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Original Article

Prevalence and Associated Factors of Frailty Among Elderly People in Taiwan☆

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ABSTRACT

Background: Frailty has begun to attract attention in recent years because it is associated with adverse health outcomes. The purpose of this study was to estimate the prevalence of frailty in elderly people in Taiwan and to examine the associated factors.

Methods: Data were extracted from a representative subsample of "The Coming of an Aging Society: An Integrative Study on Social Planning in Taiwan in 2025" that comprised 495 older adults. Multinomial logistic regression analyses were conducted to examine the relationships between frailty status and individual factors, health conditions, environmental factors, and activities.

Results: Among all the participants, 45.9% were classified as "nonfrail", 45.9% exhibited "prefrailty", and 8.3% were "frail". After controlling for the dependent variables, the factors significantly influencing prefrailty were age [odds ratio (OR) = 1.07, $p < 0.001$], diabetes (OR = 2.18, $p < 0.01$), depressive syndrome (OR = 3.66, $p < 0.001$), and the number of activities in which the participants were involved (OR = 1.24, $p < 0.05$). The factors significantly influencing frailty were age (OR = 1.14, $p < 0.001$), non-Fukien ethnicity (OR = 3.01, $p < 0.05$), depressive syndrome (OR = 6.89, $p < 0.001$), diabetes (OR = 2.69, $p < 0.05$), and the number of activities in which the participants were involved (OR = 2.39, $p < 0.001$).

Conclusion: To prevent a decline in the functions of elderly people, the results of this study should be referenced when developing intervention strategies in which preventive actions are implemented to aid elderly people with particular risk factors such as diabetes, depression, and infrequent participation in social activities.

1. Introduction

Frailty is a geriatric condition with multiple causes and risk factors, making it a crucial index of predisability; therefore, it is commonly used in gerontology. Fried et al[1] indicated that comorbidity is a risk factor of frailty, the outcome of which is disability. The advancement of frailty is a progressive process, developing in the order of nonfrailty, prefrailty, and frailty[2]. Numerous studies have indicated that frailty is a major predictor of activities related to disability[3–6]. Frailty may also lead to adverse health outcomes, such as falling[3,6], hospitalization[3,5], early admission to health care facilities[6,7], and death[3,5,6,8]. Frailty has a considerable influence on the independence and quality of life of elderly people, and available medical health care resources[9]. Therefore, frailty has begun to attract attention in recent years, and particular emphasis has been placed on its prevention.

Frailty can have a powerful influence on subsequent health status; therefore, this study was conducted to estimate the prevalence of frailty among elderly people in Taiwan according to the definition provided by Fried et al[3]. We also probed the factors influencing frailty to generate suggestions for policymakers regarding prevention of disability and promotion of health care among elderly people.

☆ Conflicts of interest: All contributing authors declare no conflicts of interest.

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2. Materials and methods

2.1. Data source and research participants

The data were sourced from "The Coming of the Aging Society: An Integrative Study on Social Planning in Taiwan in 2025", which was conducted in 2007. Household registration data in Taiwan were selected as the sampling frame, and stratified sampling with probability proportional to size was conducted to select the participants. The survey was authorized by the Center for Survey Research, RCHSS, Academia Sinica. No approval was obtained from an institutional review board for social science, but our interviewers signed a confidentiality agreement, and personal data could not be exposed. We also respected all the participants; they could reject the interview at any time.

A total of 781 participants from 25 villages were selected using systematic sampling and their frailty criteria were measured. Of the 781 participants, 503 underwent measurement, of whom eight were excluded because more than three items of frailty were missing. Therefore, the final analysis was conducted on 495 participants (Fig. 1).

2.2. Measurement of variables

Because no criteria were consistently applied to the study of frailty, we applied Fried et al's[3] definition as an indicator of frailty, which provided a potential standardized definition for frailty and validated the measurements. The dependent variables were divided into three categories: "nonfrailty", "prefrailty", and "frailty". Participants with more than three of the five criteria were categorized as those exhibiting frailty, with one to two criteria as those exhibiting prefrailty, and with none of the criteria as those exhibiting nonfrailty. These five criteria were weight loss, self-described exhaustion, weakness, slowness, and low physical activity[3]. Weakness was defined as grip strength in the slowest 20% of the participants, and was adjusted for sex and body mass index (BMI) quartiles. Slowness was defined as the time required to walk a distance of 5 m by the slowest 20% of participants, and was adjusted for sex and height. Low physical activity was determined using the Taiwan International Physical Activity Questionnaire—Short Form (Taiwanese version of the IPAQ), which was used to calculate calorie consumption, and was defined as the calorie consumption by the lowest 20% for each sex. The content validity of the Taiwanese version of the IPAQ index was 0.994, language equivalence and meaning similarity between the English and Chinese versions was 0.992, and consistency value for the English and Chinese versions according to intraclass correlation coefficients was 0.704.

The dependent variables were as follows: (1) sociodemographic characteristics, such as sex, age, level of education, and ethnicity; (2) health conditions, comprising physical and psychological aspects (arthritis, cardiovascular diseases, and diabetes were included in the physical aspects, and disease information was provided by the participants. Interviewers asked the participants the following question: "Has the doctor informed you of any diseases that you may have?" The Center for Epidemiologic Studies Depression Scale[10] was used to measure psychological aspects. The alpha internal consistency for the 11 items in the Center for Epidemiologic Studies Depression Scale was 0.81, which indicates that its reliability is satisfactory); (3) environmental factors, such as living arrangements and social support; and (4) participation in activities such as gatherings, leisure, religious activities, visiting friends and relatives, and chatting with neighbors.

2.3. Statistical analyses

SPSS version 19.0 (SPSS Inc., Chicago, IL, USA) was used to perform data analysis. A Chi-square test was applied to analyze the associations of frailty with factors such as sociodemographic characteristics, health conditions, environmental factors, and participation in activities. Multinomial logistic regression was applied to test the influence of the factors on the level of frailty, and an enter method was used to test the influence of all associated factors. The predictor variables were sociodemographic characteristics, health

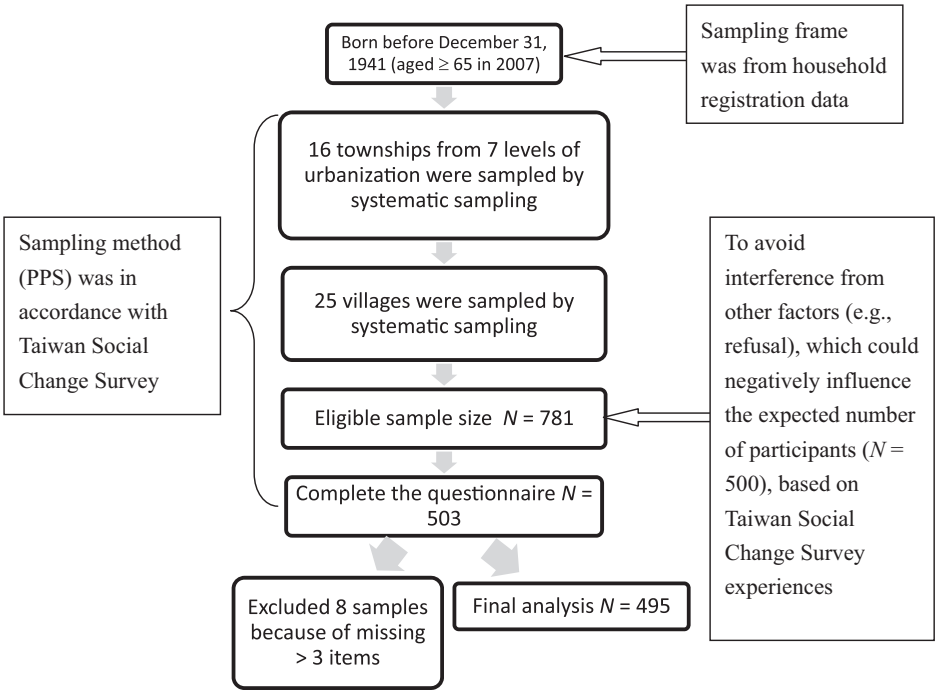

Fig. 1. Flowchart of sampling. PPS = probability proportional to size.

conditions, environmental factors, and participation in activities, and the outcome variable was the level of frailty.

3. Results

3.1. Criteria and the prevalence of frailty

The frailty criteria in Taiwan according to Fried and colleagues'[3] standard are shown in Table 1. Table 2 presents a summary of the distribution of characteristics among the sample population, and analysis of the Chi-square test on the level of frailty and dependent variables. Of the participants, 45.9% exhibited nonfrailty, 45.9% prefrailty, and 8.3% frailty. The proportion of male participants was 51.7%.

The average age of the participants was 73.4 years, and the level of frailty was significantly different among the age groups ($p < 0.000$). Prefrailty and frailty were associated with increasing age. Regarding health conditions, participants with diabetes ($p = 0.009$) or depression syndrome ($p < 0.000$) were significantly more frail than those without these conditions.

In addition, most of the participants had tangible and informational supports (75.2% and 74.9%, respectively), but the availability of people to provide financial support were significantly associated with the level of frailty ($p = 0.014$). On average, the participants participated in 1.4 activities. The results indicate that the most common interaction undertaken by elderly people was chatting with neighbors (44.2%). Participation in leisure activities ($p < 0.001$) and religious activities ($p = 0.006$), chatting with neighbors ($p = 0.008$), and visiting friends and relatives ($p = 0.038$) all had significant influences on the level of frailty.

3.2. Associated factors of frailty

Table 3 presents a summary of the results of multinomial logistic regression analysis on the factors influencing the level of frailty. After controlling for the dependent variables, considering participants exhibiting nonfrailty as the reference group, the factors significantly influencing prefrailty were age, diabetes, depressive syndrome, and the number of activities in which the participants were involved. Among these factors, age and depressive syndrome had the greatest influence ($p < 0.001$). The older the participants, the higher the prefrailty, with an odds ratio (OR) of 1.07. Participants with depressive syndrome (OR = 3.66) or diabetes (OR = 2.18) exhibited significantly higher prefrailty than those without these conditions. The level of participation in activities also had a significant influence on prefrailty. The fewer the activities the participants participated in, the higher the prefrailty, with an OR of 1.24 ($p < 0.05$).

After controlling for the dependent variables, the older the participants, the higher the probability for them to be frail, with an OR of 1.14. Depressive syndrome was a critical factor affecting frailty, with an OR as high as 6.89 (95% confidence interval = 3.05–15.55). The level of participation in activities had a significant influence on the probability of being frail. The lower the number of activities in which the participants were involved, the higher the probability of frailty (OR = 2.39). The OR for frailty of the participants with diabetes was 2.69 ($p < 0.05$). Furthermore, the participants whose ethnicity was not Fukien had a higher probability of being frail than the Fukienese participants, with an OR of 3.01 ($p < 0.05$).

4. Discussion

The prevalence of frailty ranges from 6.9% to 63%, indicating that differences in definitions have a considerable effect on identification[3,11,12]. For example, Fried and colleagues[3] used the survey database of the United States Cardiovascular Health Study to determine that the overall prevalence of frailty is 6.9%. However, Woods et al[5] enrolled participants aged 65–79 years at 40 clinical centers and determined that the prevalence of frailty is 16.3%, which is much higher than that calculated in Taiwan. The difference may be due to differences in data collection methods and research participants.

Chen et al[13] analyzed the data from a long-term follow-up study (Survey of Health and Living Status of the Elderly, fifth) on the physical, psychological, and social living statuses of middle-aged and elderly people living in various institutions in Taiwan in 2003. They determined that the prevalence of frailty among elderly people over the age of 65 years is 4.9%, which is substantially lower than that obtained in this study. The main difference is that Chen et al[13] used alternative indexes for the judgment of criteria, and the results were analyzed using proxy indicators.

In addition, frailty is a dynamic condition; if prevention and intervention policies are implemented in the future, then the prevalence may change. Therefore, to understand the prevalence of prefrailty and frailty and to further investigate the causes, long-term data must be collected. To prevent a decline in the physical functions of elderly people, future policy decisions concerning the development of intervention measures could be made according to the risk of frailty.

Table 1
Frailty criteria of Taiwan.

Definition	Criteria			
Weight loss	Unintentional weight loss of > 3 kg or 5% of their body weight over the previous year			
Self-described exhaustion	Whether they had felt fatigue or exhaustion for > 3 d in the previous week			
Grip strength	1. Using a hand-held dynamometer			
	2. Dominant hand (mean of 3 measurements)			
	3. Slowest 20% group			
	BMI/male	Cutoff	BMI/female	Cutoff
	≤ 22.3	< 19.33	≤ 22.0	< 12.13
	22.4–24.6	< 20.47	22.1–24.2	< 14.33
	24.7–26.5	< 24.27	24.3–27.0	< 13.07
	≥ 26.6	< 22.67	≥ 27.1	< 11.73
Walking speed	Walk 5 m and the slowest 20% group			
	Height (cm)/male	Cutoff (s)	Height (cm)/female	Cutoff (s)
	< 164.5	≥ 11.2	< 152	≥ 12.0
	≥ 164.5	≥ 8.5	≥ 152	≥ 11.9
Physical activity	1. Screening by Taiwan IPAQ—elderly			
	2. Lowest 20% of caloric consumption			
	Male		Female	
	< 685 kcal/wk		< 420 kcal/wk	

BMI = body mass index; Taiwan IPAQ = Taiwan International Physical Activity Questionnaire—Short Form.

Table 2
Description of independent variables according to frailty level, *n* (%).

	Total	Nonfrailty	Prefrailty	Frailty	*p*
Total	495	227 (45.9)	227 (45.9)	41 (8.3)	
Sex					
Male	256	110 (43.0)	124 (48.4)	22 (8.6)	0.407
Female	239	117 (49.0)	103 (43.1)	19 (7.9)	
Age (y)					
65–74	296	154 (52.0)	128 (43.2)	14 (4.7)	0.000
75–84	166	65 (39.2)	79 (47.6)	22 (13.3)	
≥ 85	33	8 (24.2)	20 (60.6)	5 (15.2)	
Level of education					
No formal education	196	83 (42.3)	93 (47.4)	20 (10.2)	0.454
Elementary	180	84 (46.7)	81 (45.0)	15 (8.3)	
Junior high and above	119	60 (50.4)	53 (44.5)	6 (5.0)	
Marital status					
Unmarried	156	73 (46.8)	69 (44.2)	14 (9.0)	0.858
Married	339	154 (45.4)	158 (46.6)	27 (8.0)	
Ethnicity					
Fukien	359	160 (44.6)	165 (46.0)	34 (9.5)	0.485
Mainlander	71	32 (45.1)	35 (49.3)	4 (5.6)	
Others	64	34 (53.1)	27 (42.2)	3 (4.7)	
Living arrangement					
Lived alone	38	16 (42.1)	19 (50.0)	3 (7.9)	0.479
Only with spouse	92	40 (43.5)	41 (44.6)	11 (12.0)	
With children	339	162 (47.8)	154 (45.4)	23 (6.8)	
With others	26	9 (34.6)	13 (50.0)	4 (15.4)	
Arthritis					
No	393	188 (47.8)	177 (45.0)	28 (7.1)	0.082
Yes	102	39 (38.2)	50 (49.0)	13 (12.7)	
Diabetes					
No	411	201 (48.9)	179 (43.6)	31 (7.5)	0.009
Yes	84	26 (31.0)	48 (57.1)	10 (11.9)	
Cardiovascular diseases					
No	232	118 (50.9)	100 (43.1)	14 (6.0)	0.056
Yes	263	109 (41.4)	127 (48.3)	27 (10.3)	
Depression symptom (CES-D)					
Not depressed	326	183 (56.1)	126 (38.7)	17 (5.2)	0.000
Tendency to depression	158	41 (25.9)	93 (58.9)	24 (15.2)	
Social support					
Tangible support	372	126 (46.0)	126 (46.0)	22 (8.0)	0.974
Informational support	371	131 (45.5)	132 (45.8)	25 (8.7)	0.927
Emotional support	288	173 (46.6)	169 (45.6)	29 (7.8)	0.737
Emergency support	282	165 (44.4)	171 (46.0)	36 (9.7)	0.130
Financial support	274	144 (51.1)	114 (40.4)	24 (8.5)	0.014
Number of social support					
0–1	72	31 (43.1)	35 (48.6)	6 (8.3)	0.933
2–3	179	80 (44.7)	85 (47.5)	14 (7.8)	
4–5	244	116 (47.5)	107 (43.9)	21 (8.6)	
Activities					
Chatting with neighbors	219	116 (53.0)	91 (41.6)	12 (5.5)	0.008
Religious activities	131	74 (56.5)	52 (39.7)	5 (3.8)	0.006
Leisure activities	127	71 (55.9)	55 (43.3)	1 (0.8)	0.000
Visiting friends and relatives	119	65 (54.6)	49 (41.2)	5 (4.2)	0.038
Gathering	82	47 (57.3)	31 (37.8)	4 (4.9)	0.061
Number of activities					
≤ 1	77	18 (23.4)	43 (55.8)	16 (20.8)	0.000
2	103	39 (37.9)	50 (48.5)	14 (13.6)	
3	123	63 (51.2)	53 (43.1)	7 (5.7)	
≥ 4	192	107 (55.7)	81 (42.2)	4 (2.1)	

CES-D = Center for Epidemiologic Studies Depression.

This study indicates that the factors jointly influencing prefrailty and frailty are age, diabetes, depressive syndrome, and the number of activities in which the participants were involved.

Previous research results have indicated that the prevalence of frailty is higher among older people than among younger people[3,5,7,14]; because of the natural degeneration of physical functions, the prevalence of frailty increases with age. However, the influence of age on the level of intervention is particularly noteworthy. Implementing intervention schemes that conform to different age groups requires further clarification regarding the influence of age on the level of frailty and the aspects associated with frailty.

Regarding health conditions, as indicated in the previous literature, comorbidities may increase the incidence of frailty[3,5,7]. Furthermore, cardiovascular disease[14], diabetes, stroke, Parkinson's disease[15], self-perceived poor health[3,7], functional disability, cognitive impairment, and depression may also increase the incidence of frailty[1,5,16]. Therefore, this study indicates that diabetes is the major illness that significantly influences the level of frailty. Chen et al[13] and Navarrete-Reyes and Avila-Funes[17] presented similar results. Elderly people with diabetes have a tendency to age more rapidly and exhibit frailty earlier than elderly people from the general population[18–24].

Table 3
Multinomial logistic regression of significant factors for the level of frailty.

Variable	Reference group[b]	Prefrail			Frail		
		OR	(95% CI)	*p*	OR	(95% CI)	*p*
Intercept		−7.27			−18.19		
Age	Increasing	1.07	(1.03−1.11)	0.001	1.14	(1.07−1.22)	0.000
Ethnicity	Fukien						
	Non-Fukien	1.43	(0.88−2.32)	0.148	3.01	(1.08−8.41)	0.036
Diabetes	No						
	Yes	2.18	(1.24−3.83)	0.007	2.69	(1.06−6.83)	0.037
Depression syndrome	Without depressive syndrome						
	With depressive syndrome	3.66	(2.28−5.09)	0.000	6.89	(3.05−15.55)	0.000
No. of activities	Decreasing	1.24	(1.04−1.48)	0.017	2.39	(1.50−3.82)	0.000

OR = odds ratio; CI = confidence interval.
[a] −2 Log likelihood = 1754.364; Cox and Snell $R^2 = 0.156$; Nagelkerke $R^2 = 0.195$.
[b] The reference group of dependent variable is nonfrail, $N = 1311$.

Depressive syndrome has a significant influence on both prefrailty and frailty, which is consistent with the findings reported in the previous literature[3,5,25]. Compared with young people, depressive syndrome has a greater effect on elderly people because they have more reasons to be depressed, suffer from depression for longer periods of time, or often succumb to depression accompanied by other diseases[26]. The influence of psychological health on the level of frailty should not be overlooked. Depression plays an important role in functional status and life expectancy[27]; in the future, screening and treatment guidelines for depression among elderly people will be essential for preventing frailty.

The influence of social support or participation in activities on frailty has seldom been investigated. It was found that participation in social activities and increased social support are beneficial to reducing frailty[8], and regular social participation leads to longer life expectancy in the elderly[28]. Moreover, when the participants are involved in fewer activities, they are more likely to be frail or to exhibit prefrailty. However, social support did not have a significant influence on the level of frailty, which is possibly because participation in activities and interaction with other people are beneficial to the physical and mental well-being of people. Although the preliminary findings of this study suggest that participation in leisure activities has an influence on the level of frailty, the influence of various types of leisure activities should be investigated in the future. Regarding social support, an average of 3.2 items had an influence on the level of frailty, and more than 50% of the participants received each item of social support. Therefore, the influence of social support on the level of frailty was not significant.

In the cross-sectional survey, there was no information regarding the time sequence in which influences and frailty occur; the causal relationships between frailty and the associated factors should be clarified by collecting longitudinal data. Critical factors such as self-perceived poor health and cognitive impairment may also increase the incidence of frailty, and should be addressed in future studies.

We established standards for the criteria of frailty based on the definition criteria proposed by Fried et al[3]and, based on the measurements of frailty, obtained information regarding the current prevalence of frailty among elderly people living in communities in Taiwan. Such information can help define target groups for future intervention in the prevention of disabilities. We also elucidated factors influencing the level of frailty. To enhance the health of elderly people in Taiwan and prevent frailty, we recommend attaching greater value to aspects such as diabetes and depression, and increasing elderly people's participation in activities.

To prevent or delay the onset of disabilities, it is crucial to reduce the prevalence of frailty. Therefore, an understanding of the associated factors provides a valuable reference for future prevention and intervention.

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