Original Study

Components of the Frailty Phenotype in Relation to the Frailty Index: Results From the Toulouse Frailty Platform

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Abstract

Objectives: The frailty phenotype proposed by Fried and colleagues is a widely used frailty screening instrument, consisting of 5 components: weight loss, exhaustion, low grip strength, slow gait speed, and low physical activity. Although equally considered in the computation of the frailty phenotype score, each of the components may present a specific and different weight in clinical practice. The objective of this study was to estimate the weight of each frailty phenotype component in terms of age-related deficit accumulation, defined according to the frailty index (FI) proposed by Rockwood and colleagues.

Design: Cross-sectional study.

Participants: Data were used from 484 frail older adults admitted to a geriatric day hospital unit of the Toulouse University Hospital.

Measurements: The outcome measure was a 35-item FI based on data routinely collected as part of a clinical assessment. Descriptive statistics and linear regression analyses were used to determine which components of the frailty phenotype were most strongly associated with the FI.

Results: The mean age of the participants was 83.2 (SD 6.0). All components of the frailty phenotype were significantly associated with the FI, but the magnitude of the associations varied. Linear regression analyses, adjusted for age, sex, and educational level showed that slow gait speed was the most informative component (B = 0.129, P < .001) and weight loss was the least informative component (B = 0.027, P = .037). The combination of slow gait speed and low physical activity was the most strongly associated with the FI (B = 0.144, P < .001).

Conclusion: Of the 5 components of the phenotype, slow gait speed seems to be the key indicator of frailty.
outcome measure has several advantages. First, because of its continuous nature, the instrument is able to make subtle differentiations between frailty stages. In addition, the FI can be easily constructed with routine data from electronic medical records, and does not require additional clinical measurements.31 In this study, we examined the associations between components of the frailty phenotype and the FI, using clinical data from a French geriatric day hospital.

Methods

Design and Study Sample

We used cross-sectional data from medical records of older patients admitted to the Toulouse Frailty Platform, a geriatric day hospital unit of the Toulouse University Hospital in France. Community-dwelling frail older persons, identified by their general practitioner as frail using the Gerontopole Frailty Screening Tool,12 are referred to this day hospital to undergo a comprehensive geriatric assessment. This innovative clinical service started in 2011 and was approved and supported by the regional health authority (Agence Regionale de Santé—Midi-Pyrénées). Details of the assessment and care services provided by the Toulouse Frailty Platform have been described elsewhere.13 In line with French law, this retrospective study of anonymized clinical data (routinely collected) was exempted from ethical review. Between January and November 2013, 488 patients were admitted to the Toulouse Frailty Platform; 484 of those patients provided anonymized clinical data for the current study.

Measurements

The information from comprehensive geriatric assessments was used to construct a 35-item FI14 following a standard procedure.15 The FI includes items on chronic diseases, basic and instrumental disabilities in activities of daily living (ADLs and IADLs), serum vitamin D, cognition (Mini Mental State Examination [MMSE]),16 Clinical Dementia Rating scale (CDR),17 physical performance (Short Physical Performance Battery [SPPB]),18 obesity, visual and hearing impairment, and malnutrition (Mini Nutritional Assessment [MNA]).19 A list of all items and cutoffs is available in Table 1. The FI score (range 0–1) indicates the proportion of deficits present in a person. To calculate the FI with the recommended minimum of 30 items,15 a maximum of 5 missing items was allowed. The FI was calculated for all 484 participants (only 7.8% had between 1 and 5 missing items).

The frailty phenotype includes 5 components: weight loss, exhaustion, low grip strength, slow gait speed, and low physical activity. The variables used to measure the 5 criteria of the frailty phenotype were similar to those proposed by Fried et al.9 Weight loss was defined as unintentional weight loss of more than 5 kg in the past year. Exhaustion was measured using 2 items from the Center for Epidemiologic Studies Depression Scale (CES-D).20 The exhaustion criterion was considered present if a participant answered “often” or “most of the time” to the following 2 statements: “In the last week I felt that everything I did was an effort” and “In the last week I could not get going.” Grip strength was measured with a handheld dynamometer. Original cutoff points stratified by sex and body mass index were applied to define low grip strength.9 Gait speed was assessed by recording the time taken (in seconds) to walk 4 m. Sex and body height—specific cutoffs, based on the original cutoff points, were used to identify participants with slow gait speed. Physical activity was examined using a questionnaire exploring the average time spent by the individual in physical activities during the previous week.21,22 Low physical activity was defined as performing no physical activity, spending most of the time sitting, or rarely (<2 hours a week) having a short walk or other low-intensity physical activity. Participants were classified as robust if none of these components were present, as prefrail if 1 or 2 components were present, and as frail if 3 or more components were present.

Statistical Analysis

First, we described the characteristics of the study sample. We analyzed cumulative distributions of FI scores by frailty phenotype categories, and calculated the proportions of overlap between comorbidity, disability, and frailty according to the phenotype. Second, we studied which components and combinations of 2 components of the frailty phenotype were most strongly associated with the FI. Differences in FI scores by frailty phenotype components were determined using t-test statistics. Next, linear regression analyses adjusted for age, sex, and educational level were performed to study associations between components of the frailty phenotype and FI scores. All analyses were performed in SPSS 20 (IBM Corp, Armonk, NY), with statistical significance set at P < .05.

Results

Table 2 shows the characteristics of the study population. The mean age of the 484 included patients was 83.2, 63% were women,
and 49.2% of the sample had a low educational level (primary school or less). In line with the characteristics of the study participants, frailty, prefrailty, and robustness (according to the frailty phenotype) were present in 49.9%, 43.3%, and 7.3% of the sample, respectively. The mean FI score was 0.32, with a range from 0.09 to 0.83, and a 99% upper limit of 0.67. The cumulative distributions in Figure 1 show that FI scores increased across frailty phenotype categories. The mean FI score was 0.21 for people classified as robust, 0.25 for people classified as prefrail and 0.39 for those classified as frail. Of the people classified as frail according to the frailty phenotype, 5.8% had no co-morbidity, 32.1% had no ADL impairment, and 13.6% had no IADL impairment (see Table 3).

Table 4 presents the FI scores according to components of the frailty phenotype. Of the single components, slow gait speed was the most informative (FI mean difference = 0.14) and weight loss the least informative (FI mean difference = 0.04). These results were confirmed in linear regression analyses adjusted for age, sex, and educational level. All components of the frailty phenotype were significantly associated with the FI, but slow gait speed had the strongest association (B = 0.129, P < .001). When additionally adjusting for the presence of the other components in sensitivity analyses (results not shown in table), the rank order of the strength of the associations was similar (slow gait speed B = 0.099, P < .001; low physical activity B = 0.065, P < .001; low grip strength B = 0.042, P < .001; exhaustion B = 0.031, P < .01; weight loss B = 0.005, P = .62).

Table 4 also shows the FI scores according to combinations of 2 components of the frailty phenotype. Of the combinations of 2 components, combinations A (slow gait speed and low physical activity) and B (slow gait speed and low grip strength) resulted in the largest difference in FI scores (mean difference ≥0.15). This was again confirmed in linear regression analyses adjusted for covariates. The combination of slow gait speed and low physical activity had the strongest association with the FI score (B = 0.144, P < .001).

Discussion

In this study, we examined the associations between components of the frailty phenotype and the FI, using clinical data from a French

![Fig. 1. Cumulative distribution of FI score by frailty phenotype status.](image-url)
geriatric day hospital. Our results showed that both frailty-as-a-syndrome (phenotype) and frailty-as-a-state (the FI) share a key feature: as the 5 phenotypic deficits accumulate, so do other deficits. We found that all components of the frailty phenotype were significantly associated with the FI, but that the magnitude of associations varied. Gait speed was the most informative component and weight loss the least informative component.

This was, to our knowledge, the first study looking at associations between components of the frailty phenotype and the FI. The use of the FI as an outcome measure is a very novel approach. It extends findings from previous studies, which showed that components of the frailty phenotype were not equally related to hospitalization, disability, and mortality, with slow gait speed as the most important predictor of adverse health outcomes.23,24 Our findings are in line with these previous studies, as we found that slow gait speed had strongest association with the FI.

The present study provides insight into the weight of each frailty phenotype component in terms of age-related deficit accumulation. Taking into account these weights may ultimately help to make frailty screening more efficient. Although frailty is considered a multicomponent concept (ie, deficits commonly occur together),25 the 5 components of the frailty phenotype may not all be necessary when screening for frailty. Our findings suggest that some components are not very informative, and that the use of a single component or a combination of 2 components may be enough to distinguish between different frailty stages. However, more research on this topic is needed before any conclusion can be drawn for clinical practice.

Some limitations should be considered when interpreting the results of this study. Data are used from a selected population of moderate to severe frail older adults (eg, even the people classified as robust already had an average FI score of 0.21). Results may be slightly different when applied to the general community-dwelling older population. In addition, although we tried to avoid any overlapping between components of the frailty phenotype and the FI items, this was not possible for 1 item of the FI (SPPB). In fact, because only total scores were available from the clinical data, we were not able to exclude the gait speed item from the SPPB score. However, we do not believe this had a major impact on our results, because sensitivity analyses with a 34-item FI (without the SPPB item, results not shown) did not change our main findings. Finally, our study had a cross-sectional design. Therefore, information on the ability of components of the frailty phenotype to predict adverse outcomes in our population was lacking. This may be studied in the next years when longitudinal data from the Toulouse Frailty Platform becomes available.

### Conclusion

This study revealed that components of the frailty phenotype are not equally associated with the FI. This may imply that components have different weights in the definition of the frailty status. Of the 5 components of the frailty phenotype, slow gait speed seems to be the key indicator of frailty. This confirms previous evidence looking at gait speed as the optimal screening parameter for negative health outcomes in older people.26,27

### References


