

# Fried frailty phenotype assessment components as applied to geriatric inpatients

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**Background:** Management of geriatric patients would be simplified if a universally accepted definition of frailty for clinical use was defined. Among definitions of frailty, Fried frailty phenotype criteria constitute a common reference frame for many geriatric studies. However, this reference frame has been tested primarily in elderly patients presenting with relatively good health status.

**Objective:** The aim of this article was to assess the usefulness and limitations of Fried frailty phenotype criteria in geriatric inpatients, characterized by comorbidity and functional impairments, and to estimate the frailty phenotype prevalence in this group.

**Patients and methods:** Five hundred consecutive patients of the university hospital subacute geriatric ward, aged  $79.0 \pm 8.4$  years (67% women and 33% men), participated in this cross-sectional study. Comprehensive geriatric assessment and Fried frailty phenotype component evaluation were performed in all patients.

**Results:** Multimorbidity ( $6.0 \pm 2.8$  diseases) characterized our study group, with a wide range of clinical conditions and functional states (Barthel Index of Activities of Daily Living  $72.2 \pm 28.2$  and Mini-Mental State Examination  $23.6 \pm 7.1$  scores). All five Fried frailty components were assessed in 65% of patients (95% confidence interval [CI] = 60.8–69.2) (diagnostic group). One or more components were not feasible to be assessed in 35% of the remaining patients (nondiagnostic group) because of lack of past patient's body mass control and/or cognitive or physical impairment. Patients from the nondiagnostic group, as compared to patients from the diagnostic group, presented with more advanced age, higher prevalence of dementia, lower prevalence of hypertension, lower systolic and diastolic blood pressure, body mass index, Mini-Mental State Examination and Barthel Index of Activities of Daily Living. Despite diagnostic limitations, we found  $\geq 3$  positive criteria (thus, frailty diagnosis) in 54.2% of the study group (95% CI = 49.8–58.6), with prevalence from 31.7% in sexagenarians to 67.6% in nonagenarians.

**Conclusion:** Fried frailty phenotype criteria seem useful for geriatric inpatient assessment, despite diagnostic limitations. High prevalence of frailty among geriatric inpatients suggests that evaluation for frailty should be considered a part of the comprehensive geriatric assessment.

**Keywords:** frail older adults, frailty phenotype, geriatric ward, multimorbidity, comprehensive geriatric assessment, geriatric subacute care

## Background

Population aging is increasing the demand for health and social care services. Frailty affects a significant proportion of the elderly population and requires a unique approach to caregiving.<sup>1</sup> The multidimensional nature of frailty as a medical syndrome of age-associated decline in physiologic reserve and function across multiple organ systems, resulting in diminished strength and endurance, increased vulnerability to stressors, risk of falls, disability, hospitalization, and mortality, has been broadly accepted.<sup>2–5</sup>

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However, there is no consensus regarding a single definition of frailty for clinical use.<sup>3,4</sup> Frailty can be physical or psychological or a combination of both.<sup>2,4,6</sup> Popular definitions of physical frailty include a specific phenotype model consisting of five items<sup>2,7</sup> and a frailty index defined as the proportion of accumulated deficits.<sup>8–10</sup> Although a number of other definitions have been developed, the frailty criteria worked out by Fried et al<sup>2</sup> still constitute a reference frame for many studies in community-dwelling populations,<sup>5,7,11–13</sup> as opposed to geriatric unit inpatient populations.<sup>2</sup> A consensus exists that one of the primary purposes of diagnosing frailty is to identify nonrobust and nondisabled older patients at risk of adverse health outcomes in the near future.<sup>3</sup> However, frailty can coexist with disability and comorbidity,<sup>2,14,15</sup> thus, the diagnosis of frailty can be even more useful in managing older people with chronic diseases and disability.<sup>3</sup> Fried et al<sup>2</sup> excluded patients with a history of Parkinson's disease, stroke, and considerable cognitive impairment (Mini-Mental scores <18) and patients treated with antidepressants from their study. However, Parkinson's disease-associated motor decline can contribute to frailty,<sup>16</sup> stroke has been identified as a risk factor for frailty,<sup>17</sup> individuals with cognitive impairment are more prone to become frail,<sup>18</sup> as well as a substantial correlation of frailty and depression in late life has been revealed.<sup>19</sup> Participants enrolled in the study performed by Fried et al<sup>2</sup> were younger, less likely to report limitations in activity, less likely to have high blood pressure and stroke, and more likely to perceive their health status as very good or excellent, when compared to those who were ineligible or who refused.<sup>20</sup> Thus, it can be assumed that the Cardiovascular Health Study population presented better health status than geriatric patients with coexistent medical, functional, psychological, and social problems, who are referred to the hospital and need comprehensive geriatric assessment (CGA).<sup>21,22</sup> Frailty measures other than frailty phenotype, such as modified frailty index<sup>23</sup> and Clinical Frailty Scale,<sup>24</sup> were applied in such patients in different hospital settings.<sup>23,25,26</sup> In a recently published study, accuracy of the Clinical Frailty Scale and the frailty phenotype as predictors of mortality and other clinical outcomes in a cohort of older geriatric ward patients was analyzed.<sup>27</sup> However, operationalized components proposed by Rockwood et al<sup>10</sup> for frailty phenotype assessment were applied in this study.

We examined the usefulness and diagnostic limitations of individual frailty assessment criteria proposed by Fried et al<sup>2</sup> in the setting of a geriatric subacute ward. Additionally, the prevalence of frailty was assessed according to Fried criteria in this population.

## Methods

### Participants

The study comprised 500 consecutive patients aged 79.0±8.4 years ( $\bar{x} \pm$  standard deviation [SD]), among them 67% women and 33% men were admitted to the subacute geriatric ward – Department of Geriatrics at the large multiprofile University Hospital No 7, Upper Silesian Medical Center in Katowice, Poland, between October 2013 and May 2014.

### Measurements

CGA with tests for frailty and body mass assessment was performed for all patients. CGA included a structured interview, physical examination, geriatric functional assessment, blood sampling, ECG, abdominal ultrasound, and chest X-ray. The Mini-Mental State Examination (MMSE)<sup>28</sup> was used to assess global cognitive performance and Geriatric Depression Scale (GDS)-Short Form to identify depression.<sup>29</sup> The Barthel Index of Activities of Daily Living (Barthel Index)<sup>30</sup> and Lawton's Instrumental Activities of Daily Living (IADL) Scale<sup>31</sup> were used to determine the functional status. The MMSE scores range from 0 to 30, the Barthel Index scores range from 0 to 100, and IADL scores range from 9 to 27; higher scores indicate better functional state. Geriatric Depression Scale-Short Form scores range from 0 to 15 with higher scores indicating higher depression probability. Modified get-up and go test,<sup>32</sup> scored from 0 to 10 with lower values indicating higher balance disorders, was used to assess the risk of falls. Frailty was diagnosed according to the Fried<sup>2</sup> criteria. A Polish language version of the protocol Frailty Assessment Components: Standardized Protocols was used. These criteria include five components:

1. Unintentional weight loss of >10 lbs ( $\geq 4.5$  kg) or  $\geq 5\%$  of body mass in the last year (obtained from patient, caregiver, or medical records);
2. Weakness (assessment based on the handgrip strength measurement; interpretation of results takes into account sex and body mass index [BMI]). A Kern digital dynamometer was used for grip strength measurement;
3. Exhaustion (audited information based on two questions from Center for Epidemiological Studies Depression (CES-D) scale;<sup>33</sup> a score from 1 [fatigue or exhaustion felt rarely or not at all] to 4 [fatigue or exhaustion felt most of the time], 3 or 4 points means that the test is positive for decreased physical activity);
4. Slow gait (walking time over a distance of 15 ft [4.57 m]; interpretation of results takes into account sex and height);
5. Low physical activity (energy expenditure weekly rate calculated on the basis of the modified questionnaire Minnesota Leisure Time Activity Questionnaire).<sup>34,35</sup>

Patients who fulfilled none of the criteria were considered nonfrail, patients who fulfilled 1 and 2 criteria were classified as prefrail, and patients who fulfilled  $\geq 3$  criteria were classified as frail.<sup>2</sup> We had expected that some components of frailty criteria, for example, gait speed assessment, would be impossible to perform or assess in the part of our study population. For this reason, we decided to distinguish patients for whom we could obtain all criteria (diagnostic group or D group) and patients for whom one or more criteria could not be obtained (nondiagnostic group or ND group). BMI was calculated for all patients.

## Statistical analysis

The obtained data were analyzed using the STATISTICA software Version 10 (StatSoft, Inc., USA). In the analysis of differences between groups, we used  $\chi^2$  test and the Mann–Whitney *U* statistic. *P*-values  $< 0.05$  were considered statistically significant.

## Ethics

The study protocol was registered with the Bioethical Committee of the Medical University of Silesia in Katowice. In a statement, the committee determined that “the study

is characterized by record review and in the context of law is not a medical experiment and does not require assessment by the bioethical committee” (Letter KNW/0022/KB/207/13). Based on this decision, written informed consent was not required of our study nor was separate patient consent required for our statistical analysis or research since patient data is not disclosed outside internal hospital ward staff.

## Results

Our study group consisted of patients who represent a wide range of clinical conditions and functional states (Barthel Index  $72.2 \pm 28.2$  scores in the range from 0 to 100 and MMSE  $23.6 \pm 7.1$  scores in the range from 0 to 30). A common feature was multimorbidity (mean number of diseases  $6.0 \pm 2.8$  in the range from 1 to 15), with hypertension, osteoarthritis, coronary artery disease, chronic heart failure, diabetes, and dementia as the primary conditions leading to morbidity (Table 1). All five frailty criteria as defined by Fried et al<sup>2</sup> were possible to assess in 65% of our study group (325 patients: 213 women and 112 men; 95% CI = 60.8–69.2), while assessment of all criteria was not possible in 35% of patients (175 patients in the entire

**Table 1** Comparison between ND group and D group according to clinical and functional measures

Indicator	Whole group (n=500)	ND group (n=175)	D group (n=325)	P-value (group D vs ND)
Age (years)	79.0 $\pm$ 8.4	81.4 $\pm$ 7.4	77.7 $\pm$ 7.3	<0.001
Sex (% of women)	67	70	66	0.140
Number of diseases	6.0 $\pm$ 2.8	6.0 $\pm$ 2.9	6.0 $\pm$ 2.8	0.640
Hypertension (% of patients)	84	77	87	0.001
Osteoarthritis (% of patients)	61	55	64	0.026
Coronary artery disease (% of patients)	59	54	62	0.058
Chronic heart failure (% of patients)	43	42	43	0.384
Diabetes mellitus (% of patients)	34	31	35	0.205
Cardiac arrhythmia (% of patients)	34	31	36	0.124
Dementia (% of patients)	24	44	14	<0.001
Osteoporosis (% of patients)	23	20	25	0.107
Anemia (% of patients)	22	26	19	0.051
Prior stroke (% of patients)	18	19	17	0.294
Prior myocardial infarction (% of patients)	13	11	14	0.250
Cancer (% of patients)	12	14	11	0.148
Parkinson's disease (% of patients)	7	8	6	0.260
Heart rate (beats per minute)	72.1 $\pm$ 11.2	73.8 $\pm$ 12.3	71.2 $\pm$ 10.6	0.069
Systolic blood pressure (mmHg)	135.4 $\pm$ 19.8	133.0 $\pm$ 19.1	136.8 $\pm$ 20.1	0.030
Diastolic blood pressure (mmHg)	76.8 $\pm$ 10.8	75.5 $\pm$ 10.2	77.5 $\pm$ 11.1	0.050
Barthel Index (points)	72.2 $\pm$ 28.2	50.4 $\pm$ 30.4	83.9 $\pm$ 18.2	<0.001
IADL (points)	18.8 $\pm$ 6.5	14.2 $\pm$ 6.4	21.4 $\pm$ 5.1	<0.001
MMSE (points)	23.6 $\pm$ 7.1	19.4 $\pm$ 8.0	26.2 $\pm$ 4.3	<0.001
GDS (points)	5.1 $\pm$ 3.1	5.5 $\pm$ 2.9	5.0 $\pm$ 3.2	0.026
BMI (kg/m <sup>2</sup> )	27.8 $\pm$ 5.9	26.7 $\pm$ 6.1	28.2 $\pm$ 5.8	0.027
Modified get-up and go test (points)	4.5 $\pm$ 2.7	2.6 $\pm$ 2.3	5.6 $\pm$ 2.2	<0.001

**Note:** Data is formatted as mean  $\pm$  standard deviation unless otherwise noted.

**Abbreviations:** BMI, body mass index; D, diagnostic; GDS, Geriatric Depression Scale; IADL, Instrumental Activities of Daily Living; MMSE, Mini-Mental State Examination; ND, nondiagnostic.

**Table 2** Factors leading to diagnostic component failure in the application of Fried frailty criteria in geriatric inpatients (n=500)

Criteria	Test component failure factor	Number of patients		
		n	%	95% CI
Criterion 1. Unintentional weight loss over the last year				
Interview or medical records analysis	1. Lack of weight control in the past	50	10	7.4–12.6
	2. Cognitive disorders – inability to respond the question	87	17.4	14.1–20.7
	Total (1+2)	137	27.4	23.5–31.3
Criterion 2. Weakness				
The measurement of handgrip strength	1. Cognitive disorders – inability to understand commands	26	5.2	3.3–7.1
	2. Contraindication for the test	4	0.8	0.0–1.6
	3. Lack of consent for the test	2	0.4	0.0–1.0
	4. The test not completed	6	1.2	0.2–2.2
	Total (1+2+3+4)	38	7.6	5.3–9.9
Criterion 3. Exhaustion				
A standardized interview by questionnaire	1. Cognitive disorders – inability to respond	54	10.8	8.1–13.5
Criterion 4. Slow gait				
The measurement of the transit time of 4.57 m	1. Inability to walk	70	14	11.0–17.0
	2. Cognitive disorders – inability to understand commands	17	3.4	1.8–5.0
	3. The test not completed	4	0.8	0.0–1.6
	Total (1+2+3)	91	18.2	14.8–21.6
Criterion 5. Low physical activity				
A standardized interview by questionnaire	1. Cognitive disorders – inability to respond	59	11.8	9.0–14.6

**Abbreviation:** CI, confidence interval.

group: 123 women and 52 men; 95% CI =30.8–39.2). ND group, as compared to D group, presented similar comorbidity but represented increased age, higher prevalence of dementia, lower prevalence of hypertension and osteoarthritis, lower systolic blood pressure, BMI, MMSE, Barthel Index, and IADL scores, as well as lower modified get-up and go test scores (Table 1). Assessing weight loss from 1 year ago proved to be the most difficult criterion to assess (in 137 patients), because data on body weight from a year ago were seldom available. Specific reasons were inability to obtain any information because of cognitive disorders in 87 patients (17% of the entire study group) or the lack of body weight measurement in the past (50 patients or 10% of all). Cognitive impairment was also an essential cause of diagnostic failure in other frailty criteria (Table 2). Ninety patients (51.4%) in the ND group had three or four positive frailty criteria, while 181 patients (55.7%) had three or more positive criteria ( $P=0.361$ ) in the D group (Table 3). In the entire study group, 271 patients (54.2%) had  $\geq 3$  positive components and, thus, fulfilled the diagnosis of frailty as defined by Fried frailty criteria. Apart from the body weight component, all tests for frailty gave worse results in ND group patients – both in women and men (Table 4). Analysis of our study group revealed frailty in 31.7% of patients aged 60–69 years and in 67.6% of patients aged 90 years or older, with an average of 54.2% rate of frailty for the entire study group (Table 5).

## Discussion

There is increasing evidence of the prognostic significance of frailty in elderly patients for a variety of different medical conditions. These conditions include diabetes,<sup>36</sup> heart failure,<sup>37</sup> acute coronary syndrome,<sup>38</sup> femoral fracture,<sup>23</sup> cancer,<sup>39</sup> Alzheimer's disease,<sup>40</sup> major surgery,<sup>41</sup> and hospitalization at the internal medicine ward.<sup>25</sup> Thus, frailty assessment in elderly populations may be significant for patient management personalization, allowing reduction in both excessive complications and costs of undertreatment and overtreatment.<sup>40,42–44</sup> However, the lack of consensus for a universal definition of frailty for clinical use limits the application of the diagnosis of frailty syndrome in clinical practice. An impediment for a universal definition of frailty is

**Table 3** Comparison between ND group and D group according to Fried frailty criteria score

Number of positive criteria	Number of patients				P-value
	ND group (n=175)		D group (n=325)		
	n	%	n	%	
0	26	15	24	7	0.004
1	32	18	53	16	0.287
2	27	15	67	21	0.078
3	46	26	70	22	0.115
4	44	25	75	23	0.302
5	0	0	36	11	<0.001

**Note:** P-values for differences according to  $\chi^2$  test are presented.

**Abbreviations:** D, diagnostic; ND, nondiagnostic.

**Table 4** Fried frailty criteria assessment of the ND and D groups according to sex

Frailty component	Measurement results									
	Women					Men				
	Group ND		Group D		P-value	Group ND		Group D		P-value
	n	x ± SD	n	x ± SD		n	x ± SD	n	x ± SD	
Change in body weight in the last year (kg)	27	−5.2±9.3	213	−2.5±7.0	0.119	12	−7.0±8.9	112	−2.2±4.7	0.064
Handgrip strength (kg)	101	10.4±4.3	213	13.6±5.8	<0.001	36	18.0±6.9	112	28.6±10.0	<0.001
Physical capacity (CES-D scale) (points)	92	3.2±0.8	213	2.9±0.9	0.043	31	3.1±0.9	112	2.4±1.1	0.001
Transition time 4.57 m (s)	64	9.6±3.9	213	8.8±4.6	0.023	19	9.6±4.8	112	6.4±2.8	<0.001
Physical activity (kcal)	88	146±384	213	397±1,086	0.002	30	59±200	112	951±2,819	<0.001

**Note:** Number of ND group patients was modified according to patient performance ability of particular tests.

**Abbreviations:** CES-D, Center for Epidemiological Studies Depression; D, diagnostic; ND, nondiagnostic; SD, standard deviation.

the extreme heterogeneity of elderly populations with regard to health and functional status. Among different conceptual approaches, Fried physical phenotype model<sup>2</sup> remains a reference standard for many studies.<sup>11–13</sup> However, phenotype diagnostic components require a patient to be sufficiently fit to complete the questionnaires, to perform the handgrip tests, and to walk a 15 ft length twice. These challenges may limit the applicability of the Fried<sup>2</sup> frailty assessment method in geriatric patients, but a range of these restrictions has not previously been extensively studied. To assess both the usefulness and limitations of frailty components in the elderly population with worsened health, we performed an observational study on geriatric ward inpatients. The patient sample was heterogeneous with typical geriatric morbidities (Table 1). Completion of all five Fried frailty assessment criteria was possible in 65% of studied patients (D group), which suggests that effective application of the assessment is possible in 60.8%–69.2% (95% confidence interval [CI]) of individuals in similar inpatient groups. As might be expected, cognitive impairment was an important cause of diagnostic failure in all five Fried frailty assessment criteria (Table 2). Inability to walk was another expected reason. Surprisingly, the lack of previous weight control, which is one of the simplest health measures, appeared also to be an important diagnostic problem in at least 10% of patients. Paradoxically,

this finding of the study may be the most important message for the elderly population and medical professionals. Health assessment begins with the basics, regularly controlling body weight. The study revealed a very high prevalence of frailty in the studied population, indicating need of urgent introduction of frailty assessment in hospitalized geriatric patients. There is sufficient evidence that management personalization of elderly patients without assessing this syndrome is unfeasible. Despite the limitations experienced in assessing 35% of our study group, we found that the prevalence of positive Fried frailty assessment in the ND group was not less than in the D group. A possible method for addressing patients who cannot be assessed by Fried frailty components is to apply a combination of frailty assessment methods. If we consider that a positive Fried frailty assessment needs no further evaluation, then perhaps complementary frailty assessment methods may be useful for cases where Fried frailty assessment is incomplete. Frailty definitions to consider may include the Tilburg Frailty Indicator<sup>45</sup> or the Clinical Frailty Scale.<sup>26</sup> The most auspicious proposal to solve some limitations of the Fried frailty phenotype method in relation to geriatric inpatients seems operationalized components proposed by Rockwood et al.<sup>10</sup> A limitation of this study was the lack of validation of frailty assessment methods for our specific population. Different population characteristics may necessitate the adjustment of frailty assessment values.<sup>7</sup> This issue requires further study.

In summary, we found that Fried frailty criteria are useful in geriatric inpatients, despite diagnostic limitations in a considerable proportion of this specific population. Frailty prevalence exceeded 50%, increasing with age from 31.7% in sexagenarians to 67.6% in nonagenarians, which was substantially higher than in other described elderly populations.<sup>2,7,12,15</sup> Very high prevalence of frailty in this group indicates the need of routine frailty appraisal as a part of a CGA.

**Table 5** Prevalence of prefrailty and frailty among geriatric inpatients (n=500) according to age, regardless of diagnostic limitations in 35% patients

Age	Prefrailty		Frailty	
	Patient (%)	95% CI	Patient (%)	95% CI
60–69 years	50.0	37.3–62.7	31.7	19.9–43.4
70–79 years	38.6	31.6–45.6	52.2	45.0–59.4
80–89 years	31.5	25.4–37.6	59.9	53.5–66.4
90 years or above	23.5	9.3–37.8	67.6	51.9–83.4
Total	35.8	31.6–40.0	54.2	49.8–58.6

**Abbreviation:** CI, confidence interval.



## Conclusion

Fried frailty phenotype criteria seem useful for geriatric inpatient assessment, despite diagnostic limitations. High prevalence of frailty among geriatric inpatients suggests that evaluation for frailty should be considered a part of the CGA.

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## Disclosure

The authors report no conflicts of interest in this work.

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