Evaluation of frailty and influencing factors in old people in hospital institution

Evidence for a phenotype of frailty

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Abstract
We assessed the frailty status of inpatients and analyzed the factors influencing frailty status to explore the reasons for frailty and identify feasible intervention strategies.

A total of 1494 geriatric patients aged ≥60 years were recruited as subjects. All patients were hospitalized between September 2014 and August 2015 in the internal medicine units of 3 hospitals in Chongqing and Zunyi in the southwestern area of China. Patients’ frailty status was evaluated using the Phenotype of Frailty scale, via face-to-face interviews coupled with physical examinations using simple equipment.

Of the 1494 cases, 1400 (93.71%) were eligible for analysis. Participants’ mean age was 75.52±9.28 years. The overall prevalence of frailty was 18.0%, and was higher for frail females (9.4%) than males (8.6%). Increasing age and body mass index, low income (<1000 Ren Min Bi for per month), poor self-rated health, cognitive impairment, depression, polypharmacy (≥5 medications), disability, and a history of fall in the past 1 year were independently significantly correlated with frailty (P < .05 for each comparison).

Numerous factors were associated with frailty. As treatment for frailty is focused on prevention in this study, intervention strategies should target a comprehensive list of physiological and psychological aspects of the older people.

Abbreviations: BDL = Basic Activities of Daily Living, BMI = body mass index, CI = confidence interval, FP = Phenotype of Frailty, IADL = Instrumental Activities of Daily Living, OR = odds ratio, RMB/M = Ren Min Bi for per month.

Keywords: evaluation, frailty, hospital, influencing factors, old people

1. Introduction

The global population is rapidly aging, the number of the elderly people in the world has reached 629 million. Increasing age and aging are related to body function decline and the risk of adverse outcomes. It is difficult to distinguish the difference “disease and health,” and the older adults are often in the status “neither disability nor health.” How to realize and prevent the adverse events as early as possible? The concept of frailty increasingly attracts the attention of the researchers and clinical workers in recent years, is becoming a hot point in the field of gerontology.

The academic community has not settled on a unified clinical definition for frailty. While frailty can be narrowly defined as “physiological function decrease,” this merely provides a 1-dimensional understanding of the condition; a more general and multidimensional definition of frailty would help emphasize its impacts on the overall body. Accordingly, one can define it as a decline in the reserve capacity of multiple body systems and physical degeneration.

Frailty can occur as the result of a range of chronic diseases and acute reactions or medical conditions, and is not synonymous with any specific pathological state or disability; frailty could be reversed through intervention. Indeed, the term “frailty” is often used to describe the chronic health problems experienced by elderly adults aged 65 years old or older, and it is particularly common among those over the age of 80. Frailty can severely affect work and quality of life, as well as increase social and family burden.

International scholars have recently begun focusing on the development of a frailty theory. In December 2012, the concept of frailty was “re-opened” for discussion. The experts concluded at that time that frailty is a complex medical syndrome with multiple causes and contributors that is mainly characterized by reduced strength and endurance, reduced physiological function that increases an individual’s vulnerability for developing increased dependency and/or death, and can be reversed or attenuated through appropriate intervention. It is recommended that all elderly aged 70 years old and above be routinely assessed for frailty.

As a result of research on frailty and its related influencing factors, some evaluation tools with better validity and reliability have been developed, for example, Phenotype of Frailty (FP), Study of Osteoporotic Fractures (SOF), Frailty Index (FI), Frailty Instrument of the Survey of Health, Ageing and Retirement in
In comparison to other developed countries, frailty research commenced at a later stage, the subjects of few studies were mainly community-dwelling geriatric populations in China.\textsuperscript{18–22} This study was to focus on the frailty status of inpatients aged 60 years old or over and analyze the influencing factors and reasons of frailty by FP instrument.

2. Materials and methods

2.1. Data and participants

The study received approval from the Human Research Ethics Committee of the Second Affiliated Hospital of Chongqing Medical University, Chongqing, China (No. 71, 2014). All recruited patients signed an informed consent.

This was a cross-sectional study, and stratified random samples were used to recruit geriatric inpatients from the internal medicine units of 3 general hospitals in Chongqing and Zunyi from September 2014 to August 2015. These hospitals were the Second Affiliated Hospital of Chongqing Medical University, the First People’s Hospital of Zunyi, and the Aerospace Hospital of Guizhou in southwestern area of China.

Geriatric patients who met the following criteria were included in this study: ≥60 years old; able to communicate and did not have severe cognitive impairment or psychiatric illness; had the consent of themselves and their families; and voluntarily agreed to participate. A total of 1494 patients (aged ≥60 years old) were recruited. After excluding those who refused participation (n = 32, 2.14%), who had communication impairments or seriously illness (n = 20, 1.34%), and who had missing data (n = 42, 2.81%), a total of 1400 patients were ultimately recruited and analyzed (valid response rate: 93.71%; Fig. 1).

2.2. Study design

The evaluation instrument of frailty was the FP scale. Patients’ frailty status was assessed using a questionnaire administered in a face-to-face interview by trained staffs in the first 48h of inpatients admission, along with a physical examination (which included measurements of blood pressure, heart rate, height, and weight) using simple detection equipment.

2.3. Baseline characteristics

The questionnaire included general demographic information (e.g., age, sex, educational level, marital status), degree of family and social support (e.g., whether one is living alone, relationship status with family, main monthly income, main social activities), disease status (e.g., main diseases, medication compliance, types of taking medications), and personal habits (e.g., smoking history, drinking history, etc.).

We then entered factors that might be related to frailty into a univariate analysis. The specific indicators included gender, education level, marital status, income level, smoking, drinking, history of hospitalization, and a fall in the past 1 year, duration of hospitalization, cognitive impairment, depression, disability, comorbidity, polypharmacy, poor self-rated health, age, and body mass index (BMI) (note that these latter 2 variables were treated as continuous variables; see Table 1 for details).

2.4. Frailty assessment tool

FP was proposed by Fried et al.\textsuperscript{6} the scale contained 5 items, the presence of 3 or more of the following components in the frailty scale was classified as frail, 1 or 2 criteria was considered as intermediate frailty status or prefrail, no criteria as nonfrail.
Weight loss was defined as self-reported unintentional weight loss >4.5 kg or >5% of body weight in prior year (by direct measurement of weight).

Exhaustion was indicated by a self-response as “a moderate amount the time” or “most of the time in the previous week” to either of the following 2 statements: “I felt everything I did was an effort” or “I could not get going” from the Center for Epidemiological Studies—Depression Scale.23

Low physical activity level was defined by gender-specific low weekly energy expenditure measured by Minnesota Questionnaire Assessment Scale,24 and <383 kcal/wk for males and <270 kcal/wk for females were considered as “low physical activity.”

Slow walking speed and low grip strength were analyzed according to elderly Chinese people pace and grip strength standard.25 <0.65 m/s for males, <0.60 m/s for females; <22 kg for males and <14 kg for females were indicated slow walking speed and low grip strength, respectively. Pace speed was measured by normal walking 6 m on level road; maximal handgrip strength was measured using a handheld dynamometer (CAMRY MODEL EH101, Guang Dong, China). Participants performed 2 trials on each side, the mean value of the best side was used.

The Geriatric Depression Scale (GDS) was adopted to determine whether subjects exhibited depression.27 The GDS comprises a total of 30 items, with a total score ranging from 0 to 30. Scores of ≥11 were considered as depression.

The most prevalent criterion was low handgrip strength (27.9%), followed by exhaustion (21.5%), low physical activity (18.6%), low gait speed (17.5%), and weight loss (2.9%) (Table 1).

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The over prevalence of frailty in this study was 18.0% (n = 252), while the prevalence rates of intermediate and nonfrail were 32.7% (n = 458) and 49.3% (n = 690), respectively; and prevalence of frailty for frail female patients was 9.4% (n = 131) and male patients was 8.6% (n = 121) (Table 2).

In the univariate analysis, except for smoking and drinking, frailty was more common among patients with a low education level (<5 years), low income (<1000 Ren Min Bi for per month [RMB/M]), live alone, and poor self-report health, frailty was also more likely

| Variable | Men | Women | Total |
|---------|-----|------|-------|
| Weight loss (≥4.5 kg) | 12 (2.0) | 29 (3.6) | 41 (2.9) |
| Grip strength (kg) | 168 (28.3) | 223 (27.5) | 391 (27.9) |
| Slow walk (m/s) | 123 (20.9) | 122 (15.0) | 245 (17.5) |
| Exhaustion | 136 (23.1) | 165 (20.3) | 301 (21.5) |
| Low activity (kcal/wk) | 123 (20.9) | 138 (17.0) | 261 (18.6) |

| Frequency of frailty components | Men | Women | Total |
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2.5.4. Instrumental Activities of Daily Living (IADL) (7 variables). These 7 variables reflected individuals’ ability to perform the following activities, including shopping, going out, cooking, household chores, telephone use, taking medication, and financial management.29

2.5.5. Disability. The ≥1 item of BADL or IADL need assistance to finish or cannot even finish was considered to have a disability.30

2.5.6. Comorbidity. Comorbidity was defined as having 2 or more age-related health conditions or diseases through medical charts diagnosis.31

We defined subjects as smoking if they reported currently smoking or had smoked ≥100 cigarettes in a lifetime; subjects who had never smoked or had smoked <100 cigarettes in a lifetime were considered as nonsmoking.32 Drinking alcohol referred to subjects who were still drinking, while those who never drank or occasionally drank were considered as nondrinking.

Participants were deemed as polypharmacy if they took ≥5 medications on a regular basis.

“Married” indicated that the spouse was still alive and lived together, whereas “live alone” included divorcees, single individuals, or widows but without lived with their family members.

2.6. Statistical analysis

The chi-squared test was used to compare categorical data, which were expressed as numbers and percentages. Continuous data were analyzed using 1-way analysis of variance and were expressed as means and standard deviations. We then entered above indicators into a univariate analysis. Those factors that were significantly related to frailty in the univariate analysis were then included in a multinomial logistic regression analysis to clarify the independent influencing factors of frailty status. (Using frailty as a dependent variable, variables with preliminary statistical significance from the univariate analysis were converted into independent variables.) Significance level was set at P < .05. The statistical analysis was carried out using SPSS 18.0 software (SPSS Inc., Chicago, IL).

3. Results

3.1. General subjects data

The overall recruited patients were aged between 60 and 99 years old (75.52 ± 9.28 years), with males (n = 588, 42%) ranging from 60 to 99 years old (76.11 ± 9.76 years) and females (n = 812, 58%) ranging from 60 to 97 years old (75.10 ± 8.90 years). The mean duration of hospitalization was 11.82 ± 4.65 days.

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to develop among patients with comorbidity, disability, cognitive impairment and depression, as well as those who had longer durations of hospitalization (≥7 days) and polypharmacy, a history of hospitalization and a fall in the previous year; notably, the proportion of frailty increased with increasing age and BMI (P < .05 for each comparison; Table 2).

### 3.3. Multinomial logistic regression analysis results

The above significant variables were then incorporated into a multinomial logistic regression analysis. There were various risk factors in different frailty level. Table 3 shows that increasing age and BMI, disability, cognitive impairment and depression, polypharmacy, low income (<1000 RMB/M), poor self-rated

| Table 2 |
| --- |
| The association of baseline indicators with different frailty level in percentages by univariate analysis. |
| | Total (N=1400), N (%) | Nonfrail (N=690), N (%) | Intermediate (N=458), N (%) | Frail (N=252), N (%) | P |
| Indicators (categorical variables) | | | | | |
| Sex | | | | | |
| Men | 588 (42.0) | 291 (49.5) | 176 (30.9) | 121 (20.6) | .046 |
| Women | 812 (58.0) | 399 (49.1) | 282 (44.7) | 131 (20.4) | |
| Education, y | | | | | |
| 0–5 | 489 (34.9) | 160 (32.7) | 183 (37.4) | 164 (32.9) | .001 |
| 6–11 | 520 (37.1) | 288 (55.4) | 165 (31.7) | 67 (12.9) | |
| ≥12 | 391 (28.0) | 242 (61.9) | 110 (28.1) | 39 (10.0) | |
| Marital status | | | | | |
| Married | 897 (64.1) | 545 (60.8) | 242 (27.0) | 110 (22.2) | .001 |
| Live alone | 503 (35.9) | 399 (49.1) | 216 (34.4) | 132 (28.0) | |
| Income, RMB/M | | | | | |
| <1000 | 124 (8.9) | 35 (28.2) | 47 (35.9) | 42 (33.9) | .001 |
| 1000–3000 | 655 (46.8) | 329 (50.0) | 218 (33.3) | 108 (16.5) | |
| >3000 | 621 (44.3) | 326 (61.9) | 193 (31.1) | 102 (16.4) | |
| Smoking | | | | | |
| Yes | 1099 (78.5) | 540 (49.1) | 358 (32.6) | 201 (33.9) | .864 |
| No | 301 (21.5) | 150 (49.8) | 100 (33.2) | 51 (17.0) | |
| Alcohol | | | | | |
| Yes | 1215 (86.8) | 604 (49.7) | 392 (32.3) | 219 (18.0) | .633 |
| No | 185 (13.2) | 86 (46.5) | 66 (35.7) | 33 (17.8) | |
| Admissions in the past 1 y | | | | | |
| Yes | 771 (55.1) | 294 (38.1) | 297 (38.5) | 180 (23.4) | .001 |
| No | 629 (44.9) | 396 (63.0) | 161 (25.6) | 72 (11.4) | |
| Length of stay, d | | | | | |
| <7 | 420 (30.0) | 252 (60.0) | 111 (26.4) | 57 (13.6) | .001 |
| ≥7 | 980 (70.0) | 438 (44.7) | 347 (35.4) | 196 (19.9) | |
| Cognitive impairment | | | | | |
| Yes | 321 (22.9) | 35 (10.9) | 115 (35.8) | 171 (53.3) | .001 |
| No | 1079 (77.1) | 655 (60.7) | 343 (31.8) | 81 (7.5) | |
| Depression | | | | | |
| Yes | 615 (43.9) | 143 (23.2) | 257 (41.8) | 215 (35.0) | .001 |
| No | 785 (56.1) | 547 (69.7) | 201 (26.6) | 37 (4.7) | |
| Disability | | | | | |
| Yes | 665 (47.5) | 142 (21.4) | 278 (41.8) | 245 (36.8) | .001 |
| No | 735 (52.5) | 548 (75.5) | 180 (24.5) | 7 (1.0) | |
| Fall in the past 1 y | | | | | |
| Yes | 277 (19.8) | 81 (29.2) | 113 (40.8) | 83 (30.0) | .001 |
| No | 1123 (80.2) | 609 (54.2) | 345 (30.7) | 168 (15.1) | |
| Number of comorbidity | | | | | |
| 0–1 | 232 (16.6) | 144 (62.1) | 61 (26.3) | 27 (11.6) | .001 |
| ≥2 | 1168 (83.4) | 546 (46.7) | 397 (34.0) | 225 (19.3) | |
| Number of drugs | | | | | |
| 1–4 | 932 (66.6) | 515 (55.3) | 284 (30.5) | 133 (14.2) | .001 |
| ≥5 | 468 (33.4) | 475 (34.7) | 174 (37.2) | 119 (25.4) | |
| Self-rated health | | | | | |
| Well | 394 (29.2) | 259 (66.7) | 107 (27.2) | 28 (7.1) | .001 |
| Normal | 143 (10.2) | 111 (77.6) | 23 (16.1) | 9 (6.3) | |
| Poor | 863 (61.6) | 320 (37.1) | 328 (38.0) | 215 (24.9) | |
| BMI = body mass index, RMB/M = Ren Min Bi for per month. The x^2 test for categorical data was expressed as numbers and percentages. One-way analysis of variance test for continuous data was expressed as means and standard deviations.

### 3.3. Multinomial logistic regression analysis results

The above significant variables were then incorporated into a multinomial logistic regression analysis. There were various risk factors in different frailty level. Table 3 shows that increasing age and BMI, disability, cognitive impairment and depression, polypharmacy, low income (<1000 RMB/M), poor self-rated
Because all the subjects were hospitalized patients, we included “duration of hospitalization” and “history of hospitalization in the past 1 year” as variables, both of them had no independently correlated with frailty according to the regression analysis, 1 possible reason might be that longer hospital stay was an outcome of frailty rather than the etiologic risk factor.[34] Some positive indicators in the univariate analysis in our study were similar to the results from Taiwan of China.[31]

There were 9 independent risks factors related to frailty, including increasing age and BMI, disability, cognitive impairment and depression, polypharmacy, low income (<1000 RMB/M), poor self-rated health, and a fall history in the past 1 year. Age was an independent risk factor, a numerous of studies have showed that the prevalence of frailty increased with increasing age.[19,20,22,33,40] Some scholars have explored that frailty can increase the risks of hospitalization, fall, and disability.[7,8,43] The other researches have proposed that polypharmacy was the one of presence of frailty syndrome.[44,45]

A regression analysis further explored that intermediate frail and frail had different risk factors, the strength of the correlations of these variables was dissimilar in different frail levels. As shown in Table 3, for example, when the frail compared with nonfrail groups, the odds ratio (OR) of disability was 15.01 (95% confidence interval [CI] was 6.43–35.05, P < .001). In comparison with nonfrail groups, the intermediate group had an OR of 2.19 (95% CI [1.54–3.12], P < .001). Disability was thus regarded as strong risk factors in this study.

Based on the results of this study, a timely assessment of frailty status should be given to recently admitted inpatients (especially during their prefrail or frail state). The “Silver Book” is an intercollegiate publication focusing on good care during the first 24h of an older person’s admission to hospital,[43] it recommends that all patients are assessed for depression, falls, continence, dementia, nutrition, and activities of daily living, etc.; this is especially necessary for inpatients with high-risk factors. There is currently no effective treatment for frailty, the emphasis is on prevention. Good education can improve cognitive function.[46] A timely medical care or treatment might be a result of good economic support from higher income. Exercise can improve the central nervous, endocrine, immune system, and function of skeletal system; improve the body function and mobility;[47–53] as well as reverse or attenuate sarcopenia,[44] reduce falls, disability, and its complications; and also can improve cognitive function and emotion.[55]

A meta-analysis by Kelaiditi et al showed that exercise and nutritional therapy can improve frailty status and delay the decline in function.[56] The current guidelines from the US Department of Health and Human Services (www.health.gov/paguidelines/guidelines/default.aspx) suggested that all adults over 65 years should participate in 150 min (2h and 30 min) of moderate aerobic exercise per week, and encouraged frail older adults to start with an aerobic activity such as walking, as it is more accessible, if possible, resistance exercise training should be added, depending on the frailty level. Morley was also to demonstrate the role of resistance exercise in frailty management.[57] Majority of the evidence have showed that regular physical activity or exercise was beneficial for older adults who were frail or at high risk of frailty.[58]

### 5. Conclusions

We assessed the frailty status of geriatric inpatients using FP instrument; in our data, the overall prevalence of frailty was 18.0%, the prevalence of prefrailty was 32.7%, and multidimensional

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**Table 3**

The association between positively variables and different frailty levels by multinomial logistic regression analysis.

| Phenotype of frailty | Intermediate vs nonfrail | Frail vs nonfrail |
|----------------------|--------------------------|------------------|
|                       | OR (95% CI) | P     | OR (95% CI) | P     |
| Age, y                | 1.05 (1.03–1.07) | <.001 | 1.13 (1.09–1.18) | <.001 |
| BMI, kg/m²             | 0.94 (0.90–0.98) | .007  | 0.91 (0.86–0.97) | .005  |
| Marital status        | Live alone†         | 1     | 1              |       |
|                       | Married             | 0.65 (0.47–0.91) | .011  | 0.76 (0.47–1.25) | .285  |
| Income, RMB/M         | >3000                | 1     | 1              |       |
|                       | 1000–3000            | 0.83 (0.57–1.21) | .326  | 0.76 (0.43–1.32) | .324  |
|                       | <1000                | 1.51 (0.76–3.02) | .238  | 2.58 (1.06–6.32) | .038  |
| Self-rated health     | Poor†                | 1     | 1              |       |
|                       | Normal               | 0.30 (0.17–0.51) | <.001 | 0.29 (0.12–0.70) | .006  |
|                       | Well                 | 0.65 (0.47–0.90) | .010  | 0.34 (0.19–0.61) | <.001 |
| Number of drugs       | ≥5                   | 1     | 1              |       |
|                       | 1–4                  | 0.88 (0.63–1.22) | .441  | 0.53 (0.33–0.85) | .008  |
| Admissions in the past 1 y† | 1.39 (1.02–1.88) | .035  | 1.38 (0.86–2.21) | .177  |
| Cognitive impairment (yes) | 1.51 (0.92–2.48) | .107  | 4.11 (2.34–7.21) | <.001 |
| Depression (yes)      | 2.18 (1.58–3.00) | <.001 | 3.39 (2.11–5.70) | <.001 |
| Disability (yes)      | 2.19 (1.54–3.12) | <.001 | 15.01 (6.43–35.05) | <.001 |
| Fall in the past 1 y† | 2.14 (1.47–3.11) | <.001 | 3.22 (1.94–5.35) | <.001 |

BMI = body mass index, CI = confidence interval, OR = odds ratio, RMB/M = Ren Min Bi for per month.
† Reference category.
"No" to be reference category.
factors were independently positively associated with frailty. The emphasis is on prevention, interventions would need to be comprehensive, targeting physiology and psychological aspects of geriatric patients. The effective strategies would alleviate or reverse frailty status.

China has a rapidly aging population, how to face the challenges of health care for the elderly? To our knowledge, above of, timely evaluation of frailty status for newly admitted to the hospital patients is one of methods, last but not least, a diverse health management model is urgently needed to prevent and treat frailty for the older adults. Furthermore, we will take specific interventions measures for frail patients in future research.

This study had several limitations: first, we recruited only inpatients, meaning that the results cannot represent community-dwelling elderly. Second, some data were based on self-reports, which might mean that they are subject to recall bias. Third, because this was a cross-sectional study, we could not follow-up on patients’ health status, particularly those with poor health outcomes (e.g., mortality). These factors should be further studied.

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