

# Prevalence and Associated Factors for Frailty among Elder Patients in China: A multicenter cross-sectional study

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# Abstract

**Background:** Up to date, most of previous studies of frailty among hospitalized elder Chinese patients were conducted based on a small sample, which could not represent the elder patient population. The aim of this study is to identify the prevalence and the risk factors for frailty among elder patients in China. **Study Design and Setting:** This is a cross-sectional study, 9996 elder patients from 6 tertiary level hospitals in China were surveyed. The prevalence of frailty among patients from selected wards was surveyed by trained investigators. Mixed-effect Poisson regression model were used to analyze the associated factors of frailty among elder patients. **Results:** The mean age of all subjects was  $72.47 \pm 5.77$  years. The prevalence rate of frailty in this study was 18.02%. After controlling the confounding effect of hospital wards clustering effect, Mixed-effect Poisson regression model showed that the associated factors of frailty included: age (OR: 1.016, 95% CI: 1.012 - 1.020), patients with BMI < 18.5 (OR: 1.248, 95% CI: 1.171 - 1.330), female (OR: 1.058, 95% CI: 1.004 - 1.115), ethnic minorities (OR: 1.152, 95% CI: 1.073 - 1.236), admission to hospital by the emergency department (OR: 1.104, 95% CI: 1.030 - 1.184), the former drinker (OR: 1.094, 95% CI: 1.022 - 1.171), fall history in past 12 month (OR: 1.257, 95% CI: 1.194 - 1.323), vision dysfunction (OR: 1.144, 95% CI: 1.080 - 1.211), cognition impairment (OR: 1.182, 95% CI: 1.130 - 1.237), sleeping dysfunction (OR: 1.215, 95% CI: 1.215 - 1.318), urinary dysfunction (OR: 1.175, 95% CI: 1.104 - 1.251), defecation dysfunction (OR: 1.286, 95% CI: 1.217 - 1.358). **Conclusion:** We identified a relatively high prevalence of frailty among elder patients, and there are several associate factors among the population derived from an investigation of a large-scale, multicenter, nationwide representative Chinese elderly inpatient population. **Trial registration:** Chinese clinical Trial registry, ChiCTR1800017682, Registered 09 August 2018 **Keywords:** Frailty; Elder patients; Prevalence; Associate factors

## Background

China has entered an aging society and is in the stage of deepening aging. The Chinese Census Bureau shows that population ages 65 and above grew to an estimated 166.58 million in 2018, which formed 11.9% of the total population [1]. Elder adults form the main users of medical and social care services [2]. "Healthy Aging" is the only way to cope with population aging in China and around the world. In recent years, frailty of the elderly population has attracted extensive attention of researchers. Frailty is common and especially a focus for geriatricians. The concept of frailty is multidimensional, it can be considered as a state of vulnerability to adverse outcomes resulting from the accumulation of deficits associated with clinical effects, it describes a condition in which multiple body systems gradually lose their in-built reserves [3, 4].

Frailty as a pre-condition of adverse clinical events in the elderly, can truly and objectively reflect the chronic health problems and medical needs of the elderly [5]. Frailty status seems to be most associated with the risk of incident dementia [2]. It can also predict disease complications, falls, psychological problems, impairment of daily living ability, hospitalization rate, emergency treatment rate and even mortality rate, and explain the differences of disease prognosis, rehabilitation effect and quality of life [6-8]. Recognition of frailty could improve clinical decision making by informing the prediction of benefit or

the risk of adverse effects of clinical interventions. Many studies have explored the prevalence of frailty in elder population. The prevalence of frailty in community samples ranges from 6% to 11.1% [9-11]. The inpatients have a higher prevalence of frailty, which ranges from 25 % to 65.62% [12, 13].

With the increase of life expectancy and population aging, the proportion of elderly patients in hospital will continue to increase. However, little is known about the current representative frailty prevalence among elder inpatients in China, and up to date no information on the associated factors of frailty has been reported based on large-scale multicenter study. Specifically, the aim of this study is to examine the prevalence of frailty and the associated factors among Chinese elder inpatients by a large-scale cross-sectional national survey.

## Methods

### Study design, setting and population

Our data dropped from a large-scale cohort baseline survey, it focus on a representative sample of Chinese elder inpatients. The baseline survey was conducted from October 2018 to February 2019. Two-stage cluster sampling method was used to recruit eligible subjects. First, six provinces or municipality city located in six administration regions of China, which were divided based on geographic and economic conditions, including Sichuan province(Southwest),Heilongjiang province(Northeast), Hubei province(South Central), Beijing Municipality City(North China), Qinghai province(Northwest) and Zhejiang province(East China)were randomly selected. Then one tertiary hospital was selected in each province or municipality city. All elder inpatients lived in the internal wards and surgical wards of these hospitals who met the criterion during the study period were continuous enrolled(Specific sampling methods see Figure 1). The study has been approved by the Ethics Committee of Peking Union Medical College Hospital.

Based on findings of previous studies on similar research object, we expected a rate of frailty prevalence of 25% among elderly inpatients. We determined that a sample size of 1400 to 1800 for each hospital (a total of 10,000) would provide tolerance error of 0.025 and two-sided confidence interval of 95% to yield a statistically significant result. Patients were recruited if they (1) were 65 years old or over; (2) understood the aims of this study and signed the consent form. Patients were excluded if they were with persistent unconsciousness or unable to communicate effectively and their caregivers are unable to provide effective information. The procedure of this study involves physical examination and face-to-face questionnaire interviews.

### Frailty assessment

The FRAIL scale is a clinical frailty screening tool proposed by the International Working Group on Nutrition, Health and Aging in 2008. It consists of 5 simple self-reported questions, including Fatigue, Resistance, and Ambulation, Illness and Loss of weight [5]. The FRAIL scale scores range from 0 (best)–5 (worst), which represent frail (3–5), pre-frail (1–2), and robust (0). The scale overlaps with the biological, the burden and the functional scales, and cannot affect by the acute phase of the disease [2, 5]. Meanwhile, the FRAIL scale has been validated in using among Chinese older people [14].

## **Definition of covariates**

Potential associated factors of frailty in the models including age, sex, ethnicity, marital status, education level, living conditions, tobacco smoking, alcohol drinking, body mass index (BMI), falls in the past year, vision, hearing, sleep, urinary, defecation and cognitive function. Cognitive function was assessed using the Mini-Cog, which can be used effectively after brief training in both healthcare and community settings. The Mini-Cog consists of two components: a three-item recall task to assesses memory and a clock drawing test to assesses cognitive domains such as cognitive function, language, visual motor skills and executive function. The Mini-Cog has been validated in Chinese population and it has excellent test characteristics [15]. The remaining data were collected using a self-designed questionnaire. A case report form and an Electronic Data Collection system (EDC) were designed to collect data.

## **Quality control**

Data were collected by trained nurses. Firstly, in order to guarantee the quality of the study, we developed the project survey manual, operation manual and training manual. Before the investigation was formally carried out, investigators were trained and pre-investigated to make sure all of them are proficiency in the investigation process and the method of using the Electronic Data Collection (EDC) system. Secondly, to ensure the quality of research, we have scientifically designed the EDC system so that it can perform effective data logic control. Furthermore, all the case report forms were double-checked every day to guarantee the authenticity and accuracy of raw data. Finally, we establish a management framework and quality control team, the responsibilities of the research team members were clarified and establish and communication platform was established to guarantee a smooth feedback.

## **Statistical analyses**

Continuous variables were described with mean and standard deviation (SD). Categorical variables were described with number and percentage. Considering that the elderly hospitalizing in the same ward of same hospital were more likely to be assessed as similar frailty scores, mixed-effect Poisson regression models was used to examine the relationship between frailty and covariates in order to control the cluster effect of hospital wards. Odds ratio (OR) and its 95% confidence interval (CI) were used to assess the relationship strength. All statistical analysis was conducted in SAS9.4 software (SAS institute Inc., Cary, NC, USA). Two-sided  $p < 0.05$  was considered statistically significant.

## Results

A total of 9996 patients from 314 wards of 6 hospitals were investigated in this study. The mean age of all respondents was  $72.47 \pm 5.77$  years, ranged from 65 to 97, and 57.8% of respondents were male. The prevalence for frailty was 18.0%, for pre-frailty was 43.0% (Table 1). The prevalence of frailty by demographics is shown in Table 2.

### Associated factors of frailty

The multivariate Poisson regression model was constructed after controlling the confounding effect of hospital wards clustering effect. The Mixed-effect Poisson regression model showed that the associate factors of frailty included: age, BMI < 18.5, female, ethnic minorities, emergency and referral admission, the former drinker, fall history in last year, vision dysfunction, cognition impairment, sleeping dysfunction, urinary dysfunction, defecation dysfunction. We did not find the association of marriage status, living conditions, smoking and hearing function with the prevalence of frailty.

## Discussion

This is a hospital based large-scale cross-sectional national survey to report the prevalence of frailty in China, the FRAIL scale was used in this study. Overall, our study reports the prevalence estimates of frailty and pre-frailty were 18.0% and 43.0%, which is similar to the previous results. B. He et al screened 81258 participants (14 studies) for meta-analysis, and reported that the pooled prevalence of frailty and prefrailty were 10% and 43% separately among Chinese community-dwelling adults aged 60 years or older [16]. Lina Ma et al reported that the prevalence of frailty among Chinese hypertensive participants aged 60 years or older is 19.6% with a sample of 1111, using the 68-item frailty index [17]. Binru Han et al reported that among elderly patients undergoing thoracic and abdominal surgery, the prevalence of frailty

was 26.12% with a sample of 245, using frailty phenotype [18]. The reason for this phenomenon may be attributed to three aspects. Firstly, since our 9996 subjects come from various departments of the study hospitals, including internal medicine ward and surgery ward, the prevalence of frailty (18.02%) is the average result of each department. The reported prevalence of frailty among patients post thoracic and abdominal surgery and hypertensive patients is higher than 18%, also remind us that postoperative patients and hypertensive patients may be at high-risk for frailty. Secondly, the reported prevalence of frailty and pre-frailty among community-dwelling elderly is 10%, which is lower than our findings, and 43% of pre-frailty, which is similar our findings. This result has sounded the alarm for us. The community elderly and the patients share the same rate of pre-frailty prevalence rate. Public health interventions are urgently needed. Meanwhile, the high prevalence of frailty among patients also reminds us that we should pay attention to the continuing care for discharged patients, give them positive health guidance and help them return to health balance. Thirdly, we should keep in mind that the comparison results may be affected by the use of different screening tools.

The associated factors for frailty included physical dimension, psychological dimension and social dimension [19]. There were several meaningful factors founded in our study. In general, frailty can be viewed either as a syndrome or as a state. We conducted the survey on the first or second day of hospital admission. Multivariate analysis showed that aged female patients with BMI<18.5, ethnic minorities, drinking history, emergency and referral admission, falls in the last year, cognitive impairment, vision dysfunction, sleeping dysfunction, urinary dysfunction and defecation dysfunction had a higher risk of frailty after controlling the confounding effect of department clustering.

Age as a contributing factor for frailty has been reported in lots of studies [20, 21], our research also confirmed that frailty is an age-associated syndrome. In our study, frailty was more prevalent in females, which consistent with other research findings [22, 23]. The frailty-sex differences have been explained by differences in co-morbidity, mood, cognition, and pathophysiological factors. [24]. Ethnic minorities tend to have higher rates of frailty than Han nationality. The specific difference in favor of frailty susceptibility can be explained by relatively low level of education or income in ethnic minorities inpatients [25]. The relationship between alcohol and risk of frailty is often complicated. In our study, frailty was more prevalent in patient with a history of alcohol intake. However, Gotaro Kojima et al found that non-drinkers seem more likely than those with low alcohol consumption to develop frailty with a sample of 2544 community-dwelling people [26]. The link between frailty and alcohol may depend on the drinking patterns, drinking amounts each time and cumulative alcohol consumption [27].

Nutritional status is also an associated factor for frailty, the contribution of malnutrition to frailty was identified in this study. We found that patients with low weight (BMI $\leq$ 18.5) were higher risk for frailty,

whereas high weight population did not present frailty risk. These results differed from those of previous studies. It is reported that since overweight may directly cause slowness and poor exercise tolerance, people with higher weight and obesity are more likely to be frailty [28, 29]. The difference may be due to the two previous studies were all-female sample. Malnutrition significantly influences the development of frailty can be attributed to weight loss leads to weakness, exhaustion, slow walking speed and low physical activity [19]. Thus, doctors and nurses should pay more attention to diet management and exercise education for elderly patients in order to improve patients' weight management and keep healthy weight.

Patients admission through emergency present more risk for frailty. It is also reported that the prevalence of frailty among older emergency department patients is quit high, which varied from 43.7% to 45.3% with different screening scales [30]. The condition of patients admitted from emergency department was critically ill, which may accompany by weakness, muscle loss and frailty. This study results reminds us that we not only need to pay attention to elderly patients admitted from emergency department, but also need focus on emergency care. Screening for frailty in older emergency department patients is needed, which can inform prognosis and target discharge planning including community services required [31].

Falls and frailty share many significant characteristics. Falls in older people is a well-recognized risk factor for frailty [32]. On the other hand, the presence of frailty also confers a particularly poor prognosis of falling, prolonged bed rest and immobilization may accelerate the development of frailty [33]. Furthermore, health was no longer just the absence of diseases, which was seen as a state of complete well-being on different domains [34]. Our result showed that poor vision, sleeping dysfunction, urinary dysfunction and defecation dysfunction were all important affect factors for frailty. Therefore, we strongly appeal that every country could raise additional domestic funds for public health and committed to promoting a National Fitness Program. In these projects, specially trained nurses that encourage patients to take exercise and teach them how to exercise are urgently needed.

This study reveals another phenomenon worthy of attention. We were surprised to find that the prevalence of cognitive impairment is up to 20.57% among elderly inpatients, and 26.94% of frailty prevalence rate among the population. Geriatric cognitive disorders were significantly associated with an increased risk of frailty, which were consistent with other researches [35]. Deirdre A. Robertson et al also concluded that frailty may be a marker for future cognitive impairment [36]. Make a deep understanding of the combination of cognition and physical frailty may have important clinical implications in hospitals. Early interventions in frailty patients may alleviate the progression of cognitive impairment, and vice versa.

## Conclusions

To the best of our knowledge, there was no study before that reported the prevalence of frailty and its associated factors among Chinese elder inpatient with nationally representative large sample covering six administration regions. This study brings new evidence to focus on frailty in elder inpatient population in our country. Aged female and ethnic minorities patients should get attention, a series of measures should be taken to avoid low weight, fall and stay health.

However, there are some potential limitations in this study. Firstly, the self-reported character of the FRAIL scale may lead to underestimation of frailty by the elderly. Secondly, the patient population in this study covered many departments, and we didn't analyze the impact of diseases and multiple drug use on frailty in this paper. We will continue to explore in depth in the next step of the study.

Despite the limitations, the prevalence of frailty in inpatients population in our country was determined, among a representative national sample obtained by investigating patients of 6 tertiary hospitals in China, and the risk factors of the frailty were identified, which provided the baseline database for further research. The results supported the importance of frailty in late-life health etiology, and identified the associated factors of frailty, and provided a reference for the subsequent development of targeted interventions or risk assessment tools. For effective prevention and control of frailty, attention should be paid to risk assessment, preventive measures, nursing measures and other links. In view of the associated factors of frailty, targeted and scientific measures should be taken to control them so as to reduce the prevalence of frailty and improve the quality of life of elder patients.

## Declarations

### **Ethics approval and consent to participate**

The study has been approved by the Ethics Committee of Peking Union Medical College Hospital(S-K540). All patients participated this study under the 'Ethics, consent and permissions' heading.

### **Consent for publication**

We have obtained consent to publish from the participant and the informed consent were signed.

### **Availability of data and material**

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

### **Competing interests**

The authors declare that they have no competing interests.

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## Authors' contributions

Professor Xinjuan WU design of the work; Professor Tao Xu analysed and interpreted data; Mrs. Jing Jiao design the work and drafted the paper. Yu Wang, Chen Zhu, Fangfang Li, , Minglei Zhu, Xianxiu Wen, Jingfen Jin, Hui Wang, Dongmei Lu, Shengxiu Zhao carried out the study and implementation of quality control.

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## Tables

Table 1 Observed distribution of frailty (FRAIL) (n=9996)

Frail score	N (%)
Robust	3893(38.95)
Pre-frailty	4302(43.03)
1	2625(26.26)
2	1677(16.78)
Frailty	1801(18.02)
3	1117(11.17)
4	576(5.76)
5	108(1.08)

Table 2 Prevalence conditions of frailty across demographics (n (%))

Characteristics	Case (n=9996)	Non-frailty	Frailty	P
Age				
65-	4234(42.36)	3615(85.40)	618(14.60)	<.0001
70-	2790(27.91)	2319(83.09)	472(16.91)	
75-	1753(17.54)	1364(77.81)	389(22.19)	
80-	884(8.84)	670(75.79)	214(24.21)	
85-	335(3.35)	227(67.76)	108(32.24)	
Gender				
Female	4218(42.20)	3370(79.90)	848(20.10)	<.0001
Male	5778(57.80)	4826(83.51)	953(16.49)	
Nationality				
Han nationality	9412(94.16)	7784(82.70)	1628(17.30)	<.0001
Minority	584(5.84)	411(70.38)	173(29.62)	
Education				
Illiteracy	1638(16.39)	1226(74.85)	412(25.15)	<.0001
Primary school	2869(28.71)	2338(81.49)	531(18.51)	
middle school	4027(40.29)	3387(84.11)	640(15.89)	
Diploma and above	1460(14.61)	1242(85.07)	218(14.93)	
BMI				
<18.5	698(7.09)	477(68.34)	221(31.66)	<.0001
18.5-23.9	4778(48.54)	3915(81.94)	863(18.06)	
24-27.9	3377(34.31)	2887(85.49)	490(14.51)	
>=28	991(10.07)	822(82.95)	169(17.05)	
Marriage				
Divorced or widowed	1117(11.19)	849(76.01)	268(23.99)	<.0001
Married	8867(88.81)	7336(82.73)	1531(17.26)	
Admission to hospital				
Emergency department	1319(13.20)	979(74.22)	340(25.78)	<.0001
Outpatient department	8284(82.87)	6912(83.44)	1372(16.56)	
Transit from other hospitals	329(3.29)	251(76.29)	78(23.71)	
else	64(0.64)	53(82.81)	11(17.19)	
Living conditions				
Building with elevators	3608	2965(82.18)	643(17.82)	<.0001
Building without elevators	4694	3949(84.13)	745(15.87)	
Bungalow	1694	1281(75.62)	413(24.38)	
Smoking				
Non-smoker	6608(66.11)	5386(81.51)	1222(18.49)	0.0045
Current smoker	1114(11.14)	953(85.55)	161(14.45)	
Former smoker	2274(22.75)	1856(81.62)	418(18.38)	
Drinking history				

Non-drinker	7647(76.50)	6210(81.21)	1437(18.79)	<.0001
Current drinker	1153(11.53)	1026(88.99)	127(11.01)	
Former drinker	1196(11.96)	959(80.18)	237(19.82)	
<b>Fall history in last 12 month</b>				
No	8574(85.77)	7158(83.48)	1416(16.51)	<.0001
Yes	1422(14.23)	1037(72.93)	385(27.07)	
<b>Cognition impairment</b>				
No	7469(79.43)	6377(85.38)	1092(14.62)	<.0001
Yes	1934(20.57)	1413(73.06)	521(26.94)	
<b>Vision</b>				
Normal	7794(77.97)	6532(83.81)	1262(16.19)	<.0001
Dysfunction	2202(22.03)	1663(75.52)	539(24.48)	
<b>Hearing</b>				
Normal	8057(80.60)	6740(83.65)	1317(16.35)	<.0001
Dysfunction	1939(19.40)	1455(75.04)	484(24.96)	
<b>Sleeping</b>				
Normal	5611(56.13)	4890(87.15)	721(12.85)	<.0001
Dysfunction	4385(43.87)	3305(75.37)	1080(24.63)	
<b>Urinary function</b>				
Normal	8596(85.99)	7177(83.49)	1419(16.51)	<.0001
Dysfunction	1400(14.11)	1018(72.71)	382(27.29)	
<b>Defecation function</b>				
Normal	8744(87.47)	7344*(83.99)	1400(16.01)	<.0001
Dysfunction	1252(12.53)	851(67.97)	401(32.03)	

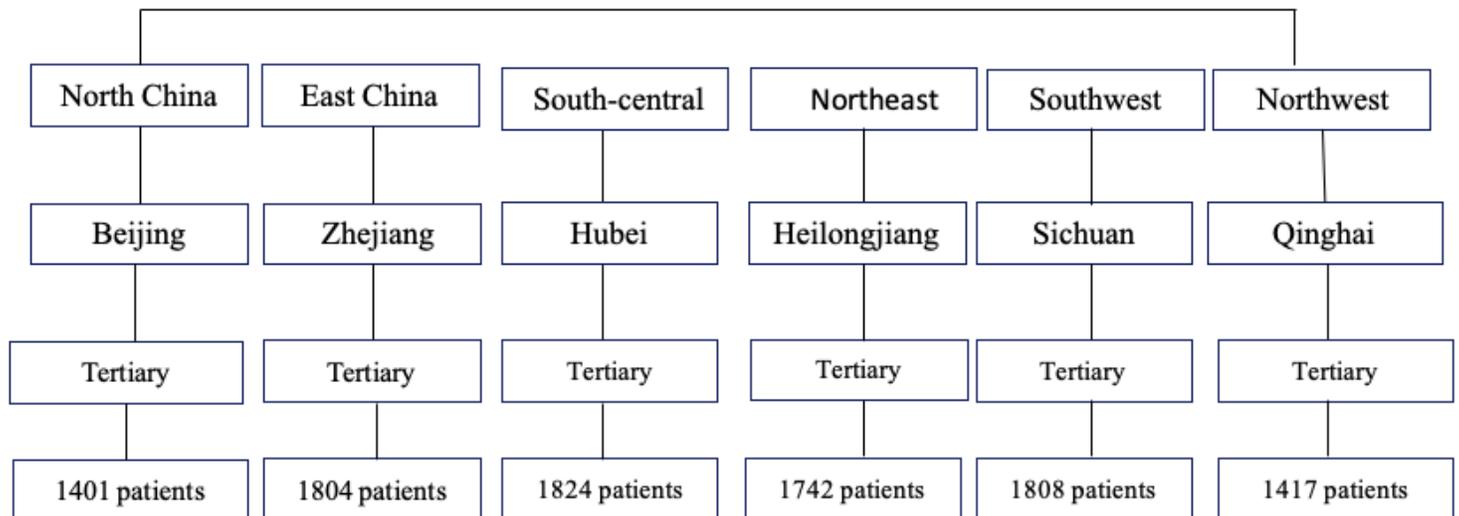
Table 3 Associated factors with frailty from mixed effect Poisson regression model

	OR	95%CI
Intercept	0.298	(0.223,0.398)
Age	1.016	(1.012,1.020)
BMI		
>=28	0.897	(0.856,0.940)
24-27.9	0.931	(0.874,0.991)
<18.5	1.248	(1.171,1.330)
18.5-23.9	1.0 (Ref.)	
Gender		
Female	1.058	(1.004,1.115)
Male	1.0 (Ref.)	
Ethnicity		
Others	1.152	(1.073,1.236)
Han	1.0 (Ref.)	
Education		
Diploma and above	0.891	(0.821,0.966)
Middle school	0.915	(0.857,0.977)
Primary school	0.946	(0.893,1.002)
Illiteracy	1.0 (Ref.)	
Marriage		
Divorced or widowed	0.988	(0.933,1.046)
Married	1.0 (Ref.)	
Admission to hospital		
Emergency department	1.104	(1.030,1.184)
Transit from other hospital	1.159	(1.049,1.279)
Others	1.118	(0.843,1.483)
Outpatient department	1.0 (Ref.)	
Living conditions		
Bungalow	1.055	(0.995,1.119)
Building without elevators	0.965	(0.923,1.010)
Building with elevators	1.0 (Ref.)	
Smoking		
Current smoker	0.989	(0.923,1.059)
Former smoker	1.016	(0.961,1.074)
Non-smoker	1.0 (Ref.)	
Drinking history		
Current drinker	0.869	(0.815,0.927)
Former drinker	1.094	(1.022,1.171)
Non-drinker	1.0 (Ref.)	
Fall history in last 12 month		
Yes	1.257	(1.194,1.323)
No	1.0 (Ref.)	

Vision		
Dysfunction	1.144	(1.080,1.211)
Normal	1.0 (Ref.)	
Hearing		
Dysfunction	1.047	(0.991,1.106)
Normal	1.0 (Ref.)	
Cognition impairment		
Yes	1.182	(1.130,1.237)
No	1.0 (Ref.)	
Sleeping		
Dysfunction	1.266	(1.215,1.318)
Normal	1.0 (Ref.)	
Urinary function		
Dysfunction	1.175	(1.104,1.251)
Normal	1.0 (Ref.)	
Defecation function		
Dysfunction	1.286	(1.217,1.358)
Normal	1.0 (Ref.)	

OR: odds ratio; CI: confidence interval

## Figures



**Figure 1**

Sampling recruitment procedure