

Frailty screening and assessment tools: a review of characteristics and use in Public Health

F. Gilardi^{1,3}, A. Capanna¹, M. Ferraro¹, P. Scarcella¹, M.C. Marazzi², L. Palombi¹, G. Liotta¹

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Parole chiave: Fragilità, persone anziane, invecchiamento della popolazione, screening della fragilità, strumenti per la valutazione dei soggetti fragili

Abstract

Introduction. *Frailty screening and assessment are a fundamental issue in Public Health in order to plan prevention programs and services.*

Methodology. *By a narrative review of the literature employing the International Narrative Systematic Assessment tool, the authors aims to develop an updated framework for the main procedures and measurement tools to assess frailty in older adults, paying attention to the use in the primary care setting.*

Results. *The study selected 10 reviews published between January 2010 and December 2016 that define some characteristics of the main tools used to measure the frailty. Within the selected reviews only one of the described tools met all the criteria (multidimensionality, quick and easy administration, accurate risk prediction of negative outcomes and high sensitivity and specificity) necessary for a screening tool.*

Conclusions. *Accurate risk prediction of negative outcomes could be the appropriate and sufficient criteria to assess a tool aimed to detect frailty in the community-dwelling elderly population. A two-step process (a first short questionnaire to detect frailty and a second longer questionnaire to define the care demand at individual level) could represent the appropriate pathway for planning care services at community level.*

Introduction

Frailty is a multidimensional syndrome characterized by a reduced ability to deal with acute, physical, psychological and socio-economic stressors, and/or to perform daily living activities (1, 2). It is widely recognized that frailty is associated with an increased risk of adverse health

outcomes (3, 4), such as death (5-8), loss of autonomy (9), functional impairment and hospitalization (7, 10). Globally, frailty can affect anyone during all stages of life, with a prevalence rate from 4% to 59.1% (11) according to various demographic or socio-economic conditions. Nevertheless, the major age group affected are the elderly (65 years and more): in a systematic review

¹ University of Rome Tor Vergata, Department of Biomedicine and Prevention, Rome, Italy

² University of L.U.M.S.A., Rome, Italy

³ Occupational Medicine, Bambino Gesù Children's Hospital, IRCCS, Rome, Italy

carried out in 2012 on the prevalence of frailty, an average 10.7% of community-dwelling adults aged 65 years or more are frail. This percentage raises to 15.7% and 26.1%, respectively, for the 80-84 and >85 age groups (12). The prevalence of frailty is even higher in the studies with the use of multidimensional tools which are mainly based on the biosocial model of frailty. A recent randomized survey on prevalence of frailty and its determinants, carried out in Lazio Region, Italy, by administering the validated multidimensional Functional Geriatric Evaluation questionnaire to an over-65 years population (13-15), recorded a 14% of frail and 7.6% of very frail community-dwelling older adults (16).

Frailty varies along time according to the changes of individuals' socio-economic and physical conditions. Therefore, the syndrome is commonly known as a relative state, with no well-defined threshold (17, 18). Many factors in different domains, such as physical, social, psychological, sensory and cognitive states, can elicit frailty syndrome (11, 17, 19-21). Among others factors (such as ethnicity, income, social isolation, chronic illness, health condition, and environmental factors) have been associated with frailty (17, 22-26). Although numerous systems and models regarding the planning of care and intervention have been built on the basis of screening and assessment of frailty in Italy (15, 27, 28), there is no international consensus for a common definition of frailty. For this reason, many tools have been developed over the years to identify, measure and assess frailty. At this time, there is a plethora of tools, with an extreme internal variability in terms of score (ordinal, dichotomous or continuous), instructions, and evaluated domains (29, 30).

The aim of this narrative review is to evaluate frailty assessment tools, in order to identify a possible tool for frailty screening for community-dwelling older people in a Primary Health Care (PHC) setting.

Methods

Search strategy

The search-method used in the present paper is based on the International Narrative Systematic Assessment (INSA) tool (31) for narrative reviews. This narrative review uses the following Population Implementation Comparator Outcome Study (PICOS) approach:

- Population: community-dwelling aged people, 65 years or over
- Implementation/indicator: frailty tool or instrument
- Comparator: n/a
- Outcome: frailty screening or frailty identification in PHC setting
- Study: review or systematic review

The selection of the reviews was made using Scopus and PubMed databases; a "lateral search" was also performed to identify other relevant papers.

The following search string was considered: (frail elderly OR frailty OR elderly population) AND (tool OR screening tool OR assessment tool OR instrument OR test OR outcome measurement OR questionnaire) AND (review OR systematic review).

The search was restricted to reviews published between January 2010 and December 2016 and was limited to the English or Italian languages. The selected period was chosen on the basis of a prior search on frailty tools, because the last 6 years have been particularly rich in reviews and systematic reviews on this argument.

Two investigators searched the databases independently in order to select the reviews to be included in the final list. A third researcher reviewed the papers proposed by the first two to assess the eligibility criteria. Finally, a definitive list was compiled through agreement between the three researchers.

Eligibility criteria

The inclusion criteria of this narrative review were: frailty measurement in the

community-dwelling people (aged 65 years or over), PHC setting. For PHC we consider the “essential health care” that is based on scientifically sound and socially acceptable methods and technology, which make universal health care accessible to all individuals and families in a community. In this definition we consider as “PHC setting” all the possible health and social services through which people can have access to healthcare system (32).

The following papers were excluded: articles focused on the definition and models of frailty; observational, cross-sectional or randomized control trials; papers focused on a specific topic or illness (for example “frailty and sarcopenia” or “frailty and diabetes” or “frailty and cancer”) or adverse outcome; papers regarding a hospital ward, such as “frailty and intensive care unit”, or the institutionalized elderly. Guidelines, task forces and reviews focused on specific frailty tools were also not included in the final list.

The process of study selection steps is summarized in the flowchart of Figure 1.

Results

The 10 reviews included in the final list were published between 2011 and 2016 (14, 33-41). Overall, the 10 reviews analysed multiple frailty instruments (7 to 67 instruments for each review) with various aims, as shown in Table 1. The plethora of frailty tools was described in terms of:

- The tool features: items (14, 33-35, 37, 39), language (35), administration duration (30, 39), type of scale (ordinal, dichotomous or continual scale) and its severity (14, 33, 37, 39), compilation mode (subjective or self-reported, objective and mixed) (14, 35, 36, 39), outcomes (33, 34, 39). Moreover, the outcomes were further compared in the Summary Receiver Operating Characteristic (SROC) curve (34).

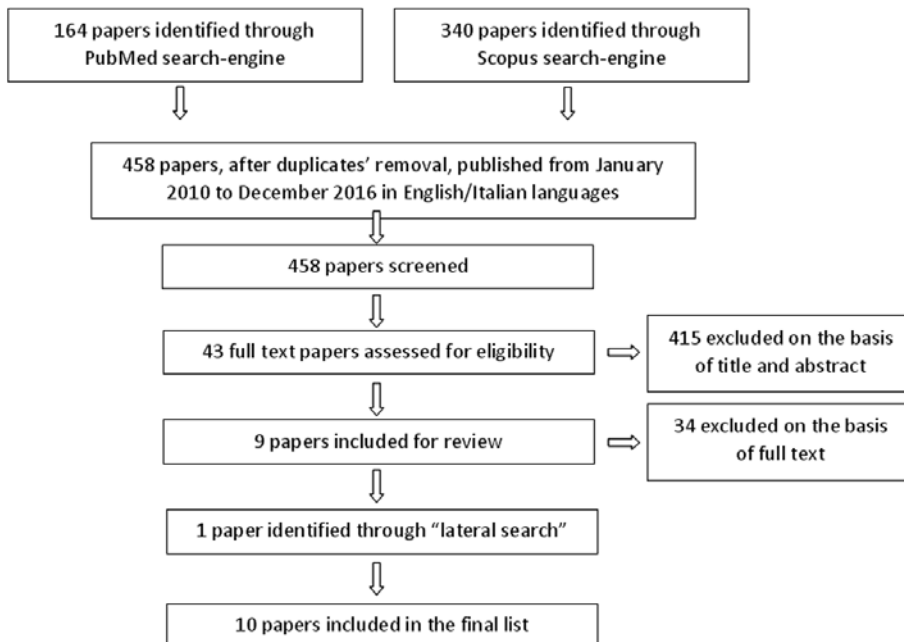


Fig. 1 - Process of study selection

- The domains (physical, psychological and social) (14, 34, 38) and the frailty risk factors (nutritional status, physical activity, mobility, energy, strength, cognition, mood and social support) (14);

- The methodology properties (clinimetric or psychometric) such as reliability, agreement, construct validity, responsiveness, interpretability, content validity, internal consistency, floor- and ceiling-effects, interpretability, measurement error, hypothesis testing, cross cultural validity and criterion validity (14, 33, 36, 39, 40). The assessment of the methodology quality of frailty tools was explained with the Consensus based Standards for the selection of Health Measurement Instruments checklist (40).

- The primary use and the setting (35, 38, 39, 41). In two selected reviews, the PHC was the only setting analysed (35, 41).

- The predictive values (sensitivity, specificity, positive predictive value, negative predictive value, positive likelihood ratio and negative likelihood ratio) (34, 41). The predictive values were further compared in the SROC curve in two papers (34, 41).

The citation search was an additional method of evaluation, selection and description of the frailty tools (36-38); the Web of Science (38) and the Scopus citation (36) were the search-engines chosen. The frailty tools were also compared to a more complete geriatric evaluation (35, 39), such as the Comprehensive Geriatric Assessment, or the assessment scale for clinimetric properties (14) or predictive values (41).

Five of the ten selected reviews identified one or more tools as possible tools to screen for frailty in the population of the elderly (14, 33, 35, 39, 40), as shown in Table 2. These tools are overall 5: the “Fried’s

Table 1 - The aim of the selected reviews.

Authors	Years	Aim
de Vries et al (14)	2011	To assess the frailty tools on clinical properties and to seek the best available tool for clinical practice and for experimental and observational studies.
Sternberg et al (33)	2011	To evaluate the clinical and operative definitions of frailty, of the tools used to screen for and to identify frailty, and of the frailty tools in terms of items, outcomes and severity of frailty.
Pijpers et al (34)	2012	To review the currently available frailty tools and to assess them as potential screening test, with particular attention to predictive values.
Pialoux et al (35)	2012	To review the different screening tools for frailty so as to identify the best test for primary care setting.
Bouillon et al (36)	2013	To describe the existing and more popular frailty tools, with particular attention to their validity and reliability.
Buckinx et al (37)	2015	To review the recent literature regarding the definition, the screening and the prevention of frailty.
Buta et al (38)	2016	To review the wide array of frailty tools and to classify the more cited tools in terms of purpose and context.
Dent et al (39)	2016	To describe the frailty tools in terms of: ability to accurately identify frailty; ability to reliably predict adverse outcome or response to therapy; biological theory.
Sutton et al (40)	2016	To evaluate the reliability and validity of multidimensional frailty assessment tools and to identify tools for research and clinical settings.
Clegg et al (41)	2015	To investigate the diagnostic test accuracy of frailty tools in the primary care setting.

Table 2 - The best frailty tools proposed.

Authors	Frailty tools
De Vries et al (14)	Frailty Index (37-38)
Sternberg et al (33)	Frailty Phenotype (35) Vulnerable Elders Survey (36) Frailty Index (37-38)
Pijpers et al (34)	No tool can be proposed as gold standard to screen population
Pialoux et al (35)	Tilburg Frailty Indicator (39) SHARE Frailty Instrument (40)
Bouillon et al (36)	No tool has been recognized as a gold standard
Buckinx et al (37)	Not evaluated
Buta et al (38)	Not evaluated
Dent et al (39)	Frailty Phenotype (35) Frailty Index (37-38)
Sutton et al (40)	Tilburg Frailty Indicator (39), even if further research is needed in terms of reliability and validity
Clegg et al (41)	No tool can be proposed as gold standard to screen population because no tool has high sensitivity and high specificity

Frailty Phenotype” (42), the “Vulnerable Elders Survey” (43), the “Frailty Index” (44, 45), the Tilburg Frailty Indicator (46) and the SHARE Frailty Instrument (47). The characteristics of the tools are summarized in Table 3.

Fried’s Frailty Phenotype (42): 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 outcome and is widely used in clinical and research settings (39), it requires the measurement of grip strength, which is not usually realized in medical activities. Therefore the Fried’s Frailty Phenotype is proposed in the research setting by Sternberg and colleagues (33).

Frailty Index (44, 45): this tool evaluates the presence of health deficits (e.g. comorbidities, symptoms, disabilities and diseases). Although the Frailty Index can be used by clinicians, both in the hospital and in the community setting, and by researchers, it is not easy to use because of its mathematical nature (39). For this reason Sternberg et al (33) had proposed this tool to plan health services (33). The Frailty Index (44, 45) is the

only tool proposed as a gold standard by de Vries et al (14) for the following reasons: it is a continuous scoring system where all the 8 frailty items and all the 3 domains (physical, psychological and social) are assessed.

Vulnerable Elders Survey (43): this tool considers age, self-rated health, limitations in physical function, and functional disabilities. The Vulnerable Elders Survey can be used to identify the vulnerable elderly living in the community since this scale is short and easy to fill in and can predict functional decline of the people and, finally, death (33).

Tilburg Frailty Indicator (46): this tool is a self-administered questionnaire, and evaluates all the three domains, physical, social and psychological. The Tilburg Frailty Indicator requires 14 minutes and has six criteria of quality on a scale of 1-10 (the quality was estimated using the Terwee assessment scale for measurement of the properties of health status questionnaire) (35, 46). The Tilburg Frailty Indicator needs further evaluation in larger studies (35, 40), despite the tool had been evaluated for almost all psychometric domains and shows good validity and reliability for the

Table 3 - Description of frailty tools proposed as possible test to screen the population.

	Frailty Phenotype (42)	Vulnerable Elders Survey (43)	Frailty Index (44-45)	Tilburg Frailty Indicator (46)	SHARE Frailty Instrument (47)
Multidimensional tool	N	N	Y	Y	N
Validated tool	Y	NA construct validity	Y	Y	Y
Type of domain	Ph	Ph	Ph, Ps, S	Ph, Ps, S	Ph
N° items	5	13	30 and more	15	6*
Type of scale	Ordinal (robust state, pre-fail, phenotype of frailty)	Dichotomous system	Continuous scoring system, without cut off	Continuous scoring system with cut off	Ordinal (non-frail, pre-frail and frail)
Compilation mode	Combination of performance tests and self-reported	Self-reported	Combination of performance tests and self-reported	Self-administered questionnaire	Combination of cognitive and physical tests, non-medical staff- and self-administered questionnaire
It requires instruments	N/Y (Possible use of dynamometer)	N	N	N	Y**

Legend:

Y: Yes; N: No; NA: Not Addressed; Ps: Psychological; Ph: Physical; S: Social; * 5 items plus the strength of grip; ** dynamometer

PHC setting (39, 40), and the physical items present a good predictive ability of adverse outcomes (39).

SHARE Frailty Instrument (47): this tool was developed specifically for the general practitioner, and can be seen for free on a web-based calculator. It has four criteria of quality on a scale of 1-10 (35, 47). Pialoux et al (35) proposed this tool as a possible instrument to screen for frailty in the PHC setting even if it still needs further evaluation in larger studies.

Even if the “Fried’s Frailty Phenotype” (42) and the “Frailty Index” (44, 45) came up as being the most used, Bouillon et al (36) asserted that these tools need an additional assessment in order to considered frailty at the best. The most notable result was suggested by Pijpers and Clegg (34, 41): in fact, the two researchers’ groups declared that no selected frailty tools built so far could

be used as a screening tool because their sensitivity or specificity were not enough for screening and diagnostic purposes.

Discussion and conclusion

The panorama offered by the analysis of the reviews on frailty tools defines a various and multi-faceted framework. Although several of the chosen reviews indicate the best tools in use, none of them seems to recognize a gold standard for the measurement and screening of frailty.

The absence of a gold standard tool can be firstly related to the different criteria of selection and the variability of application field. In the conclusions and discussions of every review, there is a tendency to classify the tools in relation to their different settings. The first selection criterion of a potentially

excellent tool is the right setting in which it could be used. There are in fact a variety of settings, just as selected reviews define, in which the measurement of frailty could be evaluated. For example:

1) a *research* branch in order to define criteria of frailty selection;

2) a *clinical* branch in order to define a therapeutic plan;

3) a *therapeutic* branch in order to organize the overall plan of intervention mainly managed by nursing categories;

4) a *public health* branch in order to screen frailty to support the process of health planning and allocation of resources;

5) a *prevention* branch in order to define a program of intervention to strengthen an individual's resources.

Furthermore, within a given branch, for example the clinical one, there are several settings in which the measurement of frailty can be carried out using different tools: in primary care (35), in emergency wards/departments, in general hospitals, in long term services, in nursing homes. The research could be oriented towards the identification of a gold standard tool for each possible setting considered, in order to reduce the possible high proportion of error rates (38, 39, 41). According to one of the selected reviews, a "careful consideration in the selection of a frailty instrument based on the intended purpose, domains captured, and how the instrument has been used in the past" is recommendable (38). This recommendation is probably useful to upgrade the current discussion on frailty between geriatricians and public health experts. In this regard, the choice of the right tool is clearly connected with the different explored physical, psychological and social domains of frailty and the continuing discussion about its concept.

An analysis of the measurement of frailty in the various described settings can better represent the frailty dimension, its nature and biology, its definition and

concept; but also its growing importance for health systems in its capability to sustain and focus the development and the improvement of the process of care planning; the definition of health outcomes based on multidimensional needs; a new perspective for the governance of prevention and the contrast to health inequalities.

As far our research on the frailty tools shows, this approach can be summarized in two types of frailty measures, as seen in the recent literature (38, 39, 41, 48): those for screening and those for assessment. Within this perspective, screening tools are different from assessment tools (49). This difference is due to their different levels of complexity and the necessary sensitivity and specificity of the screening tools (33, 41).

The recent research on frailty is pointing towards multidimensional tools. This more comprehensive vision of all domains (physical, psychological and socioeconomic) is inspired by a holistic approach to health and by the theory of health determinants of the World Health Organization. Moreover this approach is mainly correlated to a growing recognition of the importance of social determinants, as the lack of a social network and the concomitant loneliness. These conditions, in fact, are frequently observed among frail older adults and very often crucial for their health status (14, 16). In any case the multidimensional vision seems more appropriate, especially in the current phase of the health systems where a whole approach can be more effective to plan and to implement integrated care services and prevention programs and to tackle the progressively ageing population and her chronic diseases.

A crucial and almost unmet point until now, clearly underlined by several reviews (34, 41) is to define the sensitivity and specificity of these tools (34, 39, 41) in order

to get a realistic picture of the reliability of the results of the questionnaires. This topic is closely connected to the measurement of a physical dimension of frailty, about which a definitive consensus has not been reached yet (50). However, the usefulness of any predictive values, as has been well defined for any ethical screening tool in public health, is dependent upon an existing intervention capable of changing the natural history of the disease detected. In a multidimensional view, frailty is not only definable as a disease, but also as a reversible condition of risk. Hence it seems inappropriate to apply the concept of sensitivity and specificity to a multidimensional tool thought to assess a risk rather than to diagnose a clinical condition, when describing the tool's effectiveness and the reliability of any assessment results. In a Public Health perspective the key point is what level of risk prediction indicated by frailty assessment would be acceptable and for which outcome of interest, i.e. mortality and/or hospitalization and/or institutionalization (38).

Another important criterion to assess these various tools (not addressed by the selected reviews), is to appoint the right person to administer the questionnaire (physician, general practitioner, nurse, caregiver, self administration). A screening tool, intended for use in a PHC setting, should be of short duration (no longer than 10 min) and, if possible, administered by phone, by different professional, in order to reach easily a large number of individuals. Of course a tool would have to be administered in a PHC setting to a large population, by personnel including informal caregivers, in order to provide information for both individual care and planning of care services at population level. It should be a multidimensional screening tool to detect also the frailty related to the socio-economic domains that affect the survival

and the quality of life of the citizens as well as their demand of care services (51). The administration of this First Level tool should be followed by the administration, only to the frail individual, of a Second Level questionnaire, more detailed and aimed to plan care at individual level (41).

According to the results of the study, a frailty screening tool can be used in the PHC setting if it has three features: multidimensional structure, quick and easy use, high accurate risk prediction of negative outcomes.

From our results, four of five identified frailty tools could be used in the PHC setting: the Vulnerable Elders Survey (43), the Frailty Index (44, 45), the Tilburg Frailty Indicator (46) and the SHARE Frailty Instrument (47). In this setting, our narrative review identified the Tilburg Frailty Indicator as the best screening tool, because it was the only one of the selected tool with all the three features:

- Multidimensionality: only the Frailty Index (44, 45) and the Tilburg Frailty Indicator (46) respect this feature.
- To be quick and easy: only the Tilburg Frailty Indicator (46) and the Vulnerable Elders Survey (43) are straightforward enough to be carried out quickly. The Frailty Index needs mathematical software, while the Share Frailty Instrument requires a dynamometer.
- Accurate risk prediction value:

All the selected tools show a high prediction value of negative outcomes.

This conclusion doesn't exclude other possible multidimensional tools with a quick and easy application and with a high predictive value. In the future, researchers can compare other possible screening and assessment tools as well as the efficacy of the two level strategy to detect and assess the frailty status.

Additional studies are ongoing in several European countries to find a new generation of very short multidimensional tools (52-56),

especially in the framework of the strategies of the European Partnership on Active and Healthy Aging (EIP on AHA) (57).

In conclusion, studies on frailty and its specific measurement tools are increasing everywhere in the world (58-65) and the debate on the importance of frailty in the planning of care is fast evolving (48, 66, 67). More than the specific tool, what really matters is to define a common pathway to be followed by the different actors involved; this could be the two step pathways (First Level, multidimensional screening, to all the individuals and a Second Level assessment, only to the frail ones). The use of Information and Communication Technology tools could improve the administration of the questionnaire and communication among the participants interested in the process of primary and secondary care level (68).

Strengths and limitations of the study

The strengths of this narrative review is the selection methodology of the recent reviews. This approach allowed us to analyse the most frequently used or cited frailty tools with respect to their setting, their predictive value, the investigated domains, and the compilation mode.

The limitations of our study were: the exclusion of guidelines and task forces products; the use of the keyword “frailty” in the reviews selection process that is not used by all the papers dealing with this issue; the use of the keyword “elderly” instead of “older adults” which is also largely used in the international literature.

Conflicts of interest: The author have no conflicts of interest to declare

Riassunto

Gli strumenti di screening e valutazione della fragilità: caratteristiche e fruibilità in Sanità Pubblica

Introduzione. Lo screening e la valutazione della fragilità dell’anziano costituiscono tema centrale in Sa-

nità Pubblica per la programmazione dei servizi e degli interventi di prevenzione.

Metodologia. Attraverso una revisione narrativa della letteratura, realizzata utilizzando l’International Narrative Systematic Assessment Tool, il presente lavoro ha l’obiettivo di offrire un quadro aggiornato dei principali strumenti di misurazione della fragilità nella popolazione anziana con particolare riguardo agli strumenti di screening nell’ambito dell’assistenza primaria.

Risultati. Lo studio ha selezionato 10 revisioni pubblicate tra gennaio 2010 e dicembre 2016, che tracciano alcune caratteristiche dei principali strumenti utilizzati per la misurazione della fragilità. Tra gli strumenti selezionati uno risponde ai criteri (multidimensionalità, somministrazione facile e breve, predittività ed elevata sensibilità e specificità) considerati necessari per un test di screening.

Conclusioni. La predittività di eventi avversi potrebbe costituire il criterio appropriato e sufficiente per valutare uno strumento che abbia l’obiettivo di individuare la fragilità nella popolazione anziana che vive in comunità. Lo studio propone un percorso a due step di rilevazione della fragilità (un primo livello di screening multidimensionale per individuare lo stato di fragilità ed un secondo dedicato all’assessment per definire la domanda di assistenza a livello individuale) per la programmazione dei servizi di assistenza a livello di comunità.

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Corresponding author: Dr. Francesco Gilardi, Department of Biomedicine and Prevention, University of Rome Tor Vergata, Viale Montpellier 1, 00133 Rome, Italy
 e-mail: francesco.gilardi@uniroma2.it
 glrfnc01@uniroma2.it