Self-Rated Health and Frailty in Older Adults from the Population-Based Three-City Bordeaux Cohort

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Self-rated health · Frailty · Cross-sectional study · Cohort study · Observational study

Abstract

Introduction: This study aimed to investigate whether self-rated health (SRH) predict frailty and its components among community dwellers aged 75 years and older. Methods: We ran a cross-sectional and prospective analysis from 643 and 379 participants of the Bordeaux Center (France) of the Three-City Study, respectively. We assessed SRH using a single question with 5 response options. We defined frailty as having at least 3 out of the following 5 criteria: weight loss, exhaustion, slowness, weakness, and low energy expenditure. We used multivariate logistic regression and Cox proportional hazard models. Results: At baseline, poor SRH was significantly associated with frailty (odds ratio = 5.2; 95% confidence interval [CI]: 2.9–9.5) and its components except for weakness. In the prospective analysis on nonfrail participants, poor SRH was associated with the 4-year risk of slowness (hazard ratio [HR] = 1.7; 95% CI: 1.1–2.6) but not with that of frailty (HR = 1.6; 95% CI: 0.9–2.9) or the other components. Conclusions: In a French cohort of community dwellers aged 75 years or older, poorer SRH was associated with concomitant frailty and 70% higher risk of slowness over 4 years.

Introduction

Frailty is a long process resulting from the loss of reserve capacity in multiple physiological systems making older adults vulnerable to adverse environment [1]. Frailty has been associated with falls, hospitalizations, disability, institutionalization, and mortality [2]. The “phenotype of frailty” is one of the most commonly used operational definitions and defined by the presence of at least 3 criteria among unintentional weight loss, exhaustion, weakness, slowness, and low energy expenditure [3]. Frailty would be reversible and could be attenuated by appropriate interventions [4].
As a full frailty assessment requests time and time constraints in clinical practice, it is useful to have tools to screen people for further frailty assessment. Several frailty screening tools have been developed and validated. Self-rated health (SRH) has been suggested as one potential screening tool [5]. SRH, a simple subjective measure of health status [6, 7], predicted disability and mortality in various health settings [8]. SRH might better capture the burden of clinical and subclinical conditions than morbidity and disability. It is a complex concept involving psychological and health aspects [9], usually defined by asking individuals to evaluate their health status from excellent to very poor.

Poor SRH was cross-sectionally associated with frailty in older adults [10, 11]. SRH had a sensitivity of 63% and a specificity of 94% for frailty screening in general practice patients aged 75+ [5]. The Helsinki Businessmen Study including 1,753 men (mean age = 41 at baseline) followed for maximum 26 years found poor SRH at midlife was associated with a higher risk of frailty at older ages [9]. However, no prospective study has investigated the association of SRH with frailty at late-life yet. This study investigated whether or not SRH, a single question, may be used to identify and/or predict frailty and its components in French noninstitutionalized individuals aged 75 years and over without apparent frailty enrolled in the Three-City (3C) Bordeaux Study.

Methods

Study Population

The 3C Study is a prospective cohort study of vascular risk factors for dementia. Its protocol has previously been detailed [12]. In brief, in 1999–2000, 2,104 noninstitutionalized adults aged 65 years or older living in Bordeaux and its suburbs were recruited through a 2-step sampling: (1) selection of administrative districts and (2) invitation to all eligible inhabitants within the selected districts. At baseline and every 2–3 years since then, trained psychologists collect sociodemographic and lifestyle characteristics and medical history and perform neuropsychological testing, physical examination, and blood sampling at participants’ home. We used data of the 10- and 14-year follow-up visits, with frailty being defined the same way at both times.

Frailty

We used an adapted version of the Fried’s definition of frailty [3]. Participants were classified as frail if they met at least 3 criteria among the following: (i) weight loss, (ii) exhaustion, (iii) weakness, (iv) slowness, and (v) low energy expenditure (online suppl. Table 1; see www.karger.com/doi/10.1159/000518864 for all online suppl. material).

(i) Weight loss was defined as the self-reported recent loss of 3+ kg, or BMI was <21 kg/m². (ii) Exhaustion was defined using 2 items of the Center for Epidemiologic Studies Depression Scale (CES-D) [13]: “I felt that everything I did was an effort” and “I could not get going” during the past week. Respondents were considered as exhausted if they answered yes (often or very often/all the time) to 1 or 2 items. (iii) Weakness was defined using the weakest quintile stratified by BMI and sex of the handgrip strength ascertained by using a Jamar dynamometer. (iv) Slowness was ascertained using the slowest quintile stratified by height and sex of the 3-meter gait speed. Respondents unable to complete the respective physical performance tests were considered weak and slow, respectively. (v) Low energy expenditure was defined as reporting no engagement in physical activities (strenuous leisure activities or sport). Nonfrail participants are those reporting <3 criteria. The frailty variable was missing if participants had 3 or more missing frailty components.

Self-Rated Health

SRH was assessed every 2 years by asking “Do you consider that your present health is ‘very good,’ ‘good,’ ‘average,’ ‘poor,’ ‘very poor,’ and don’t know?” Participants reporting “very poor” (n = 3) or “poor” (n = 23) health were combined with those reporting “average” health (n = 217) into a “poor” category. The “good” category combined participants reporting “good” (n = 342) or “very good” (n = 53) health. “Don’t know” response (n = 14) was considered as missing data and were excluded from analysis.

Covariates

Baseline sociodemographic information included age, sex, education (no diploma vs. elementary school with diploma or more), monthly income (<1,500 EUR, [1,500–2,250 EUR], and ≥2,250 EUR), and marital status (married vs. widower/single/divorced/separated). Polypharmacy was defined as the use of 5+ drugs at least once a week during the last month. The Mini-Mental State Examination (MMSE) assessed global cognitive performance [14]. A CES-D score ≥23 for women and ≥17 for men (maximum score = 60) defined depressive symptomatology [13, 15]. Disability in basic activities of daily living (ADL) was defined using the 5-item Katz scale [16]. A participant was ADL-disabled if they could not perform at least one activity among bathing, dressing, toileting, transferring from bed to chair, and eating, without a given level of assistance. The Rosow-Breslau scale assessed mobility restriction [17]; a participant was restricted in their mobility if they could not get going (CES-D) [13]: “I felt that everything I did was an effort” and “I could not get going” during the past week. Respondents were considered as exhausted if they answered yes (often or very often/all the time) to 1 or 2 items. (iii) Weakness was defined using the weakest quintile stratified by BMI and sex of the handgrip strength ascertained by using a Jamar dynamometer. (iv) Slowness was ascertained using the slowest quintile stratified by height and sex of the 3-meter gait speed. Respondents unable to complete the respective physical performance tests were considered weak and slow, respectively. (v) Low energy expenditure was defined as reporting no engagement in physical activities (strenuous leisure activities or sport). Nonfrail participants are those reporting <3 criteria. The frailty variable was missing if participants had 3 or more missing frailty components.

Analytical Sample Selection

Figure 1 shows the flowchart. In brief, out of 1,214 participants seen in 2009–2010, we retained 643 participants for the cross-sectional analysis of the relationship between SRH and frailty and 379 initially nonfrail participants for the analysis of the 4-year risk of frailty. Participants with dementia, Parkinson’s disease, history of stroke, disability to ADL, restriction of mobility, and/or depressive symptomatology were excluded because these conditions by themselves may result in frailty characteristics [3]. We further excluded participants who reported getting a cancer diagnosis 3
years prior to the baseline as well as those who were living in an institution in 2009–2010. For the prospective analysis, we further excluded participants with missing frailty variable at follow-up, no follow-up, and those deceased between the baseline and the follow-up.

**Statistical Analysis**

Regarding the cross-sectional analysis, we first described sociodemographic and health-related characteristics based on frailty status at baseline. We calculated the sensitivity of SRH to screen for frailty and its specificity as well as the false-positive rate and the false-negative rate. We estimated the association between frailty and SRH using logistic regression models unadjusted and adjusted for sex and age.

Regarding the prospective analysis, we described baseline sociodemographic and health-related characteristics based on incident frailty status. We estimated the 4-year risk of frailty using Cox proportional hazards models with age as the underlying time scale unadjusted and adjusted for sex. Proportional hazard assumption was tested using standardized Schoenfeld residuals (online suppl. Table 2).

In a complementary analysis, we repeated the above analyses on each individual frailty component. Analyzed samples size differed because of different number of missing data on components of the frailty phenotype.

**Sensitivity Analyses**

We used the method of the “best” and “worst-case” scenarios to investigate the impact of missing values for frailty and SRH variables in the estimated associations. We ran 4 models where we replaced 1 – missing frailty values with frail and missing SRH values with poor SRH, 2 – missing SRH values with good SRH, 3 – missing frailty values with nonfrail and missing SRH values with poor SRH, and 4 – missing SRH values with good SRH.

Fig. 1. Flowchart of the studied sample. SRH, self-rated health.
The level of statistical significance was fixed at $\alpha = 0.05$ for all analyses. Statistical analyses were performed with SAS Statistical package release 9.3 (SAS Institute Inc., Cary, NC, USA).

Results

Cross-Sectional Association

Out of 643 participants aged 82.1 (SD 4.3) years on average and 64.2% females, 68 (10.6%) were frail. Frail participants were older, less likely to be married, with lower income, more likely to be polymedicated, and had lower MMSE score than nonfrail participants (Table 1). A fifth of participants reporting poor SRH (21%) against 4% of those reporting good SRH were frail. The sensitivity of SRH to screen for frailty was 75.0% (95% CI: 63.0–84.7), and its specificity was 66.4% (95% CI: 62.4–70.3), the false positive rate was 25.0%, and the false negative rate was 33.6%.

After adjustment for age and sex, participants with poor SRH had 5.2 times higher odds of frailty than those with good SRH (95% CI: 2.9–9.5). When considering each frailty component individually, compared with participants with good SRH, those with poor SRH had twice higher odds of weight loss (OR = 2.3; 1.2–4.4) and low energy expenditure (OR = 2.1; 1.5–3.0), 3 times higher odds of slowness (OR = 3.1; 2.0–4.6), 4 times higher odds of exhaustion (OR = 4.3; 2.5–7.5), and 20% higher odds of weakness (OR = 1.2; 0.8–1.9).

Prospective Association

Out of 379 nonfrail participants at baseline (mean age 81.1 ± 3.7), 49 (12.9%) became frail over the 4 years of follow-up. Participants who became frail did not differ from their counterparts in terms of sociodemographic or medical characteristics, but they were 2.2 years older than nonfrail participants (Table 2). The frailty hazard over 4 years adjusted for sex was on average 60% higher in participants with poor SRH compared with those with good SRH (Table 3). No participant who reported poor SRH at baseline reported weight loss over the 4-year of follow-up. Adjusted for sex, the hazard of slowness was significantly 70% higher in participants with poor SRH compared with participants with poor SRH compared with participants with good SRH. Hazard ratios for the other frailty criteria were not significantly different from 1 (Table 3).

Sensitivity Analyses

Regardless of the imputed SRH values, models ran with missing frailty values replaced with the value “non-

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**Table 1. Characteristics of older adults living in the Bordeaux area (France) based on self-rated health at baseline, the Bordeaux sample of the Three-City Study, 2009–2010**

|                      | Overall | Good | Poor |
|----------------------|---------|------|------|
| Sample, n            | 643     | 399  | 244  |
| Sociodemography      |         |      |      |
| Age, mean (SD), years| 82.1 (4.3) | 81.6 (4.1) | 82.9 (4.4) |
| Sex, n (%)           |         |      |      |
| Men                  | 230 (35.8) | 155 (38.9) | 75 (30.7) |
| Women                | 413 (64.2) | 244 (61.2) | 169 (69.3) |
| Marital status, n (%)|         |      |      |
| Married              | 305 (47.4) | 208 (52.1) | 97 (39.8) |
| Widower, single, divorced, separated | 338 (52.6) | 191 (47.9) | 147 (60.3) |
| Education level, n (%)|      |      |      |
| No diploma           | 184 (28.6) | 106 (26.6) | 78 (32.0) |
| Elementary with diploma | 459 (71.4) | 293 (73.4) | 166 (68.0) |
| Income$, n (%), euros|         |      |      |
| <1,500               | 189 (32.3) | 110 (29.7) | 79 (36.7) |
| [1,500–2,250]        | 163 (27.8) | 89 (24.0) | 74 (34.4) |
| ≥2,250               | 234 (39.9) | 172 (46.4) | 62 (28.8) |
| Health               |         |      |      |
| MMSE$, mean (SD)     | 27.6 (2.1) | 27.8 (2.1) | 27.5 (2.1) |
| Polypharmacy, n (%)  | 382 (59.4) | 199 (49.9) | 183 (75.0) |
| Frailty, n (%)       |         |      |      |
| Frail                | 68 (10.6) | 17 (4.3) | 51 (20.9) |
| Nonfrail             | 575 (89.4) | 382 (95.7) | 193 (79.1) |

Polypharmacy: ≥5 drugs taken regularly. MMSE, Mini-Mental State Examination; SD, standard deviation. $a$ Fifty-seven missing values. $b$ Eight missing values.
“frail” yielded similar results to those of the main cross-sectional and prospective analyses. When we replaced missing frailty values with the value “frail,” the cross-sectional association was attenuated, but still significant with an odds ratio adjusted for age and sex equals to 2.9 (95% CI: 1.9–4.3). The prospective analyses showed higher HRs which were around 3 (online suppl. Table 3).

**Discussion**

In this sample of French adults aged 75+, one-fifth who reported poor health were frail, and the performance of SRH to screen for frailty was moderate. Besides, non-frail older adults reporting poor health at baseline had 60% higher risk for frailty and notably 70% higher risk of

| Sample, n | Overall | Free from frailty over time | Incident frailty over time |
|-----------|---------|----------------------------|---------------------------|
| Sociodemography | | | |
| Age, mean (SD), years | 81.1 (3.7) | 80.8 (3.5) | 83.0 (4.4) |
| Sex, n (%) | | | |
| Men | 140 (36.9) | 122 (37.0) | 18 (36.7) |
| Women | 239 (63.1) | 208 (63.0) | 31 (63.3) |
| Marital status, n (%) | | | |
| Married | 198 (52.2) | 173 (52.4) | 25 (51.0) |
| Widower, single, divorced, separated | 181 (47.8) | 157 (47.6) | 24 (49.0) |
| Education level, n (%) | | | |
| No diploma | 105 (277) | 90 (27.3) | 15 (30.6) |
| Elementary with diploma | 274 (72.3) | 240 (72.7) | 34 (69.4) |
| Incomea, n (%), euros | | | |
| <1,500 | 103 (29.0) | 93 (30.1) | 10 (21.7) |
| [1,500–2,500] | 99 (27.9) | 84 (27.2) | 15 (32.6) |
| ≥2,500 | 153 (43.1) | 132 (42.7) | 21 (45.7) |
| Health | | | |
| MMSEb, mean (SD) | 28.0 (1.9) | 28.0 (1.8) | 27.4 (2.3) |
| Polypharmacy, n (%) | 196 (51.7) | 167 (50.6) | 29 (59.2) |

Polypharmacy: ≥5 drugs taken regularly. MMSE, Mini-Mental State Examination; SD, standard deviation. a Twenty-four missing data. b Two missing data.
slowness over 4 years compared with older adults with good SRH. Due to its simplicity of use, SRH may be used to identify individuals that need further assessment for frailty and those who need closer health monitoring.

The performance of SRH as a screening tool in our study was moderate. Australian authors studied the diagnostic performance of several frailty screening tools among community dwellers aged 75+ recruited in general practice [5]. SRH had a sensitivity of 62.5% (95 CI: 45.8–77.3) and a specificity of 93.6% (89.1–96.7) and diagnostic performances inferior to those of other screening tools such as the Reported Edmonton Frail Scale and the Kihon Checklist. However, SRH has the main advantage to be simple and easy to implement, making it suitable in clinical practice and large cohort of older adults assessed at home.

The cross-sectional association between frailty and SRH among older adults found in our study is congruent with the literature [18]. González-Pichardo et al. [11] have shown poor SRH was cross-sectionally associated with pre-frail and frail status in adults aged 65+. Pérez-Zepeda et al. [19] confirmed the correlation of SRH and physical function as assessed by using the Short Physical Performance Battery across different older populations. In patients with advanced chronic kidney disease, Bad-dour et al. [20] found SRH was moderately correlated with both frailty and IADLs. In 121 community-dwelling Chinese near-centenarians and centenarians, frailty and poor SRH were concomitant in 32.4% of participants [21].

In addition, our findings suggested poor SRH predicts frailty over the 4-year period. We are not aware of other studies investigating this prospective association with the frailty risk. Our results are yet in line with those of previous studies showing poor SRH predicted functional disability, cognitive dysfunction, hospitalization, morbidity, and mortality [22–24]. The prediction would have been likely more efficient over a shorter period of time, let us say 1–2 years, but frailty assessment was not standardized across follow-up visits.

Among all frailty components, slowness, as measured using gait speed, was the only one predicted by poor SRH. Gait speed is recommended for the assessment of physical performance in routine clinical practice, low values requesting further clinical workups to identify potential underlying conditions [25]. Our results were congruent with previous studies showing gait speed was a useful tool to screen older community dwellers for adverse outcomes, including falls, cognitive impairments, sarcopenia, and mortality [26–28]. Overall, our results suggested poor SRH may identify individuals with subclinical signs of physical decline early in the process.

Altogether, our findings encourage clinicians to ask their fit patients how they rate their health as part of their routine practice. Clinicians should be alerted when their patients report poor health and request a further assessment for frailty, even in the absence of abnormal biological markers. If the patient is eventually not frail, reporting poor health should lead to closer monitoring as the occurrence of frailty is progressive.

The study’s strengths include both cross-sectional and prospective designs and a representative sample of community dwellers aged 75+ [29]. Moreover, SRH and frailty were examined at the same time, during home face-to-face interviews by trained nurses and psychologists using standardized protocols. Our study has, however, limitations. Participants were considered from the age of 75. Results may be different when applied to older adults living in nursing homes, who are likely to be at least frail, or even dependent and/or sick. Several frailty criteria were proxies of those originally proposed by Fried et al. [3] (online suppl. Table 1), which might have led to classification bias. However, definitions are not that different, and the difference is likely to be minimal. Also, there is no gold standard to assess frailty, and Fried et al. [3] definition does not reach a consensus [30]. Additionally, the prevalence of frailty in our study was that expected for this age group [31].

Conclusions

Our findings revealed poor SRH assessed by a single question may (i) identify individuals who need assessment for frailty and (ii) predict slowness over 4 years in adults aged 75+. SRH may be an easy and rapid tool to identify individuals who would need to be further assessed for frailty in the clinical setting. Further studies need to confirm its predictive qualities. Older adults reporting a good health should not be excluded from interventions to prevent frailty.

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Statement of Ethics

This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects were approved by the Consultative Committee for the Protection of Persons participating in Biomedical Research of the Kremlin-Bicêtre University Hospital (Paris) (Reference No. 99-28) and the Ethics Committee Sud-Méditerranée II (Reference No. 2008.07.05). All participants gave their written informed consent.

Conflict of Interest Statement

No authors have conflicts of interest to declare.

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Author Contributions

Maturin Tabue-Teguo and Sophie Pilleron contributed to conceptualization and design and interpretation of data. Both wrote the manuscript, have full access to all of the data in the study, and take responsibility for the integrity of the data and the accuracy of the data analysis. Sophie Pilleron, Melanie Le Goff, and Soufiane Ajana contributed to statistical analyses, interpretation of data, and drafting the manuscript. Catherine Helmer and Jean-François Dartigues contributed to interpretation of data and revision of the article. Catherine Féart contributed to conceptualization and design, interpretation of data, and drafting the manuscript and has full access to study’s data.

Data Availability Statement

Data described in the manuscript, code book, and analytic code will be made available upon request: http://www.three-city-study.com/ancillary-studies.php.

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