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ORIGINAL RESEARCH

Physiological indexes, psychological resilience, sensory functions, and sleep quality on the cognitive function of older adults with pre-frailty: a predictive study

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Abstract

Population ageing has increased the prevalence of prefrailty comorbid with cognitive impairment among older adults. However, few studies have explored the risk factors common to both prefrailty and cognitive impairment. This study determined the predictive accuracy of demographic characteristics, physiological indexes, psychological resilience, sensory function, and sleep quality on the cognitive function of older adults with prefrailty. In this cross-sectional study, the physiological indexes, psychological resilience, sensory function, sleep quality, and cognitive function of 167 community-dwelling older adults with prefrailty recruited through purposive sampling were measured. SPSS software was used for data coding and compilation. Data analysis involved the use of descriptive statistics, the independent samples *t* test, the chi-square test, and logistic regression. Overall, in cognitive function, there was no difference in gender but were in age, were incapable of text messaging, had a greater number of chronic diseases, were less able to perform activities of daily living, had low psychological resilience, and had depressive tendencies. In addition, Text messaging capability and depression status can all predict the cognitive impairment state of prefrail older elderly. Physiological indexes, psychological resilience, sensory function, and sleep quality can affect cognitive function in older adults with prefrailty. Meanwhile, depressive tendencies and the inability to send text messages on a mobile device constituted critical predictors of cognitive function in the participants.

Keywords

Prefrailty; Physiological index; Psychological resilience; Sensory function; Sleep quality; Cognitive status

1. Introduction

According to "Healthy People 2020", a white paper published by the Taiwanese government, older adults are expected to account for 24.5% and 35.5% of the national population by 2030 and 2050, up from the current 16.1%. This white paper considered older adults as one of the focus groups. A longitudinal study on the health status of middle-aged and older adults in Taiwan indicates that the prevalence of frailty among community-dwelling older adults is 7.4%, and that 38.1% of these individuals are in the prefrailty stage [1]. Dementia, the chronic and progressive decline of cognitive functions, including attention, memory, language, spatial orientation, and the ability to make and execute decisions, can induce brain damage, impairing memory, thinking, behaviour, and the ability to perform activities of daily living. Therefore, mild cognitive impairment has been recognised as a sign of very early dementia [2]. On the basis of the three-stage, five-level model, Chang *et al*. [3] designed a frailty prevention programme for older adults with dementia in which secondary prevention involved early detection and early treatment through health examination. Older adults with frailty were identified as a group potentially at high risk of cognitive impairment. The incidence of prefrailty comorbid with cognitive impairment among community-dwelling older adults is expected to increase with population ageing. Consequently, health problems induced by the cognitive decline associated with ageing and extended life expectancy have received considerable scholarly attention.

According to Chang and Lin [3], who conducted a systematic literature review and meta-analysis of frailty among 35,538 older people. The prevalence of frailty is higher in female than in male. Notably, the increased risk of mortality (frail compared to robust) was significantly higher for male compared to female (summary HR for male and female: 2.656 and 1.875, respectively; Q between ÷ 2 = 4.92, $p = 0.027$). It showed that male frail older people have a higher risk of death and need to be paid to the prevention of frailty.

Sleep problem is a common and serious status in the older population. About 50% of older adults have sleep problems

[4]. Poor sleep quality was reported to be related to prevalent and incident frailty at follow-up in U.S. community-dwelling older people [5]. Sleep disturbances have been found to be associated with an increased risk of different adverse outcomes, such as cognitive impairment, depression, and death. Frailty is defined as "a state of reduced resilience to stress". Poor sleep quality and low resilience were main related factors for frailty [6].

The presence of risk factors common to both prefrailty and cognitive impairment can be determined through health examination, after which clinical referral can proceed to control disease progression, thus reducing both medical costs and caregiving burden. This study investigated the predictability of prefrailty among older adults through the assessment of physiological indexes, psychological resilience, sensory function, sleep quality, and cognitive function.

2. Method

2.1 Participants

This cross-sectional study was conducted from September 2019 to May 2020. Community-dwelling older adults were recruited through purposive sampling. The inclusion criteria were as follows: aged $\geq$65 years; having sufficient ability to communicate in either Mandarin or Taiwanese; diagnosed as having prefrailty according to the Study of Osteoporotic Fractures (SOF) index; having sufficiently good hearing and oral communication abilities, as well as sufficiently clear vision, to not hinder communication with researchers or impede the data collection process (the responses of illiterate individuals were entered by researchers on their behalf). Individuals diagnosed as having dementia or determined to be nonfrail or frail through assessment were excluded.

2.2 Sample Size

G*Power version 3.1.7 software (Uiversität Kiel, Kiel, Germany) was used with α at 0.05, power at 0.80, and effect size at 0.15, and 16 variables were considered. The minimum sample size was 152. The estimated sample loss rate is about 10%, therefore, the number of samples was increased to 167.

2.3 Informed Consent

To protect the privacy as well as the rights and interests of the study participants, the study objectives, methods, and amount of time to be spent were explained to the older people. The older people could decide whether to take part in the study or withdraw midway without it having an adverse effect on the care that they received in the institution. All the written consent was obtained from participants. The research data were solely used for research purposes and strictly kept confidential. The names of the participants and the questionnaire numbers were replaced with codes prior to analyses to ensure the participants' data security.

2.4 Research Assessment

2.4.1 Frailty

The SOF index was used to assess frailty. Its three components served as the basis on which the questionnaire items were developed. They are as follows: (1) unintentional weight loss of more than 5% in the past year; (2) inability to rise from a chair five times without using the arms; and (3) feeling poor in energy more than three times in the past week. Responses of "yes" were given 1 point, whereas responses of "no" were give 0 points, with a total score of 1 point from the three components combined indicating prefrailty [4]. Individuals with a total score of at least 1 point were enrolled as participants. Luciani *et al*. [5] noted that the sensitivity, specificity, and accuracy of the SOF index on older adults aged 65 years and over with early-stage cancer was 89.0%, 81.1%, and 86.5%, respectively. The predictive power of the SOF index surpasses that of the Cardiovascular Health Study index of frailty. Moreover, as mentioned, the reliability and validity of the SOF index are favourable. In addition, SOF-based approaches are easy to use, can be applied in regular community venues, and are not restricted to clinical settings. In essence, the SOF index is an ideal indicator of frailty among older adults [4]. A study conducted in Taipei, Taiwan Hu *et al*. [6] applied both the SOF index and Fried's frailty phenotype on 471 community-dwelling older adults aged 65 years and over, observing that the two were moderately correlated ($p < 0.001$). The AUC of the SOF index was significantly correlated with the ability of the index to predict falls ($p < 0.001$). Furthermore, Fried's frailty phenotype had greater accuracy in predicting disability ($p < 0.001$).

2.4.2 Demographic Characteristics

A structured questionnaire was developed and used to collect data on the participants' age, sex, marital status, residential status, community activity participation, text messaging capability, self-rated health, number of chronic diseases, height, weight, and waist circumference.

2.4.3 Pain

Pain was assessed using the numeric rating scale (NRS), which rates pain from 0 to 10, with 0 and 10 indicating no and the worst pain imaginable, respectively. It can be administered verbally or on paper [7]. Ferraz *et al*. [7] applied the NRS on 91 patients, reporting a Pearson product-moment correlation coefficient of 0.937 between the first and second tests. Alghadir *et al*. [8] indicated that the NRS had excellent test–retest reliability (0.95).

2.4.4 Physical Activity

Physical leisure activity was assessed using a 2-item questionnaire, and the participants were grouped according to their responses. Regarding the first item ("Do you exercise on a regular basis?"), the response options were "no", "less than twice a week", "three to five times a week", and "six or more times a week". As for the second item ("How long do you exercise at a time?"), the response options were "15 minutes or fewer", "16 to 29 minutes", "30–59 minutes", and "60 or more minutes". The respondents answering "no" or "less than twice a week" were assigned to the low physical activity group; those answering “three to five times a week” or “16 to 29 minutes” were assigned to the moderate physical activity category; and those answering more than six times a week, 30 to 59 minutes, or 60 or more minutes were assigned to the high physical activity group. The Godin-Shephard Leisure-Time Physical Activity Questionnaire (GSLTPAQ), developed in 1985, a simple assessment comprising four items that measure the frequency of mild, moderate, and strenuous physical activity, as well as sweat-inducing exercise. Lee *et al*. [9] administered the GSLTPAQ to 39 community-dwelling women (mean age 51 years). Strenuous exercise score, moderate exercise score, and total score were significantly correlated with maximum oxygen uptake (r = 0.35, 0.36, and 0.58, respectively). Moreover, total score was significantly negatively correlated with body fat percentage (r = 0.37, $p < 0.01$), and strenuous exercise score and total score were significantly correlated with muscle endurance (r = 0.35 and 0.39, respectively; $p < 0.05$). The strenuous exercise score and total score had a 4-week test-retest reliability of 0.85 and 0.93, respectively.

2.4.5 Independent Living Skills

The Lawton Instrumental Activities of Daily Living (IADL) Scale, developed by Lawton and Brody in 1969, consists of eight items, namely ability to use telephone, shopping, food preparation, housekeeping, laundry, mode of transportation, responsibility for own medications, and ability to handle finances. The scoring model is dichotomous; for each item, respondents are given 1 point if they are able to partially or complete the activities described. If they partially or completely rely on others, 0 points are given. Higher scores indicate a better functional level (maximum score: 8 points). The scale has a scorer reliability of 0.85 [10]. A 2014 study evaluated the reliability and validity of the IADL scale on dementia, using the data of 60 patients with dementia obtained from the Iran Dementia & Alzheimer’s Association. Content validity was rated on a 4-point Likert scale. Isik *et al*. [11] used the IADL scale to evaluate 80 participants’ independent living skills (mean age 71.6 years). Internal consistency and (Cronbach α) inter-item correlation were of 0.843 and 0.915, respectively. Reliability was satisfactory, as indicated by the high inter-scorer correlation (r = 0.961, $p < 0.001$) between the items correlated with the total score ($0.427 < r < 0.606$; $p < 0.001$) and the intraclass correlation coefficient.

2.4.6 Psychological Resilience

The Resilience Scale for Adults (RSA), developed by Friborg *et al*. [12], is a semantic differential scale with excellent reliability that assesses psychological resilience and recoverability in the face of adversity on a 7-point Likert scale. It comprises 33 items that can be categorised under five factors. Chang *et al*. [3] translated the RSA into traditional Chinese with the developer’s consent. The traditional Chinese version contains 29 items (4 items were removed according to factor analysis results) that are categorised into five dimensions. Specifically, the personal strength, family unity, social resources, social skills, and future organisational style dimensions contain 6, 7, 8, 4, and 4 items, respectively. Scores range from 0 to 203 points, with higher scores indicating higher psychological resilience. The traditional Chinese version has favourable reliability and internal consistency, with a Cronbach α of 0.88 and a 4-month test-retest reliability between 0.69 and 0.84. In the original study by Friborg *et al*. [12], the participants were grouped according to their scores on the scale. Mean score differed significantly ($t = 10.58$, $p < 0.001$) between the high-score group (6.02; standard deviation (SD) = 0.45) and the low-score group (4.61; SD = 0.77). Specifically, the RSA was used to examine the relationship between psychological resilience and symptoms of posttraumatic stress disorder. The Chinese version of the RSA has excellent reliability, with an internal consistency (Cronbach α) of 0.89 and a 4-week test-retest reliability of 0.89.

2.4.7 Depression

As its name implies, the Geriatric Depression Scale is used to evaluate depressive symptoms in older adults. Sheikh and Yesavage [13] developed the Geriatric Depression Scale-Short form (GDS-SF), which consists of 15 highly correlated items from the original 30. The GDS-SF allows quick and easy measurement of depression status in the past week, and the administrator is not required to receive special training in advance. All the items are yes/no questions, and the total score ranges between 0 and 15 points. Scores from 0 to 4, 5 to 9, and $\geq$10 indicate no depression; mild depression, and moderate-to-severe depression, respectively. With a sensitivity of 92% and a specificity of 89%, the GDS-SF can accurately differentiate between individuals with and without depression (r = 0.84, $p < 0.001$). Liao *et al*. [10] divided 136 patients into a depression and a non-depression group (containing 45 and 91 patients, respectively) according to the *Diagnostic and Statistical Manual of Mental Disorders*, *Third Edition*, *Revised*, reporting a correlation coefficient of 0.86, an AUC of 0.97, a sensitivity of 93.3%, and a specificity of 92.3%. In short, its excellent reliability and validity make the GDS-SF it an ideal instrument for assessing depression in older adults.

2.4.8 Sensory Function

Vision and hearing were assessed with the 4-item questionnaire used in the Taiwan Longitudinal Study on Aging (TLSA). Affirmative and negative responses are given 1 and 0 points, respectively, with a lower score indicating better sensory function [14]. In a study conducted from 1987 to 1988, Nondahl *et al*. [15] administered the Hearing Handicap Inventory-Screening Version (HHIE-S) to 3556 older adults who were on average aged 65.8 years and had eye diseases and hearing impairment. The sensitivity, specificity, positive predictive value, and negative predictive value of the questionnaire and four self-rated items were 0.67, 0.80, 0.87, and 0.56, respectively. In their study on 2696 participants aged 55 to 59 years, Sindhusake *et al*. [16] reported that the item on hearing had a sensitivity of 71%, specificity of 72%, positive likelihood ratio (PLR) of 71%, and negative likelihood ratio (NLR) of 69%. The results were confirmed using air conduction pure tone audiometry.

2.4.9 Sleep Quality

Buysse *et al*. [17] initially developed the Pittsburgh Sleep Quality Index (PSQI) for clinical use in patients with psychotic disorders. This self-rated questionnaire, which assesses sleep quality and sleep disturbances over a 1-month time interval, comprises 10 items under seven components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction. In the original study, which included 168 participants, the PSQI achieved a Cronbach α of 0.83, a specificity of 89.5%, and a sensitivity of 89.6% (κ = 0.75, $p < 0.001$). Scores on each item range from 0 to 3 points, and the total score ranges between 0 and 21 points. Scores exceeding 5 points indicate unsatisfactory sleep quality, and the higher the score, the poorer the sleep quality.

2.4.10 Dementia

The Ascertain Dementia 8-item Informant Questionnaire (AD-8) was developed by researchers at Washington University in St. Louis. A Chinese version is used in Taiwan. Affirmative responses to more than two of the eight items indicates a high risk of dementia [18]. Yang *et al.* [19] tested the predictive accuracy of the AD-8 in discriminating between patients with Alzheimer disease from healthy individuals in Taiwan. Under a threshold for cognitive impairment of $\geq$2, the AUC, sensitivity, specificity, PLR, and NLR were 0.961, 97.6%, 78.1%, and 0.03, respectively.

2.5 Statistical Analysis

The present analyses were performed using IBM SPSS Statistics for Windows, version 22 (IBM Corp., Armonk, NY, USA). The demographic characteristics were analysed using descriptive statistics, and the questionnaire items were analysed by examining the relationship between linked items. The cognitive function data are presented as means and standard deviations. The independent samples *t* test was conducted to compare cognitive function among participants with different demographic characteristics. The chi-square test was applied to data on cognitive function and the physiological, psychological, sensory, and sleep variables. Logistic regression was performed to identify predictors of cognitive function. Nagelkerke's R^2 was obtained as an estimation of the total log likelihood explained by a summation of the significant occlusal factors.

3. Results

3.1 Demographic Characteristics

The 167 participants were aged between 65 and 89 years, with a mean age of 74.31 years (SD = 6.408 years). The participants aged 65 to 74 years constituted the largest group (88 individuals), and men and women (69 and 98 individuals) accounted for 41.3% and 58.7% of the participants, respectively. Most of the participants were married (105; 62.9%), lived with family members (152; 91.0%), and capable of text messaging (104; 62.3%). Constituting the largest proportion, 68 and 81 of the participants (40.7% and 48.5%) rated their health as moderately good and reported having two to three chronic diseases, respectively (Table 1).

The average height, weight, and waist circumference was 159.31 cm (SD = 8.933), 64.49 kg (SD = 12.74), and 81.44 cm (SD = 10.252), respectively. Pain scores of 2 were reported by the largest group—46 participants (27.5%). The IADL scores revealed that the vast majority of the participants (153; 91.6%) experienced no difficulty in performing activities of daily living. The mean IADL score was 7.62 (SD = 0.639). The RSA scores ranged between 29 and 203. The mean score was 159.59 (SD = 30.633). The mean GDS-SF score was 3.59 (SD = 2.777), with 74.3%, 20.4%, and 5.4% of the participants being categorised as normal (0–4 points), having mild depression (5–9 points), and moderately to severely depressed, respectively (Table 1).

Regarding vision, 111 (65.9%) of the participants noted that they wore glasses and 110 (65.9%) reported being able to see clearly. As for hearing, 16 (9.6%) of the participants noted that they wore hearing aids, and 117 (70.1%) reported being able to hear clearly. Mean score on sleep quality was 7.05 (SD = 3.717). Most of the participants (129; 77.2%) had poor sleep quality. The mean AD-8 score was 1.47 (SD = 1.590). Among the participants, 90 and 77 (53.89%) were considered having normal and impaired cognitive function, respectively (Table 1).

3.2 Participant Differences in Demographic Characteristics, Physiological Indexes, Psychological Resilience, Sensory Function, Sleep Quality, and Cognitive Function

Age (χ^2 = 20.540, $p < 0.05$), text messaging capability (χ^2 = 22.932, $p < 0.05$), and number of chronic diseases (χ^2 = 6.196, $p < 0.05$) were significantly correlated with cognitive function ($p < 0.05$), indicative of a correlation with cognitive function. Moreover, this suggests that individuals with prefrailty who are older or have more chronic diseases are more likely to have cognitive impairment, and that those capable of text messaging are more likely to have normal cognitive function than those of who not. In terms of physiological indexes, IADL score correlated significantly with cognitive function (χ^2 = 3.943, $p < 0.05$), indicating that a high IADL score (disability) is associated with cognitive impairment. Psychological resilience (χ^2 = 16.867, $p < 0.05$), depression tendency (χ^2 = 24.352, $p < 0.05$), and sleep quality (χ^2 = 7.735, $p < 0.05$) correlated significantly with cognitive function, clearly indicating that the psychological indexes and sleep of older adults with prefrailty are related to their cognitive function. With the correlation coefficient of psychological resilience and geriatric depression attending statistical significance, those older adults with prefrailty whose sleep quality has a low score are more prone to cognitive impairment (Table 2).

3.3 Predictors of Cognitive Function in Community-Dwelling Older Adults with Prefrailty

Logistic regression analysis was performed to determine the predictive accuracy of the independent variables—that is, the demographic characteristics (age, text messaging capability, and number of chronic diseases), physiological indexes (IADL score), psychological indexes (psychological resilience and geriatric depression), and sleep quality—regarding cognitive function. Text messaging capability attained statistical significance (β = −0.981, OR: 0.375, 95% CI: 0.149–0.941, $p < 0.05$) with cognitive impairment. In other words, the participants incapable of using mobile devices had a higher risk

TABLE 1. Descriptive statistics of the participants (n = 167).

Variable	Number	Percentage	Mean	SD
Age (years)			74.31	6.408
65–74	88	52.7		
75–84	68	40.7		
≥85	11	6.6		
Sex				
Male	69	41.3		
Female	98	58.7		
Marital status				
Married	105	62.9		
Divorced	7	4.2		
Unmarried	8	4.8		
Widowed	47	28.1		
Residential status				
Living alone	15	9.0		
Living with family	152	91.0		
Community activity participation				
Yes	142	85.0		
No	25	15.0		
Text messaging capability				
Yes	104	62.3		
No	63	37.7		
Health (Self-rated)				
Very good	33	19.8		
Good	55	32.9		
Moderately good	68	40.7		
Not very good	11	6.6		
Very bad	0	0		
Number of chronic diseases				
≤1	78	46.7		
2 to 3	81	48.5		
≥4	8	4.8		
Physiological indexes				
Height			159.31	8.933
Weight			64.49	12.74
Waist circumference			61.5	10.252
Normal (men ≤90 cm, women ≤80 cm)	109	65.3	1.53	0.501
Excessive (men ≥90 cm, women ≥80 cm)	58	34.7	1.69	0.467
Instrumental activities of daily living				
Yes	14	8.4	3.71	1.858
No	153	91.6	7.62	0.639

TABLE 1. Continued.

Variable	Number	Percentage	Mean	SD
Physical activity				
Low	51	30.5	2.00	0.000
Moderate	92	55.1	3.43	0.498
High	24	14.4	5.29	0.464
Pain (Numeric rating scale score)			1.99	1.668
0	42	25.1		
1	21	12.6		
2	46	27.5		
3	36	21.6		
4	10	6.0		
5	6	3.6		
6	2	1.2		
7	3	1.8		
8	1	0.6		
Psychological resilience				
Low score group	2	1.2	1.00	0.000
Moderate score group	56	33.5	0.66	0.478
High score group	109	65.3	0.35	0.479
Geriatric depression				
No depression	124	74.3	2.23	0.989
Mild depression	34	20.4	6.35	1.252
Moderate-to-severe depression	9	5.4	11.78	1.481
Sensory function				
Wearing glasses	111	66.5		
Not wearing glasses	56	33.5		
Able to see clearly	110	65.9		
Unable to see clearly	57	34.1		
Wearing hearing aids	16	9.6		
Not wearing hearing aids	151	90.4		
Able to hear clearly	117	70.1		
Unable to hear clearly	50	29.9		
Sleep quality (Pittsburgh sleep quality index score)				
Good sleep quality (0–5 points)	38	22.8	2.84	1.079
Poor sleep quality (6–21 points)	129	77.2	8.29	3.284
Cognitive function				
Normal	90	53.89	0.30	0.461
Impaired	77	46.11	2.84	1.319

TABLE 2. Participant differences in demographic characteristics, physiological indexes, psychological resilience, sensory functions, sleep quality, and cognitive function (n = 167).

Variable	Cognitive function		χ^2	*p*
	Normal	Impaired		
	n (%)	n (%)		
Age (years)			20.540	<0.001
65–74	62 (37.1)	26 (15.6)		
75–84	24 (14.4)	44 (26.3)		
≥85	4 (2.4)	7 (4.2)		
Sex			1.741	0.187
Male	33 (19.8)	36 (21.6)		
Female	57 (34.1)	41 (24.6)		
Marital status			3.569	0.313
Married	61 (36.5)	44 (26.3)		
Divorced	2 (1.2)	5 (3.0)		
Unmarried	3 (1.8)	5 (3.0)		
Widowed	24 (14.4)	23 (13.8)		
Residential status			1.280	0.258
Living alone	6 (3.6)	9 (5.4)		
Living with family	84 (50.3)	68 (40.7)		
Community activity participation			0.053	0.819
Yes	76 (45.5)	66 (39.5)		
No	14 (8.4)	11 (6.6)		
Text messaging capability			22.932	<0.001
Yes	71 (42.5)	33 (19.8)		
No	19 (11.4)	44 (26.3)		
Health (Self-rated)			8.582	0.055
Very good	22 (13.2)	11 (6.6)		
Good	34 (20.4)	21 (12.6)		
Moderate	31 (18.6)	37 (22.2)		
Not very good	3 (1.8)	8 (4.8)		
Very bad	0 (0.0)	0 (0.0)		
Number of chronic diseases			6.196	0.040*
≤1	51 (30.5)	29 (17.4)		
2 to 3	36 (21.6)	43 (25.7)		
≥4	3 (1.8)	5 (3.0)		
Waist circumference			54.366	0.064
Men, normal (≤90 cm)	22 (13.2)	29 (17.4)		
Men, excessive (>91 cm)	11 (6.6)	7 (4.2)		
Women, normal (≤80 cm)	28 (16.8)	30 (18.0)		
Women, excessive (>81 cm)	29 (17.4)	11 (6.6)		

TABLE 2. Continued.

Variable	Cognitive function		χ^2	p
	Normal	Impaired		
	n (%)	n (%)		
Impaired	4 (2.4)	10 (6.0)		
Not impaired	86 (51.5)	67 (40.1)		
Physical activity			24.352	0.982
Low	28 (16.8)	23 (13.8)		
Moderate	49 (29.3)	43 (25.7)		
High	13 (7.8)	11 (6.6)		
Pain			3.499	0.176
Mild (≤3)	28 (16.8)	23 (13.8)		
Moderate (4–6)	49 (29.3)	43 (25.7)		
Severe (≥7)	13 (7.8)	11 (6.6)		
Psychological resilience			16.867	<0.001
Low score group (score: <86)	0 (0.0)	2 (1.2)		
Moderate score group (score: 87–145)	19 (11.4)	37 (22.2)		
High score group (score: >146)	71 (42.5)	38 (22.8)		
Geriatric depression			24.352	<0.001
No depression (score: 0–4)	80 (47.9)	44 (26.3)		
Mild depression (score: 5–9)	10 (6.0)	24 (14.4)		
Moderate-to-severe depression (score: ≥10)	0 (0.0)	9 (5.4)		
Wearing glasses			0.514	0.474
Yes	62 (37.1)	49 (29.3)		
No	28 (16.8)	28 (16.8)		
Able to see clearly			3.505	0.061
Yes	65 (38.9)	45 (26.9)		
No	25 (15.0)	32 (19.2)		
Wearing hearing aids			0.733	0.392
Yes	7 (4.2)	9 (5.4)		
No	83 (49.7)	68 (40.7)		
Able to hear clearly			2.811	0.094
Yes	68 (40.7)	49 (29.3)		
No	22 (13.2)	28 (16.8)		
Sleep quality			7.755	0.005**
Good	28 (16.8)	10 (6.0)		
Poor	62 (37.1)	67 (40.1)		

Note: *$p < 0.05$, **$p < 0.01$.

TABLE 3. Results from logistic regression on cognitive function (n = 167).

Independent variable	β	S.E.	Wald	p	OR	95% CI of OR
Constant	–3.581	3.106	1.329	0.249	0.028	
Age	0.060	0.037	2.599	0.107	1.061	0.987–1.141
Text messaging capability	–0.981	0.469	4.370	0.037*	0.375	0.149–0.941
Number of chronic diseases	0.099	0.197	0.251	0.616	1.104	0.751–1.622
Instrumental activities of daily living	–0.500	0.769	0.422	0.516	0.607	0.134–2.740
Psychological resilience	–0.005	0.007	0.549	0.459	0.995	0.981–1.009
Geriatric depression	1.432	0.420	11.625	0.001***	4.188	1.838–9.539
Sleep quality	–0.361	0.488	0.546	0.460	0.697	0.268–1.814

*Note: β is the unstandardised regression coefficient. S.E., standard error; OR, odds ratio; CI, confidence interval. *$p < 0.05$, ***$p < 0.001$.*

of cognitive impairment than those capable. The participants with depression were 4.188 times more likely to have cognitive impairment than those without depression ($\beta = 1.432$, OR: 4.188, 95% CI: 1.838–9.539) (Table 3), with a mean of 43.75% for specificity, 52.95% for sensitivity and an accuracy of 52.25%. The percentage of the total log likelihood for disc displacement with reduction explained by the significant occlusal factors was low, with a Nagelkerke's $R^2 = 0.124$.

4. Discussion

As mentioned, the mean age of the participants was 74.31 years, and most of them were female, married, and living with family. Moreover, most of them participated in community activities, were capable of text messaging, considered themselves moderately healthy, and reported having 2 to 3 chronic diseases. In a study conducted in 2015 in Miaoli, Taiwan, 94 of the 275 middle-aged and older community-dwelling adults had prefrailty [20]. Those participants' age and number of chronic diseases were relatively similar to those of the present participants. Studies have confirmed that ageing, history of stroke, and depression tendency can result in a high risk of cognitive impairment, and that community-dwelling older adults who frequently participate in community activities, which present opportunities for physical activity and social interaction, have significantly better cognitive function [21]. In a study by Nakai *et al.* [22], the number of participants with high RSA scores was similar to that of those considered to have no depression. In a study on older adults by Chen and Chang [23], most (52.3%) of the participants had poor sleep quality (PSQI score >5), and sleep duration was found to affect body mass index and sleep quality. On average, the present participants went to bed between 9 and 10 PM, fell asleep within 30 minutes, and slept for 6 hours. These results are in line with those from another study on community-dwelling older adults in Taiwan [24], in which the mean PSQI score and mean sleep duration were 5.73 and 6 hours, respectively, and 55% of their participants slept poorly (PSQI score >5).

The AD-8 results revealed that 90 and 77 (53.89% and 46.11%) of the present participants had normal and impaired cognitive function, respectively. Similarly, in a cross-sectional study on the relationship between frailty, cognition, and self-perceived decline in cognitive function, 174 and 132 participants (43%) were determined to have normal and mildly impaired cognitive function, respectively, suggesting correlations between frailty, cognitive impairment, and self-perceived decline in cognitive function. Robertson *et al.* [25] reported that cognitive function was significantly poorer in older adults with prefrailty than in their nonfrail counterparts ($p < 0.05$). Furthermore, self-rated cognitive function was correlated with actual cognitive function. The proportion of older adults with prefrailty and cognitive impairment (46.11%) in the present study is comparable to corresponding results from studies conducted in other countries.

4.1 Participant Differences in Demographic Characteristics, Physiological Indexes, Psychological Resilience, Sensory Function, Sleep Quality, and Cognitive Function

In the present study, age, text messaging capability, and number of chronic diseases were correlated with cognitive function. Specifically, the participants who were more advanced in age, incapable of text messaging, and had more chronic diseases were more likely to have cognitive impairment. In a study by Turner Goins *et al.* [26], older age, being female, a higher number of chronic diseases, and a low IADL score were identified as factors significantly correlated with prefrailty in community-dwelling older adults. Few studies have explored the relationship between mobile device use and cognitive function of older adults with prefrailty. Navabi *et al.* [27] conducted a questionnaire survey on 328 older adults, noting that 80% and 20% of the participants used regular mobile phones and smartphones, respectively. Moreover, the participants mostly used mobile devices to make calls, and only 7% knew how to send text messages online. These results differ considerably from what was observed in the present study—that 62.3% of the participants were capable of text messaging. The obvious connection between physiological indexes and cognitive function that the lower the IADL scores, the higher the likelihood that they were cognitively impaired. A higher proportion of the participants who scored high in depression were cognitively impaired. Cognitive impairment and depression are similar in pattern. The prevalence of geriatric depression and dementia, both highly complex conditions requiring extensive care and a high number of medical resources, expected to increase in the future [28]. The correlation coefficient of psychological resilience was negative and attained statistical significance ($p < 0.05$), indicating that the participants had low psychological resilience overall. A cross-sectional study on 121 institutionalised older adults found that psychological resilience was moderately high and significantly positively correlated with physiological and psychological health [29]. By contrast, most of the present participants had high psychological resilience, but a similar trend was observed in that individuals with low psychological resilience had poorer cognitive function.

In the present study, the participants who slept poorly were more likely to have cognitive impairment than those who slept well. Ma *et al*. [30] indicated that overall PSQI score was not correlated with cognitive function, but in the component of sleep quality, poor sleep efficiency was significantly correlated with poor cognitive function. This contrasts with the present finding of a correlation between sleep quality and cognitive function. Notably, the greatest differences in the seven components of the PSQI between the participants with and without cognitive impairment were in their sleep duration.

4.2 Demographic Characteristics, Physiological Indexes, Psychological Resilience, Sensory Function, and Sleep Quality in Predicting Cognitive Function

Older age, text messaging capability, number of chronic diseases, IADL score, psychological resilience, geriatric depression, and sleep quality were significantly correlated with the participants' cognitive function. Predictor analysis revealed that the participants who were incapable of text messaging and had depressive tendencies were more likely to have cognitive impairment. The literature indicates that text messaging capability and geriatric depression are significant predictors of cognitive impairment in older adults with prefrailty. For example, Almeida [31] noted that social media use lowered the risk of dementia in older adults. However, few studies have investigated the relationship between mobile device use and cognitive function in older adults with prefrailty. In the present study, 62% of the participants were capable of text messaging, and not being capable of this task was associated with an increased risk of cognitive impairment. Therefore, courses on using the Internet and mobile devices should be promoted, both to increase older adults' exposure to social media and familiarise them with these platforms and their functions. The present results indicate that most of the participants did not have depression, but that those with depressive tendencies were more likely to be cognitively impaired, in line with the findings of Nakai *et al*. [22]. According to studies on prefrailty, frailty, and geriatric depression, prefrailty can aggravate depressive symptoms [32–34]. The simplification of scales for geriatric depression and cognition would facilitate the identification of residents with these conditions. The presentation of assessment results and referral information in residents' files can expedite access to relevant resources. In addition, attending courses on Internet or mobile device use can help older adults socialise with others and receive mental support.

This study investigated the accuracy the demographic characteristics, physiological indexes, psychological resilience, sensory function, and sleep quality in predicting cognitive function in older adults with prefrailty. According to the AD-8 results, 77 (46.11%) of the 167 participants had cognitive impairment. Statistical analysis revealed that factors affecting participants' cognitive state include older age, text messaging capability, number of chronic diseases, IADL score, physiological indexes, and sleep quality. As mentioned, the participants were aged between 65 and 89 years. Those aged 65 to 74 years accounted for the largest proportion of the total: 52.7%. Cognitive impairment was more common among the participants of more advanced age, consistent with the evidence that the prevalence of cognitive impairment increases with age. Participants with 2 to 3 chronic diseases constituted the largest proportion, and only eight individuals had four or more chronic diseases. Cognitive impairment was more common among participants with more chronic diseases than among those with fewer [35, 36]. A total of 104 participants (62.3%) were capable of text messaging, and cognitive impairment was more common among those who were not. Regarding the scores on the IADL scale, most of the participants (153; 91.6%) did not experienced difficulty in performing activities of daily living, and those that did were more likely to be cognitively impaired. Based on the demographic characteristics and physiological indexes, cognitive impairment clearly correlated with the structural or functional decline of body organs or systems. Cognitive impairment is also caused by brain degeneration. Functional and systemic decline that occur with age cannot be reversed. However, adequate systemic protection and the introduction of a mental or physical training programme in middle age or older age can delay the damage attributable to ageing [37, 38].

In the present study, psychological resilience and geriatric depression were correlated with cognitive impairment. The literature indicates that enhancing psychological resilience can delay the development of frailty and improve both health and quality of life. This premise supported by the present findings; most of the participants had high psychological resilience, of whom 71 did not have cognitive impairment. Moreover, a high score in geriatric depression indicated tendencies to develop cognitive impairment. In addition, poor mental health, lack of support from friends or family, and lack of interpersonal interactions were determined to be critical factors affecting cognitive function. Social support and positive interpersonal interactions may constitute the best mental health protection for community-dwelling older adults [39–41]. Care facilities are advised to provide courses held in various venues to allow gatherings among residents and thereby increase the care and support they receive from those around them.

Most of the participants with poor sleep quality had cognitive impairment (67; 40.1%). The most substantial differences in the seven components of the PSQI between the participants with and without cognitive impairment were in their sleep duration. This supports the evidence that sleep impairment can considerably affect both frailty and cognitive function. In this regard, the influence of sleep quality cannot be underestimated. Older adults tend to doze off or take naps during the day if they have no arranged activities; some of them also like to watch television in bed or on the couch. Increasing the frequency of daytime activities and outings can help older adults expend their energy, thereby benefiting sleep duration and sleep quality in general [42–44]. The present findings serve as a reference for the Taiwanese government with regard to the prevention and mitigation of cognitive impairment in older adults with prefrailty and minimizing the costs borne by individuals, families, and society as a whole.

Predictor analysis indicated that older adults who were incapable of text messaging and had depressive tendencies were more likely to be cognitively impaired. For reference, 62% of the participants were capable of text messaging. Courses on the use of mobile devices and the Internet should be promoted to encourage older adults to use mobile devices in daily life and equip them with the necessary skills. Familiarisation with social media allows older adults to socialise and receive mental support, thereby reducing their risk of developing cognitive impairment.

4.3 Limitations

There are some limitations. This a cross sectional study and one of the aims of this study was to explore the relationship between text messaging capability and cognitive function. We found they are high correlation. Due to it is not cohort study, the causal relationship is not test. Restrictions imposed by the lack of human resources and the COVID-19 pandemic meant that participants could only be recruited from a single care facility in New Taipei City, Taiwan. Thus, the generalizability of the present findings may be limited.

5. Conclusions

Physiological indexes, psychological resilience, sensory function, and sleep quality can affect cognitive function in older adults with prefrailty. Also, depressive tendencies and the inability to send text messages on a mobile device constituted critical predictors of cognitive function in the participants.

AUTHOR CONTRIBUTIONS

SFC made substantial contributions to research conception. SFC also designed the draft of the research process and submitted the manuscript as corresponding author. LLH made substantial contributions to analysis and interpretation of data. SFC, LLH and HCT had been involved in revising manuscript critically for important intellectual content. SFC, LLH and HCT modified the manuscript format, discussed reviewer opinions, and clarified the professional name. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study passed the review and ethical approval by the Behavioral and Social Sciences Research Ethics Office of National Taiwan University (IRB-Reference Code: 202002ES013) in Taiwan. All methods were performed in accordance with the relevant guidelines and regulations. All the written consent was obtained from participants. The research data were solely used for research purposes and strictly kept confidential.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] Kim HJ, Min KB, Min JY. Healthy aging predicts mortality risks: Results from the Korean longitudinal study of aging (2006–2014). Archives of Gerontology and Geriatrics. 2021; 94: 104333.

[2] Burns DK, Alexander RC, Welsh-Bohmer KA, Culp M, Chiang C, O'Neil J, *et al*. Safety and efficacy of pioglitazone for the delay of cognitive impairment in people at risk of Alzheimer's disease (TOMMORROW): a prognostic biomarker study and a phase 3, randomised, double-blind, placebo-controlled trial. The Lancet Neurology. 2021; 20: 537–547.

[3] Chang S, Lin P. Frail phenotype and mortality prediction: a systematic review and meta-analysis of prospective cohort studies. International Journal of Nursing Studies. 2015; 52: 1362–1374.

[4] Ensrud KE, Ewing SK, Taylor BC, Fink HA, Cawthon PM, Stone KL, *et al*. Comparison of 2 frailty indexes for prediction of falls, disability, fractures, and death in older women. Archives of Internal Medicine. 2008; 168: 382–389.

[5] Luciani A, Ascione G, Bertuzzi C, Marussi D, Codecà C, Di Maria G, *et al*. Detecting disabilities in older patients with cancer: comparison between comprehensive geriatric assessment and vulnerable elders survey-13. Journal of Clinical Oncology. 2010; 28: 2046–2050.

[6] Hu B, Hsiao-Wei Y, Chiu T, Li-Ling L, Chen Y. The validity of the study of osteoporotic fractures (SOF) index for assessing community-based older adults in Taiwan. Innovation in Aging. 2018; 2: 1015.

[7] Williamson A, Hoggart B. Pain: a review of three commonly used pain rating scales. Journal of Clinical Nursing. 2005; 14: 798–804.

[8] Alghadir AH, Anwer S, Iqbal A, Iqbal ZA. Test-retest reliability, validity, and minimum detectable change of visual analog, numerical rating, and verbal rating scales for measurement of osteoarthritic knee pain. Journal of Pain Research. 2018; 11: 851–856.

[9] Lee MS, Lin SL, Lui CM. The study of validity and reliability of four simple self-reported questionnaire on physical activity—using RT3 Triaxial accelerometer as criterion. Journal of Health Promotion and Health Education. 2002; 17: 1–14.

[10] Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. The Gerontologist. 1969; 9: 179–186.

[11] Isik EI, Yilmaz S, Uysal I, Basar S. Adaptation of the lawton instrumental activities of daily living scale to Turkish: validity and reliability study. Annals of Geriatric Medicine and Research. 2020; 24: 35–40.

[12] Friborg O, Hjemdal O, Rosenvinge JH, Martinussen M, Aslaksen PM,

Flaten MA. Resilience as a moderator of pain and stress. Journal of Psychosomatic Research. 2006; 61: 213–219.
[13] Sheikh JI, Yesavage JA. Geriatric depression scale (GDS) recent evidence and development of a shorter version. Clinical Gerontologist. 1986; 5: 165–173.
[14] Chiu CJ, Chen YT, Huang HM, Lin YH. The construction of disability process database in Taiwan. Journal of Health Science. 2018; 1–10.
[15] Nondahl DM, Cruickshanks KJ, Wiley TL, Tweed TS, Klein R, Klein BEK. Accuracy of self-reported hearing loss. International Journal of Audiology. 1998; 37: 295–301.
[16] Sindhusake D, Mitchell P, Smith W, Golding M, Newall P, Hartley D, *et al*. Validation of self-reported hearing loss. The blue mountains hearing study. International Journal of Epidemiology. 2001; 30: 1371–1378.
[17] Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh sleep quality index: a new instrument for psychiatric practice and research. Psychiatry Research. 1989; 28: 193–213.
[18] Galvin JE, Roe CM, Powlishta KK, Coats MA, Muich SJ, Grant E, *et al*. The AD8: a brief informant interview to detect dementia. Neurology. 2005; 65: 559–564.
[19] Yang Y, Galvin JE, Morris JC, Lai C, Chou M, Liu C. Application of AD8 questionnaire to screen very mild dementia in Taiwanese. American Journal of Alzheimer's Disease and other Dementiasr. 2011; 26: 134–138.
[20] Yang WT, Lu CY, Chen SC, Chien KY. The relationship between walking speed and functional fitness in the non- frailty and pre- frailty elderly. International Journal of Sports Physiology and Performance. 2018; 5: 89–96.
[21] Tang TC, Hwang AC, Liu LK, Lee WJ, Chen LY, Wu YH, *et al*. FNIH-defined sarcopenia predicts adverse outcomes among community-dwelling older people in Taiwan: results from I-Lan longitudinal aging study. The Journals of Gerontology: Series A. 2018; 73: 828–834.
[22] Nakai Y, Makizako H, Kiyama R, Tomioka K, Taniguchi Y, Kubozono T, *et al*. Association between chronic pain and physical frailty in community-dwelling older adults. International Journal of Environmental Research and Public Health. 2019; 16: 1330.
[23] Chen YH, Chang SP. Investigation of relationship between sleep duration and body mass index. Journal of Sport and Recreation Researches. 2012; 7: 68–78.
[24] Song, Dan, S. F. Doris. Effects of a moderate-intensity aerobic exercise programme on the cognitive function and quality of life of community-dwelling elderly people with mild cognitive impairment: a randomised controlled trial. International journal of nursing studies. 2019; 93: 97–105.
[25] Robertson DA, Savva GM, Coen RF, Kenny R. Cognitive function in the prefrailty and frailty syndrome. Journal of the American Geriatrics Society. 2014; 62: 2118–2124.
[26] Turner Goins R, Schure M, Winchester B. Frailty in older american indians: the native elder care study. Gerontology and Geriatric Medicine. 2019; 5: 2333721419855669.
[27] Navabi N, Ghaffari F, Jannat-Alipoor Z. Older adults' attitudes and barriers toward the use of mobile phones. Clinical Interventions in Aging. 2016; 11: 1371–1378.
[28] Weng CF, Lin KP, Chan DC. Geriatric depression and cognitive impairment. Journal of Internal Medicine of Taiwan. 2014; 25: 158–164.
[29] Liu X, Chiou CJ. The resilience of elderly residents in long-term care facilities and related factors. Journal of Nursing & Healthcare Research. 2012; 8: 179–190.
[30] MA XQ, Jiang CQ, Xu L, Zhang WS, Zhu F, Jin YL, *et al*. Sleep quality and cognitive impairment in older Chinese: Guangzhou biobank cohort study. Age and Ageing. 2019; 49: 119–124.
[31] Almeida OP, Yeap BB, Alfonso H, Hankey GJ, Flicker L, Norman PE. Older men who use computers have lower risk of dementia. PLoS ONE. 2012; 7: e44239.
[32] Albala C, Lera L, Sanchez H, Angel B, Márquez C, Arroyo P, *et al*. Frequency of frailty and its association with cognitive status and survival in older Chileans. Clinical Interventions in Aging. 2017; 12: 995–1001.
[33] Chu X, Zhang N, Shi G, Wang Y, Wang Z, Guo J, *et al*. Frailty and incident depressive symptoms in a Chinese sample: the Rugao longevity and ageing study. Psychogeriatrics. 2020; 20: 691–698.
[34] Zhang SM, Tang XD, Yang XR, Zheng RR, Xu L, Wu JH. Relationship between frailty and depression in elderly patients. Zhonghua Yi Xue Za Zhi. 2017; 2017: 3384–3387. (In Chinese)
[35] Buchner DM, Wagner EH. Preventing frail health. Clinics in Geriatric Medicine. 1992; 8: 1–17.
[36] Cable N, Hiyoshi A, Kondo N, Aida J, Sjöqvist H, Kondo K. Identifying frail-related biomarkers among community-dwelling older adults in Japan: a research example from the Japanese gerontological evaluation study. BioMed Research International. 2018; 2018: 5362948.
[37] Downer B, Al Snih S, Howrey BT, Raji MA, Markides KS, Ottenbacher KJ. Combined effects of cognitive impairment and pre-frailty on future frailty and death in older Mexican Americans. Aging and Mental Health. 2019; 23: 1405–1412.
[38] Freitag S, Schmidt S. Psychosocial correlates of frailty in older adults. Geriatrics. 2016; 1: 26.
[39] Fried LP, Ferrucci L, Darer J, Williamson JD, Anderson G. Untangling the concepts of disability, frailty, and comorbidity: implications for improved targeting and care. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences. 2004; 59: M255–M263.
[40] Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, *et al*. Frailty in older adults: evidence for a phenotype. The Journals of Gerontology Series a: Biological Sciences and Medical Sciences. 2001; 56: M146–M157.
[41] Gifford KA, Bell SP, Liu D, Neal JE, Turchan M, Shah AS, *et al*. Frailty is related to subjective cognitive decline in older women without dementia. Journal of the American Geriatrics Society. 2019; 67: 1803–1811.
[42] Hsieh CC, Hsiao YY, Lin MC, Chen BC. Frailty elderly. Journal of Family Medicine and Primary Care. 2010; 25: 410–417.
[43] Moreno-Tamayo K, Ramírez-García E, Sánchez-García S. Sleep disturbances are associated with frailty in older adults. Revista Medica del Instituto Mexicano del Seguro Social. 2018; 56: S38–S44. (In Spanish)
[44] Yan ZX, Hsieh MF. Frailty of the elderly. Medicine Today. 2013; 473: 167–173.

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