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Factor structure for the frailty syndrome was consistent across Europe

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Abstract

Objectives: We explored the measurement properties of frailty with the goal of optimizing frailty assessment according to phenotype definition of Fried and comparing measurement properties across countries.

Study Design and Setting: Data are from the Survey of Health, Ageing and Retirement in Europe (n = 27,938), a population-based study of community-dwelling adults aged ≥50 years. Frailty was specified as a unidimensional construct, and measurement invariance across the 12 countries was tested. To assess our measurement model, we used confirmatory factor analysis (CFA) and multigroup CFA to assess measurement invariance.

Results: The unidimensional model fit the data well (adjusted $\chi^2(48) = 82.74$, $P = 0.001$), and the same structure was satisfactory for all countries. Inclusion of equality constraints led to significant model deterioration (adjusted $\chi^2\text{diff}(88) = 995.05$, $P < 0.001$), suggesting differences in parameters across countries. Spain was removed from further analyses, and equality constraints for Greece, Sweden, Israel, Italy, and France were not tenable. Accounting for these led to satisfactory model fit (adjusted $\chi^2(113) = 414.33$, $P < 0.001$). Significant mean frailty differences were identified.

Conclusion: The relationships between the construct of frailty and indicators, although broadly constant, do vary across some countries. Furthermore, there was evidence of differing levels of frailty for the middle-aged and older populations across European countries.

Keywords: Frailty; Older persons; Confirmatory factor analysis; Cross cultural; Psychometric properties; Measurement invariance

1. Introduction

Frailty is increasingly recognized as a target for prevention of decline in older people both in research and in clinical practice [1]. Many concepts and measures of frailty exist [2], but the model most widely used is the phenotypic model introduced by Fried et al. [3]. This definition conceptualizes frailty as a physiological cycle of decline. Five components are indicative of various phases of the frailty cycle, these include unintentional weight loss, exhaustion, muscle weakness, slow gait, and low levels of physical activity. For an operational definition, each component is captured with a single item that is dichotomized and summed, reducing frailty to a unidimensional construct where each indicator has equal importance. An individual is regarded as ''prefrail'' if their score is 1 or 2 and ''frail'' if their score is ≥ [3]. This definition is popular owing to its face validity, ease of measurement within existing data sets, and its distinction from the concepts of disability and disease. Studies applying these criteria report the prevalence of frailty in community-dwelling older populations to be between 6% and 20% [3−5].

The frailty construct depends on the measurement and reporting of the five indicators and in epidemiologic research, is frequently an opportunistic measure constructed from items in large data sets that are similar to those originally proposed by Fried et al. [3]. Comparisons of frailty are often then made across subgroups. However, if groups of individuals separated by language or other aspects of national culture report indicators differently when the same underlying level of frailty is present, then comparisons between nations will be biased. Cross-national studies can identify any such ''measurement bias'' among groups.

1.1. Prevalence of frailty in Europe

The prevalence of frailty has been previously estimated across Europe based on data from the Survey of Health, Ageing, and Retirement in Europe (SHARE). The definition

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What is new?

Key findings

- Using confirmatory factor analysis we were able to show that a frailty phenotype as measured by appetite loss, exhaustion, weakness, slowness and reduced physical activity is a valid construct with a qualitatively similar factor structure across the twelve European countries.

What this adds to what was known?

- Once the variation in items used to assess frailty has been accounted for there was evidence for differing levels of frailty amongst the middle aged and older populations of European countries.

What is the implication, what should change now?

- Researchers and clinicians must take care to explore differences in the measurement of certain components of frailty in different countries, and adjust for these difference when making cross-cultural comparisons or applying the findings from one country into a clinical population in a different country.

used is similar to that described previously [6] but opportunistic as it relies on the items available within the SHARE data set. The prevalence of frailty in respondents aged ≥65 years across all countries was found to be 17% and prefrailty 42%. However, estimates varied between individual countries, Switzerland with the lowest prevalence (5.8%) and Spain with the highest prevalence (27.3%). It remains unclear whether this finding reflects a genuine difference in frailty across Europe or a difference in reporting of particular indicators in different countries. The psychometric properties of the SHARE frailty instrument have not been previously explored, although all the components of the SHARE frailty instrument have been individually validated cross nationally; specifically, as part of the EURO-D scale to measure depression [7] or as part of the "Health and Retirement Study" disability scale and activity questionnaire. The SHARE frailty instrument has also been shown to predict mortality within the SHARE sample [8].

1.2. Factor structure of frailty

Previous research investigating the factor structure and measurement properties of any frailty construct is limited [9–12]. Using principal components analysis to assess the dimensionality of the frailty syndrome based on 1,118 participants aged 70–79 years of the MacArthur Study, the authors identified two factors: one defined by physical activity, slowness, and weakness and the second defined by weight loss and exhaustion [9]. This suggests that frailty in older people has at least two dimensions. Other studies have considered frailty as a latent class [10,11]. Further psychometric work with respect to the factor structure in large community samples is required to better understand the dimensionality of frailty and refine its measurement.

In this article, we address three objectives using data from the first wave of SHARE. First, we estimate the hypothesized unidimensional factor structure of the SHARE frailty instrument and test its *configural invariance*, that is, whether the factor structure is the same across 12 European countries. Second, we explore *measurement invariance*, that is, whether individuals from different countries respond differently to different frailty items given their underlying frailty level. Finally, we examine whether violations of measurement invariance (measurement bias) explain the difference in frailty prevalence previously reported across SHARE countries.

2. Methods

2.1. Data source and participants

Participants were part of the first wave of SHARE (release 2.5.0) and were recruited from Denmark, Germany, Sweden, the Netherlands, Spain, Italy, France, Austria, Greece, Switzerland, Belgium, and Israel between 2004 and 2006 using sampling techniques described elsewhere [13,14]. To be eligible, the sampled household had to have one resident who was aged ≥50 years, speak the native language, and not be living abroad. Those in institutions were not sampled. The country-specific individual response rates ranged from 53% to 63% apart from 38.8% in Switzerland, 49.6% in Sweden, and 80.1% in France.

A total of 31,115 participants are included in the data set. We excluded participants aged <50 years (n = 1,288), with more than one missing value on any frailty item (n = 625), and those who had experienced a stroke or had Parkinson disease (n = 1,264), resulting in a final sample of 27,938.

2.2. Measures

Frailty was defined as previously within this cohort [6] and comprised items that mapped closely to the components defined by Fried et al. [3]. Table 1 displays the exact item wording of the five components of exhaustion, low physical activity, slowness, weakness, and weight loss as captured in SHARE. As can be seen in Table 1, items differ from the frailty phenotype: weigh loss/shrinking is replaced by appetite loss, slowness in SHARE is self-reported rather than a walking test, and low physical activity in SHARE is measured by one self-report item in place of an activity questionnaire. Grip strength and exhaustion are essentially captured in the same way as Fried et al. originally proposed.