Indicator (TFI) (*31*) is a self-reported scale. It was proposed in 2010, and it is regularly used in the context of community-dwelling older people. Besides, over the past years since its introduction, the TFI scale has been widely used in research and has been translated into many languages (including Italian). This tool is a self-administered questionnaire and evaluates all physical, social, and psychological domains. The Tilburg Frailty Indicator questionnaire administration requires 14 min and measures six criteria for quality on a scale of 1–10 (*32,33*). The TFI is composed of two parts, part A evaluates "determinants of frailty and diseases", and part B about the "presence of frailty" that generates a final score. Part B includes three domains (physical, psychological, and social) and a total of 15 items. A total score ≥ 5 is set as the threshold for frailty. The TFI Part B is a self-reported scale used in several countries, and it is associated with short-term disability, lower quality of life, hospitalization, and falls (*32*). The TFI needs further evaluation in larger studies (*33,34*), even though the tool has been evaluated for almost all psychometric domains and shows good validity and reliability for the PHC setting (*33,34*) and the physical items present a good predictive ability of adverse outcomes (*32*).

3. Frailty screening tools in various countries

Every country chooses a debilitation scale that is appropriate for use in its own country. Debilitation scales used in various countries are shown in Table 2. Each country also validates commonly used debilitation scales and develops a debilitation scale as required. In recent years, a Chinese self-reported frailty screening questionnaire (FSQ) based on modified Fried FP criteria was developed and validated in different settings (*35*). A Chinese version of the TFI was also developed to measure frailty among community-dwelling older adults (*36*). A 10-item Chinese frailty screening scale (CFSS-10) (*17*) was successfully developed and validated. The CFSS-10 has good validity and reliability as a quick and acculturative frailty screening scale for community-dwelling older adults in Shanghai. It might also supplement the existing frailty screening tools. In 2006, the Japanese government implemented the Long-Term Care Insurance (LTCI) system with the introduction of preventive care and the improvement of quality of care. The LTCI system uses the Kihon Checklist (KCL), a self-reported comprehensive health checklist designed by a study group from the MHLW, as a screening tool to identify community-dwelling older adults who were vulnerable to frailty (*37*). The CFS is a valid, reliable and easy-to-use tool that has been translated in several languages. A Greek version of the revised nine-scale CFS is a valid and reliable instrument for the identification of frailty in Greek population (*38*). Our academic hospital-based study used the Thai-language version of the Frailty Assessment Tool (Thai Ministry of Public Health) and the Frail Non-Disabled (FiND) questionnaire and showed that the two scales had slight to moderate agreement with Fried's Frailty Phenotype (FFP). Additionally, their predictive power was low and, thus, insufficient for frailty detection in a clinical setting. Further research in a multicenter setting of these and other assessment tools is needed to improve frailty screening in older Thai populations (*15*). In Korea, the Korean Frailty Index (KFI) and the modified KFI (mKFI) are valid instruments for frailty screening and might be useful as simple frailty screening tools to identify older adults who might benefit from comprehensive geriatric assessment and integrated, multidisciplinary geriatric care services (*39*).

4. Frailty screening tools for various diseases

Due to the complexity and specificity of the tools, a wide variety of tools are available for assessment and screening for different diseases (Table 3).

4.1. Cardiovascular diseases (CVD)

Frailty is an important prognostic factor in patients with cardiovascular diseases (CVD), and so identifying frailty in these patients might help to tailor the cardiovascular treatment to these individuals. The first step is to identify frailty. Several tools have been validated as screening methods for frailty. However, to the tools vary in complexity, nature, feasibility and the outcomes that can be predicted (*40*). An ideal frailty screening tool should (*i*) be able to accurately identify frailty, (*ii*) predict the response of frail patients to potential therapies, and (*iii*) be simple and easy to apply and have low cost (*41*). For CVD, the two most used and robust frailty assessment tools for clinicians and researchers are the Fried criteria and frailty indices (*40*). In addition to these two screening tools, other screening tools can also be used to evaluate the cardiovascular system. Kang *et al*. used the CFS for assessment of acute coronary syndrome (ACS) in older patients to predict all-cause mortality, unscheduled return visit, and in-hospital and recurrent major adverse cardiovascular events (*42*). Boxer *et al*. also found that the six-minute walk and the five-item Cardiovascular Health Study were independently predictive of mortality in older adults with heart failure, with hazard ratio (HR) 0.82 and 1.64, respectively, and these were a useful measure of frailty (*43*). However, there is no optimal assessment method for debilitating cardiovascular diseases.

4.2. Cancer

The incidence of frailty in older cancer patients is

Table 2. Frailty screening tools in various countries

US (*71*)	1) The Brief Risk Identification of Geriatric Health Tool (BRIGHT Tool); 2) Frailty Index; 3) Fried Phenotype; 4) The Gerontopole Frailty Screening Tool; 5) Groningen Frailty Index; 6) The PRISMA-7; 7) Simple Fatigue, Resistance, Ambulation, Illnesses, & Loss of Weight (FRAIL) Scale; 8) Strawbridge Questionnaire; 9) Tilburg Frailty Indicator.
UK (*72-74*)	1) The Fried Frailty Phenotype; 2) The FRAIL scale; 3) General Medical Services (GMS); 4) Short physical performance battery (SPPB); 5) The Clinical Frailty Scale (CFS); 6) The PRISMA-7; 7) The electronic Frailty Index (eFI); 8) The Frailty Index (FI).
Canada (*10,11,75*)	1) The frailty phenotype model; 2) The Clinical Frailty Scale (CFS); 3) The Edmonton Frail Scale; 4) Groningen Frailty Indicator (GFI); 5) Tilburg Frailty Indicator; 6) PRISMA 7, gait speed, hand grip strength, balance testing and Timed Up and Go; 7) A comprehensive geriatric assessment (CGA); 8) The Assessment Urgency Algorithm (AUA); 9) Seniors Fitness Test (SFT); 10) Short physical performance battery (SPPB); 11) The Tilburg Frailty Indicator (TFI); 2) the Sherbrooke Postal Questionnaire (SPQ).
French (*76*)	1) The Study of Osteoporotic Fractures (SOF) index; 2) The Fried frailty phenotype.
Italian (*77*)	1) The Italian Frailty index (IFi); 2) The Comprehensive Geriatric Assessment (CGA); 3) The AGILE; 4) The Clinical Frailty Scale (CFS); 5) The Study of Osteoporotic Fractures (SOF) index; 6) The FRAIL index; 7) The Tilburg Frailty Indicator (TFI); 8) The PRISMA-7.
Netherlands (*20,78*)	1) The 13-item RISK scale; 2) The validated 15-item Groningen Frailty Indicator (GFI); 3) The validated Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP); 4) The PERSSILAA.
Spain (*79*)	1) Timed up and go test (TUG); 2) Short Physical Performance battery (SPPB); 3) Tilburg Frailty Indicator (TFI); 4) The Gerontopole Frailty Scale (GFS).
Japan (*80,81*)	1) The phenotype model; 2) The defcit accumulation model; 3) The Kihon Checklist (KCL); 4) Frailty screening index (FSI); 5) A Japan frailty scale (JFS).
China (*17,20,82,83*)	1) A 10-item Chinese frailty screening scale (CFSS-10); 2) The Tilburg frailty indictor (TFI); 3) A 49-item Frailty Index (FI); 4) The Fried frailty phenotype (FP); 5) A Chinese self-reported frailty screening questionnaire (FSQ); 6) The FI-35; 7) A Chinese version of the Tilburg frailty indictor (TFI); 8) A Japan frailty scale (JFS); 9) Multidisciplinary teams (MDT); 10) Clinical Frailty Scale (CFS); 11) FRAIL scale; 12) The Edmonton frail scale; 13) The comprehensive geriatric assessment – frailty index (CGA-FI); 14) The combined index; 15) The Chinese version of Trauma-Specific Frailty Index(C-TSFI).
Singapore (*84,85*)	1) Frail-PPS (Frail-Physical, Psychological and Social); 2) Frailty Assessment Measure (FAM); 3) Identification of seniors at-risk hospitalized patients (ISAR-HP); 4) The frailty phenotype; 5) The deficit accumulation models; 6) Asia-Pacific Clinical Practice Guidelines for the Management of Frailty (AP-CPGMF); 7) The Comprehensive Geriatric Assessment (CGA); 8) The Edmonton frail scale; 9) The Frailty Index (FI).
Denmark (*86*)	1) Fried's Phenotype (FP); 2) The Clinical Frailty Scale (CFS).
Greek (*38*)	1) The Clinical Frailty Scale (CFS).
African (*87*)	1) The Fried frailty phenotype (FFP); 2) The Clinical Frailty Scale (CFS); 3) Brief Frailty Instrument for Tanzania (B-FIT 2).
Thai (*15,88*)	1) The Thai version of the Simple Frailty Questionnaire (T- FRAIL); 2) The Thai Frailty Index (TFI); 3) The Frailty Assessment Tool of the Thai Ministry of Public Health (FATMPH); 4) The Frail Non-Disabled (FiND) questionnaire; 5) Fried's Frailty Phenotype (FFP); 6) The Clinical Frailty Scale (CFS); 7) The PRISMA-7 questionnaire; 8) The Timed Up and Go (TUG) test; 9) The Gerontopole frailty screening tool (GFST).
Korean (*39,89*)	1) The Korean Frailty Index (KFI); 2) The modified KFI (mKFI); 3) Cardiovascular Health Study (CHS); 4) Comprehensive geriatric assessment (CGA); 5) The timed up and go (TUGT) test; 6) The short physical performance battery (SPPB); 7) The Clinical Frailty Scale (CFS); 8) The Korean version of FRAIL (K-FRAIL); 9) Korean Cancer Study Group Geriatric Score (KG-7); 10) Korean Frailty Index; 11) The Korean version of the CSF (CSF-K); 12) The Eastern Cooperative Oncology Group Performance Status (ECOG PS) scale.

significantly higher than that in people of the same age (*44*). Frailty assessments can detect more health problems, prevent function deterioration, and determine the most feasible cancer. Frailty assessment is also vital in deciding if a patient would benefit from the proposed treatment. Therefore, it is necessary to assess the degree of frailty in older patients with cancer to optimize personalized care strategies (*45*). Comprehensive Geriatric Assessment (CGA) is the gold standard for detecting frailty in older patients with cancer. Since CGA is time- and resource-consuming, many alternative frailty screening tools have been developed; however, it remains unknown whether these tools are suitable for older and adult patients with cancer (*46*). Both the Geriatric 8 questionnaire (G8) and the Korean Cancer Study Group Geriatric Score (KG-7) were designed to screen for frailty in older patients with cancer. The KG-7 is a novel geriatric screening tool. Shorter screening tools can identify patients who might benefit from a full Geriatric assessment (GA) (*45*).

4.3. Nephrology

There is a correlation between kidney-like diseases and

Table 3. Frailty screening tools for various diseases

Cardiovascular disease (CVD) (*40*)	1) The Clinical Frailty Scale (CFS); 2) The Tilburg Frailty Indicator (TFI) and its mental and physical domains; 3) The six-minute walk and the five-item Cardiovascular Health Study; 4) The seven-item Cardiovascular Health Study score, the Short Physical Performance Battery (SPPB) and a 35-item frailty index; 5) CAF; 6) Modified Fried frailty criteria; 7) 4 scales used:5-item Modified Fried Criteria; 7-item expanded Modified Fried Criteria; 4-item MSSA;Five-Meter Gait Speed Test; 8) Multidimensional Geriatric Assessment; 9) Geriatric baseline examination; 10) 31-item deficit index; 11) Essential Frailty Toolset.
Cancer (*45,47,90,91*)	1) Geriatric assessment (GA); 2) The Groningen Frailty Indicator (GFI); 3) The Vulnerable Elders Survey-13 (VES-13); 4) The Geriatric 8 (G8) questionnaire; 5) The Korean Cancer Study Group Geriatric Score (KG-7); 6) Flemish version of the Triage Risk Screening Tool (fTRST); 7) The modifed frailty index score (mFI-5); 8) The frailty phenotype; 9) The accumulated deficits theories; 10) The comprehensive geriatric assessment (CGA); 11) The Eastern Cooperative Oncology Group Performance Status (ECOG PS).
Nephrology (*47,49,50,92*)	1) The Fried Phenotype; 2) The Clinical Frailty Scale (CFS); 3) The Frailty Index (FI); 4) Self-rated health (SRH); 5) The surprise question (SQ); 6) The Clinical Frailty Scale (CFS); 7) A Comprehensive Geriatric Assessment (CGA); 8) The Vulnerable Elders Survey-13 (VES-13); 9) The Geriatric 8 (G8) questionnaire.
Cirrhosis (*51,93*)	1) The Fried Frailty Index (FFI); 2) The Clinical Frailty Scale (CFS) and the Montreal Cognitive Assessment (MoCA); 3) The Short Physical Performance Battery (SPPB); 4) The Liver Frailty Index (LFI); 5) Timed-up-and-go test (TUG); 6) The Liver Frailty Index; 7) Combining grip strength, chair stands (CST) and balance tests; 8) The frailty phenotype; 9) Fried Frailty Criteria (FFC); 10) 6-minute walk test (6MWT); 11) Activities of Daily Living (ADL); 12) Cardiopulmonary exercise testing (CPET); 13) Gait speed; 14) Grip strength; 15) Instrumental Activities of Daily Living (IADL); 16) Karnofsky Performance Status (KPS).
Chronic obstructive pulmonary disease (COPD) (*56*)	1) The Fried frailty phenotype (FFP); 2) The Clinical Frailty Scale (CFS); 3) Frailty Index of Accumulative Defcits (FI-CD); 4) The Short Physical Performance Battery (SPPB).
HIV (*61,62*)	1) The gait speed (GS); 2) Timed-up-and-go test (TUGT); 3) The British Geriatric Society (BGS); 4) The Fried frailty phenotype (FFP); 5) The Short Physical Performance Battery (SPPB); 6) The VACS index; 7) The Clinical Frailty Scale (CFS); 8) Brief Frailty Instrument for Tanzania (B-FIT 2).

debilitation. There are appropriate screening tools for various types of kidney disease. Chronic kidney disease (CKD) is common in older adults. It is associated with frailty and functional limitations and has a heterogenous natural history (*47*). CKD promotes the activation of multiple pro-ageing pathways, which can lead to an early onset of frailty and increase the risks for morbidity and mortality (*48*). Therefore, we need to have early detection of chronic kidney disease through screening tools. For patients with prostate cancer, the Vulnerable Elders Survey-13 (VES-13) questionnaire is very sensitive in the population of older patients with prostate cancer, and therefore, it would be a good frailty screening tool in these patients. Although the VES-13 questionnaire had a large number of false positives, it has a high negative predictive value, which is important statistic for a good screening questionnaire. However, the G8 accurately identifies individuals among those initially detected to be frail using the VES-13 questionnaire (*49*). In addition, for dialysis patients, frailty assessments of incident dialysis patients are moderately to strongly correlated with FI. At the specified FI cutoff values, the overall CFS score (FACT-CFS) and Dialysis Morbidity and Mortality Study (DMMS) are highly sensitive measures of frailty. The CFS and FACT-CFS could be viable alternative screening tools for dialysis patients (*50*).

4.4. Cirrhosis

There is no "gold standard" for the assessment of frailty in cirrhosis. In 2019, the American Society of Transplantation Liver and Intestinal Community of Practice described the tools available for the evaluation of physical frailty in patients with cirrhosis (*51*). These tools included the Short Physical Performance Battery (SPPB), Fried Frailty Criteria (FFC), CFS, Liver Frailty Index (LFI), 6-minute walk test (6MWT), Activities of Daily Living (ADL), cardiopulmonary exercise testing (CPET), gait speed, grip strength, Instrumental Activities of Daily Living (IADL) and Karnofsky Performance Status (KPS). Each tool has its advantages or disadvantages depending upon the setting as the tools vary in the test characteristics, subjectivity, predictive validity for outcomes, reliability, responsiveness to change over time, time taken to administer, and whether specialized equipment or highly trained personnel would be required for testing. For example, the CFS is easy and quick to perform but is subjective. The FFC is lengthy and has some subjective components but is a reliable predictor of outcomes. The LFI is objective but requires specialized equipment. The SPPB is objective without the need for equipment, but includes three tests (similarly to the LFI) and requires more time than a single measure (52). Therefore, when assessing the degree of frailty in patients with cirrhosis, it is important to select the appropriate assessment tool for screening.

4.5. Chronic obstructive pulmonary disease

According to a review, the FFP and FI are the most used tools for assessing frailty in patients with stable chronic obstructive pulmonary disease (COPD), used both in

clinics and rehabilitation centers (*53*). The FFP has been demonstrated to predict mortality and adverse clinical outcomes in community-based patients with stable COPD and hospitalized and immunodeficient patients with advanced COPD (*54*). The SPPB is also a well-established tool for accessing lower limb functional impairment in older adults, and mortality risk in patients with stable COPD (*55*). Zhang *et al*. showed a high prevalence of frailty in older adults with stable COPD assessed using the FFP, CFS, Frail index of accumulative deficits (FI-CD), and the SPPB screening tools Frailty, as assessed by the four assessment tools was associated with poor outcomes, including 1-year acute exacerbation of COPD, hospitalization, or death. The FFP, CFS, FI-CD, and SPPB tools showed comparable performance in predicting 1-year mortality (*56*).

4.6. HIV

People living with HIV are an ageing population with a high prevalence of frailty (*57*). Frailty in people living with HIV has been identified at younger ages than in the general population (*58*), meaning there is a risk of delayed identification of frailty and at a more advanced stage, where some interventions may be less effective, resulting in greater health and social care costs (*59*). The 2019 European AIDS Clinical Society (EACS) guidelines recommended frailty screening in older people living with HIV (*60*). Frailty has increasingly become a cause for concern for caretakers who look after patients with HIV. A study by Beanland *et al*. (*61*) showed that objective measures of frailty screening (gait speed (GS) and timed-up-and-go test) are more closely associated with clinical parameters than the subjective measure of frailty screening done with the self-reported health questionnaire in people with HIV. In another follow-up study of eight years (*62*), frailty and SPPB was significantly associated with increased risk of mortality in middle-aged individuals with HIV. For people living with HIV to gain the most from frailty screening, it is essential that information regarding frailty status is shared in conjunction with a clear plan of the next steps in their care. In addition, services should prioritize the social and psychological aspects of frailty going beyond just the physical domains (*57*).

5. Electronic frailty assessment tool

Primary care screening for frailty status is recommended in clinical guidelines. But is impeded by doctor and nurse workloads and the lack of valid, easy-to-use, and time-saving screening tools (*63*). Vulnerable states can be identified automatically and at scale using electronic screening tools, thereby addressing the current situation of high workload for clinical workers. Over the last few years, COVID-19 pandemic, which is caused by severe acute respiratory distress syndrome coronavirus 2, continues to particularly affect older adults worldwide. The novel coronavirus strain was first detected in December 2019 and the World Health Organization declared the severe acute respiratory distress syndrome coronavirus 2 outbreak a pandemic on March 11, 2020 (*64*). Although the COVID-19 pandemic has disproportionately affected the older populations (*65*), it has been argued that frailty and certain comorbidities, rather than the chronological age, are the main factors influencing the clinical manifestations and pathophysiological mechanisms of COVID-19 (*66*). This makes screening for frailty particularly important. However, since COVID-19 is transmitted by the respiratory tract, an electronic screening tool fits the bill for avoiding exposure. With the continuing global spread of COVID-19, an automated FI could be a useful and efficient tool for risk stratification in hospitalized patients with COVID-19. Based on the deficit accumulation model proposed by Rockwood *et al*. (*28,67*), Clegg *et al*. (*68*) developed and validated an electronic frailty index (e-FI). The e-FI is a 36-item tool with good correlation with hospitalization, longer hospital stays, nursing home admissions, and mortality. The e-FI was associated with in-hospital mortality throughout the pandemic, and it outperformed other frailty and comorbidity measures, including the CFS, the Hospital Frailty Risk Score (HFRS), and Charlson Comorbidity Index (CCI) in discriminating short- and long-term mortality (*69*). However, the e-FI has limited application outside the UK, as the coding system (terms and codes used) is not in the format of the International Classification of Diseases version 10 (ICD-10); hence, it needs to be adapted and validated for transfer to other countries. The e-SIF automatically and instantaneously classifies frailty status in individuals aged ≥ 65 years for whom computerized clinical histories are available (*68*). The e-SIF can predict mortality, hospitalization and institutionalization, and is correlated with health resources consumption. These results suggest that the e-SIF is a valid frailty screening instrument for older adults in a primary care setting. In addition to the e-fi and e-SIF electronic screening tools, the FTA system is equally effective for frailty screening. The FTA system provides results immediately and is an advantageous alternative to traditional manual measurements. The use of the FAT score for predicting pre-frailty will help to provide early interventions to prevent individuals to progress to frailty. The FAT system provides a more convenient and comprehensive frailty screening hence, using this computerized automatic screening platform it might be possible to expand the scope of frailty prevention (*70*).

6. Conclusion

We reviewed global frailty screening tools published between 2001 and 2023. There is currently no gold standard in the Global Frailty Screening tool. Over the

past few decades, frailty screening tools have allowed for early detection and early prevention, but the number of people with debilitating conditions continues to rise globally. Frailty has severe effects on the quality of survival and health outcomes in older adults However, frailty is dynamic and reversible, and can improve or worsen over time. Early identification of frailty in older adults is therefore important for the development of interventions to slow or even reverse the progression of frailty. A summary of the frailty screening tool can help clinical staff to quickly and accurately select a suitable scale, but more work is needed to develop a globally recognized gold-standard scale to screen for frailty. A globally standardized screening tool can allow for earlier effective measures to be taken to improve health problems in older adults, to prevent progression of frailty, and to improve the quality of survival. We intend to conduct a large-scale validation of the frailty screening tools that are available.

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