Are physically frail older persons more at risk of adverse outcomes if they also suffer from cognitive, social, and psychological frailty?

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Published online: 19 February 2014
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Abstract Frailty is considered a predictor for negative outcomes such as disability, decreased quality of life, and hospital admission. Frailty measures have been developed that include different dimensions. We examined whether people who are physically frail are more at risk for negative outcomes of frailty if they also suffer from psychological, cognitive, or social frailty. Frailty was measured at baseline by means of the Groningen Frailty Indicator (GFI), which comprises a physical, cognitive, social, and psychological dimension. Only frail persons were included in the study (GFI ≥ 5) that, in addition, had to be frail in the physical dimension (i.e., ≥ 1 on this dimension). IADL disability and quality of life were measured at baseline and at 12 months. Hospital admission was assessed during this period. In this, physically frail sample effects of the other three frailty dimensions were studied in regression models. The sample ($n = 334$, mean age 78.1, and range 70–92) included 40.1 % frail men and 59.9 % frail women. Overall, no additional effects for the cognitive, social, or psychosocial dimensions were found: other frailty dimensions did not have an additional impact on disability, quality of life, or hospital admission in people who already suffered from physical frailty. Higher scores of physical

frailty were significantly related to IADL disability ($p < 0.05$) and hospital admission ($p < 0.05$). Additional analysis showed that the physical frailty score predicted IADL disability and hospital admission better than the GFI overall score. Results of this study suggest that persons, who are physically frail, according to the GFI, are not more at risk for negative outcomes of frailty (i.e., IADL disability, decreased quality of life, and hospital admission) if they in addition suffer from cognitive, social, or psychological frailty. In addition, for the prediction of IADL disability or hospital admission, the focus for screening should be on the physical frailty score instead of the GFI overall score including different dimensions.

Keywords Frailty · IADL disability · Determinants · Screening · Quality of life · Hospital admission

Introduction

Frailty is believed to be an increasingly common condition in older people but is not an inevitable part of aging (Slaets 2006). Although frailty has been conceptualized by several authors as a mainly physiological phenomenon (Campbell and Buchner 1997; Fried et al. 2001; Buchner and Wagner 1992; Hamerman 1999), others consider frailty more as a multidimensional concept (Slaets 2006; Strawbridge et al. 1998; Raphael et al. 1995; Rockwood et al. 1994) including physical, cognitive, social, and/or psychological indicators. Research has shown that frailty is an important indicator of health status in old age (Schoor et al. 2004; Fairhall et al. 2008). Frail people are at risk of negative health outcomes such as disability, decreased quality of life, and hospital admission. Disability and frailty are considered to be two

Responsible Editor: Dorly J. H. Deeg.

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different concepts (Fried et al. 2004). Frailty, from a multidimensional approach, is generally focused on personal deficits, possibly taking resources into account (Ament et al. 2012), without reference to actual performance of roles and tasks. Disability is a complex and highly dynamic process and is defined as a limitation in the performance of socially defined roles and tasks within a socio-cultural and physical environment (Verbrugge and Jette 1994), and is, therefore, different from frailty. Recent studies have indicated that the physical, cognitive, psychological, and social dimensions are of great importance in the concept of frailty (Gobbens et al. 2007, 2012; Markle-Reid and Browne 2003).

Although several frailty measures such as the Groningen Frailty Indicator (GFI) (Steverink et al. 2001), the Tilburg Frailty Indicator (TFI) (Gobbens et al. 2010), the Frailty Index (FI) (Mitnitski et al. 2001), and the Clinical Global Impression of Change in Physical Frailty (CGIC-PF) (Studenski et al. 2004) include different dimensions, they all generally assume a cumulative model of frailty i.e., scores are created by adding different items from different dimensions. However, older persons with the same sum score may suffer from different symptoms or from deficits in different dimensions, and these screening instruments do not take the co-occurrence of deficits in different frailty dimensions into account. Instead, people are defined as frail based on a sum score. There are studies that report on the predictability of such cumulative frailty instruments (Daniels et al. 2012; Metzelthin et al. 2010a). Gobbens and colleagues studied the differential effect of dimensions within a frailty screening instrument on negative outcomes (Gobbens et al. 2012). They found that physical frailty was mostly responsible for the significant effect of frailty on the outcomes of disability, decreased quality of life, and health care utilization. However, it remains unclear whether people who suffer from multiple frailty dimensions are at greater risk for negative outcomes of frailty. As deficits in the physical dimension are particularly known to be important predictors for negative outcomes, this dimension may be taken as reference (Gill et al. 2006; Gobbens et al. 2012). Are people more at risk if they, in addition to physical frailty, also suffer from psychological frailty, for example? So more specifically, in the present study we seek to examine whether cognitive, social, and/or psychological frailty measures have predictive value for IADL disability, quality of life, and hospital admission in a physically frail sample of community-living older people. We expect that a 1-year follow-up period is sufficient to detect any changes in IADL disability, quality of life, and hospital admission in a sample of frail older people since they are more susceptible for change compared with relatively healthy older people.

Methods

Study design and participants

A longitudinal study was conducted from January 2010 to June 2011 in a sample of frail community-living people aged 70 or older in the southern part of the Netherlands. Potential participants were recruited via the general practitioners (GPs) at 14 general practices. The GPs' databases were used to send out a screening questionnaire including the GFI (Steverink et al. 2001) to persons aged 70 or older, with a maximum of 350 persons per general practice. If more than 350 persons per practice were aged 70 or older, a random selection was drawn for initial screening purposes. Initially, 4,298 persons were approached to participate in the study. A total of 3,521 persons responded. Only frail older people were included in the study because they are expected to be more at risk for adverse outcomes than relatively healthy older people. Participants with a GFI score of 5 or higher were considered frail (Metzelthin et al. 2010b) and this was used as the baseline measurement for frailty. Of the 3,521 persons who responded, 498 were frail according to the GFI and signed an informed consent. Since our research question focuses on physically frail people, an additional 23 peoples were excluded who were not physically frail, i.e., did not score on any of the items for physical frailty. In total, 475 peoples were eligible for the study. In addition, IADL disability and quality of life were measured at baseline and at a 12-month follow-up. Hospital admission between baseline and follow-up was measured retrospectively at follow-up. A total number of 421 peoples completed baseline measurements. All data were collected through postal questionnaires. The study obtained approval from the Medical Ethical Committee of Maastricht University Medical Center in the Netherlands.

Independent variables

Frailty was measured using the GFI, a self-reporting screening instrument that consists of 15 items and focuses on deficits in four different dimensions (Steverink et al. 2001): physical (nine items, mobility functions, physical fitness, unintentional weight loss, vision, and hearing), cognitive (one item, memory problems), social (three items, missing people around, feeling abandoned, and experiencing emptiness), and psychological (two items, feeling downhearted or blue and feeling nervous or anxious). Every item is scored either 0 or 1. Scores for the total GFI theoretically range from 0 to 15 with higher scores indicating higher levels of frailty (Steverink et al. 2001; Schuurmans et al. 2004). Scores on the GFI dimensions theoretically range from 0 to 9 (physical), 0 to 1 (cognitive), 0 to 3 (social), and 0 to 2 (psychological). As we

included only physically frail older persons in the present study, the observed range for this dimension could range from 1 to 9.

Dependent variables

IADL disability was measured using the Katz IADL scale which consists of seven items (Katz et al. 1970). The Katz IADL scale measures whether personal assistance is needed for the following functions in the instrumental activities of daily living: telephone use, taking medication, shopping, preparing meals, taking care of the house, ability to handle finances, and traveling. Items can be answered with “yes” or “no.” Scores for the Katz IADL scale theoretically range from 0 to 7 with higher scores indicating higher levels of IADL disability. Quality of life was measured on a five-point scale: “How would you, in general, rate your quality of life?” The answer options were “excellent,” “very good,” “good,” “moderate,” and “bad.” Two groups were formed: good to excellent, and moderate to bad. Hospital admission was measured by asking how many days in the past year had been spent in a hospital. Two groups were created, those who spent one or more days in hospital in the past year and those who did not spend any days in hospital.

Statistical analysis

First, descriptive statistics were computed for sociodemographics, independent, and dependent variables.

To examine whether people are more at risk for developing IADL disability, decreased quality of life and hospital admission if they, in addition to physical frailty, also

suffer from cognitive, social, and/or psychological frailty the following procedure was conducted. Note that all of the participants are physically frail. However, not all participants are frail in the other three dimensions (i.e., cognitive, social, and psychological). Based on the median score we made, two categories for each of the three dimensions (i.e., cognitive, social, and psychological) indicating that they were either frail (1) or not frail (0). For the outcome measure IADL disability, a linear regression analysis was performed. Basic assumptions for regression analysis (including normality of distribution) were checked for the variable IADL disability. Logistic regression analyses were performed for hospital admission and quality of life. For each outcome measure, we performed three separate analyses (for each of the three dimensions, i.e., cognitive, social, and psychological). Gender, age, multimorbidity, and an index score for the physical dimension were included as covariates in all models. With respect to multimorbidity, two groups were created: people without multimorbidity (i.e., no or only one disease) and people with multimorbidity (i.e., two or more diseases). Baseline levels of IADL disability and quality of life were included in the analyses where either IADL disability or quality of life was the outcome measure.

Results

Initially, 4,298 persons aged 70 years or older were approached to participate in the study. A total of 3,521 persons responded, of whom 421 were included in the study as they met the inclusion criteria (i.e., $GFI \geq 5$,

Fig. 1 Flow of participants through measurements

informed consent, completed baseline measurement). Ultimately, 334 persons completed the follow-up measurement after 1 year and were used in the analyses (see Fig. 1 for flow of participants).

T tests show no statistically significant differences with respect to GFI scores between the persons who completed the follow-up measurement after 1 year and those lost to follow-up (mean GFI scores 6.9 and 7.1, respectively, $p = 0.251$). A significant difference with respect to age could be identified between those who completed the follow-up and those lost to follow-up (mean age 78.1 and 79.6, respectively, ($p = 0.025$)). Descriptive statistics of the sample ($n = 334$) is shown in Table 1.

Table 1 Participant characteristics ($N = 334$)

Variables	Total group
Age (mean $\pm$ SD)	78.1 $\pm$ 4.9
Sex	
Female	200 (59.9 %)
Male	134 (40.1 %)
GFI (mean $\pm$ SD)	
Overall (range 5–14) ^a	6.9 $\pm$ 1.7
Physical dimension (index)	
Range 1–8 ^a	2.8 $\pm$ 1.4
Cognitive	
No	77.8 %
Yes	22.2 %
Social	
No	48.5 %
Yes	51.5 %
Psychological	
No	34.9 %
Yes	65.1 %
Katz IADL baseline (mean $\pm$ SD)	
Range 0–7 ^a	2.0 $\pm$ 1.6
Hospital admission ^b	
Yes	25.3 %
No	74.7 %
Quality of life	
Excellent—good	49.9 %
Moderate—bad	50.1 %
Multimorbidity ^c	
Yes	93.7 %
No	6.3 %

^a Observed range

^b Hospital admission was measured over the period between baseline and 12 months follow-up

^c Multimorbidity was defined as having two or more diseases. Note: Cognitive, social, and psychological dimension were coded as “yes” or “no.” No indicates only physical frailty. Yes indicates physical frailty and frail concerning the dimension (i.e., cognitive, social, and psychological)

The Spearman correlation between IADL at baseline and at 12 months follow-up was 0.767 ($p < 0.001$); the correlation for quality of life (five categories) was 0.544 ($p < 0.001$).

The linear regression analysis showed that the physical frailty score significantly predicts IADL disability at 12 months (Table 2). We did not find an effect for cognitive, social, or psychological frailty on IADL disability.

The logistic regression analysis with respect to hospital admission revealed a significant effect for the physical frailty score of the GFI (Table 3). Again, we did not find an effect for cognitive, social, or psychological frailty.

Finally, with respect to quality of life at 12 months, the logistic regression analyses showed no significant effects except for the baseline value of quality of life (Table 3).

As we found significant effects of the physical frailty score for both IADL disability and hospitalization, we additionally compared the effects of the physical frailty

Table 2 Multiple regression analysis: impact of frailty components on IADL disability after 1 year

IADL disability			
	<i>B</i>	β	95 % CI
GFI cognitive (0,1)	0.036	0.009	−0.248–0.320
GFI physical (1–9)	0.108	0.093*	0.015–0.201
Age	0.030	0.090*	0.006–0.054
Sex (1,2)	−0.050	−0.015	−0.291–0.191
IADL disability T0 (0–7)	0.679	0.688***	0.598–0.760
Multimorbidity (0,1)	0.417	0.072*	0.012–0.821
GFI social (0,1)	−0.099	−0.030	−0.328–0.131
GFI physical (1–9)	0.101	0.087*	0.007–0.194
Age	0.030	0.091*	0.007–0.054
Sex (1,2)	−0.051	−0.015	−0.285–0.183
IADL disability T0 (0–7)	0.685	0.694***	0.605–0.765
Multimorbidity (0,1)	0.419	0.072*	0.015–0.823
GFI psychological (0,1)	−0.071	−0.021	−0.314–0.171
GFI physical (1–9)	0.101	0.087*	0.008–0.194
Age	0.029	0.087*	0.005–0.053
Sex (1,2)	−0.066	−0.020	−0.301–0.169
IADL disability T0 (0–7)	0.684	0.694***	0.604–0.764
Multimorbidity (0,1)	0.431	0.074*	0.026–0.837

GFI cognitive was coded 0 = only physical frailty 1 = cognitive and physical frailty; GFI social was coded 0 = only physical frailty 1 = social and physical frailty; GFI psychological was coded 0 = only physical frailty 1 = psychological and physical frailty; GFI Physical is an index score ranging from 0–9, higher scores indicate higher levels of physical frailty; age is in years; sex was coded 1 = male, 2 = female; disability T0 is an index score ranging from 0 to 7, higher scores indicate higher levels of IADL disability; multimorbidity was coded 0 = no multimorbidity, 1 = multimorbidity

GFI groningen frailty indicator, CI confidence interval

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 3 Logistic regression analysis: impact of frailty components on hospital admission and quality of life after 1 year

CI confidence interval; GFI Cognitive was coded 0 = only physical frailty 1 = cognitive and physical frailty; GFI Social was coded 0 = only physical frailty 1 = social and physical frailty; GFI Psychological was coded 0 = only physical frailty 1 = psychological and physical frailty; GFI Physical is an index score ranging from 0 to 9, higher scores indicate higher levels of physical frailty; Age is in years; Sex was coded 1 = male, 2 = female; Quality of life was coded 0 = excellent-good, 1 = moderate-bad, higher scores indicate higher levels of IADL disability; multimorbidity was coded 0 = no

	Hospital admission OR [95 % CI]	Quality of life OR [95 % CI]
GFI cognitive (0,1)	1.090 [0.591–2.009]	0.664 [0.353–1.250]
GFI physical (1–9)	1.256 [1.048–1.506]*	1.059 [0.879–1.277]
Age	0.958 [0.907–1.010]	0.981 [0.929–1.035]
Sex (1,2)	0.805 [0.477–1.357]	0.757 [0.445–1.287]
Quality of life T0 (0,1)	NA	10.007 [5.948–16.838]**
Multimorbidity (0,1)	0.975 [0.393–2.423]	0.953 [0.387–2.348]
GFI social (0,1)	1.272 [0.765–2.126]	1.293 [0.768–2.176]
GFI physical (1–9)	1.267 [1.057–1.520]*	1.077 [0.889–1.303]
Age	0.957 [0.907–1.010]	0.976 [0.925–1.030]
Sex (1,2)	0.775 [0.464–1.293]	0.794 [0.472–1.337]
Quality of life T0 (0,1)	NA	9.260 [5.501–15.588]**
Multimorbidity (0,1)	0.981 [0.394–2.442]	0.955 [0.389–2.347]
GFI psychological (0,1)	0.915 [0.537–1.558]	1.141 [0.662–1.967]
GFI physical (1–9)	1.251 [1.043–1.500]*	1.064 [0.881–1.285]
Age	0.956 [0.906–1.009]	0.981 [0.930–1.035]
Sex (1,2)	0.792 [0.476–1.319]	0.799 [0.474–1.346]
Quality of life T0 (0,1)	NA	9.649 [5.710–16.304]**
Multimorbidity (0,1)	0.999 [0.401–2.490]	0.922 [0.374–2.269]

score with the full GFI score on both IADL disability and hospitalization. The results show stronger effects for the physical frailty score of the GFI than for the full GFI score for both IADL disability (β 0.092, CI 0.015–0.200 vs. β 0.022, 95 % CI –0.056–0.099, respectively) and hospital admission (OR 1.240, 95 % CI 1.033–1.487 vs OR 1.101, 95 % CI 0.948–1.277, respectively).

Discussion

Our aim was to study whether physically frail older people are more at risk for developing IADL disability, decreased quality of life, and hospital admission if they also suffer from cognitive, social, or psychological frailty. Neither one of the cognitive, social, or psychological dimension did show a predictive effect on any of the outcome measures in a physically frail sample. This suggests that people who are physically frail are not more at risk of IADL disability, poor quality of life, or hospital admission during a 1-year period if they additionally suffer from other frailty dimensions (i.e., cognitive, social, and psychological). The physical frailty score predicts change in IADL disability better than does the GFI overall score. This also holds true for hospital admission, where the physical frailty score is a better predictor than the overall GFI score.

The importance of physical frailty has already been pointed out (Fried et al. 2001). Several studies investigated the predictive value of different screening instruments on negative outcomes of frailty. Daniels et al. (2012)

compared the predictive value of three multidimensional screening instruments [i.e., the GFI, the TFI, and the Sherbrooke Postal Questionnaire (SPQ)] for the development of disability, hospital admission, and mortality. They found that those identified as frail have more than twice the risk of developing a disability compared to their non-frail counterparts (Daniels et al. 2012). Gobbens and colleagues tested the predictive value of the TFI (Gobbens et al. 2010) and its three dimensions of frailty (physical, social, and psychological) and concluded that physical frailty had the most significant effect on disability, quality of life, and health care utilization (Gobbens et al. 2012). This is in line with our findings which point out that physical frailty seems to be the best predictor of IADL disability and hospital admission.

Quality of life has been shown to be negatively affected by frailty (Bilotta et al. 2010). Quality of life is a general reflection of how satisfied someone is with their own life. The literature suggests that factors contributing to quality of life can be physical, psychological, or social (King et al. 2012). Although these three dimensions are present in the GFI, we did not find any additional effect of any of the dimensions to the effect of the physical dimension. Gobbens and colleagues, for example, did find a significant effect for the physical, psychological, and social dimension on quality of life (Gobbens et al. 2012). They, however, recruited people from an open population and, therefore, included older persons who were both frail and non-frail. The variability in quality of life between those who are frail and those who are not frail is expected to be

larger. In this study, only frail older persons were included.

Important risk factors for hospital admission are severe morbidity and previous hospitalization (Comette et al. 2005). Among older persons, a decrease in functional capacities often accompanies a disease before hospital admission (Covinsky et al. 2000). This may explain the significant prediction of hospital admission for the physical frailty score. It seems plausible that people are admitted to a hospital because they have physical problems which are particularly related to physical frailty. A possible explanation for the absence of a positive association for the other dimension of frailty might be that older people are not more likely to be admitted to a hospital when they are feeling abandoned, anxious, or sad than when they are not. In our analysis, multimorbidity was not significantly related to hospital admission. It remains unclear, however, whether physical frailty in itself predicts hospital admission or whether a disease underlying frailty, accompanied by functional decline, is responsible for admission to a hospital. To make it even more complex, there are many other variables that may influence hospital admission such as living alone without an informal caregiver or economic hardship (Landi et al. 2004).

Outcome measures were chosen based on what is known from the literature. IADL disability, hospital admission, and decreased quality of life are well-known consequences of frailty (Daniels et al. 2012; Gobbens et al. 2012). Although frailty is increasingly acknowledged as a multi-dimensional concept (i.e., including physical, psychological, social, and cognitive factors), the outcome measures IADL disability and hospital admission can be viewed as particularly physically related. Considering this perspective, it is not surprising that the physical frailty score is related to hospital admission and IADL disability. Hospital admission is usually due to physical problems and less to social or psychological problems.

One important advantage of this study is that the participants included were all frail older persons. This makes this study different from those that recruit in open populations in which small subsets are considered frail (Daniels et al. 2012; Gobbens et al. 2012). It makes the results, with respect to physical frailty, hospital admission, and IADL disability, more robust compared to studies that include both frail and non-frail older persons. On the other hand, the outcomes of our study are not representative for the general older population as we included only physically frail older people.

Findings must be interpreted with some caution. Items on the GFI are not equally distributed among the four different dimensions; the cognitive dimension, for example, has only one item, whereas the physical dimension has nine items. Furthermore, our measures are based on self-report data which are

collected by using self-completion questionnaires. The method of collecting self-report data (e.g., face-to-face interview, telephone interview, and postal survey) may influence the representativeness and quality of the data (Hebert et al. 1996). In the current study, data were collected by means of postal surveys. Compared with other methods of self-report data, postal surveys have both disadvantages and advantages. Hébert and colleagues concluded that, especially in very old people, health-related information collected with postal questionnaires may be influenced by nonresponse bias (Hebert et al. 1996). Results should, therefore, be interpreted with caution (Barreto 2012; Hebert et al. 1996). But in other methods of self-report, such as face-to-face and telephone interviews, the presence of an interviewer can also cause bias as this can be distracting to respondents. Postal questionnaires obviously avoid this type of bias (Bowling 2005). For research purposes, postal questionnaires are generally considered as a feasible method to collect data (de Vries et al. 2011). Large groups can be approached efficiently and in a financially viable way. Although health care utilization is often underestimated with self-report measures, with respect to major life events such as hospital admission, self-reported data correspond well with administrative data (Hoogendoorn et al. 2009; Short et al. 2009; van den Brink et al. 2004). Finally, quality of life was measured with a single question and is, in addition, a very broad concept. This might be too inaccurate to measure effects.

This study has several implications. Other frailty dimensions (i.e., psychological, cognitive, or social) did not show any effect on IADL disability, quality of life, and hospital admission in a physically frail population. It is possible that outcome measures with a stronger psychological and/or social focus would yield different results, and hence justifying the inclusion of such dimensions in a screening instrument for frailty. Effective screening is, from a public health point of view, generally considered useful for optimizing health care for frail older persons. When predicting IADL disability or hospital admission during a 1-year period of follow-up, the focus should be on the physical frailty score instead of the overall GFI score, which includes different dimensions.

Acknowledgments The authors thank the patients for their willingness to participate in the present study. The Centre for Data and Information Management (MEMIC) at Maastricht University is acknowledged for their assistance in the data collection. This research was conducted as part of a study that was funded by ZonMw—the Netherlands Organization for Health Research and Development (Grant 311070201).

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