



## Perceived Stress and Frailty in Older Adults

Se Hui Lee<sup>1,2</sup>, Jinyoung Shin<sup>1,2</sup>, Sarang Um<sup>3</sup>, Hye Ri Shin<sup>3</sup>, Young Sun Kim<sup>3</sup>, Jae Kyung Choi<sup>1,2</sup>

<sup>1</sup>Department of Family Medicine, Konkuk University Medical Center, Seoul, Korea

<sup>2</sup>Research Institute of Medical Science, Konkuk University School of Medicine, Seoul, Korea

<sup>3</sup>Department of Gerontology (AgeTech-Service Convergence Major), Graduate School of East-West Medicine Science, Kyung Hee University, Yongin, Korea

### Corresponding Author:

Jae Kyung Choi, MD, PhD

Department of Family Medicine,  
Konkuk University Medical Center,  
120-1 Neungdong-ro, Gwangjin-gu,  
Seoul 05030, Korea

E-mail: [cjk@kuh.ac.kr](mailto:cjk@kuh.ac.kr)

ORCID:

<https://orcid.org/0000-0002-0875-7505>

Received: August 18, 2023

Revised: August 29, 2023

Accepted: September 3, 2023

**Background:** Individuals with frailty are susceptible to adverse events. Although a psychological correlation with frailty has been observed, few studies have investigated the relationship between stress and frailty. This study examined the association between perceived stress and frailty in older adults. **Methods:** This cross-sectional observational study included participants recruited between September 2021 and January 2022. The Korean version of the Perceived Stress Scale-10 was used to measure stress levels, while the frailty status was assessed using the Korean Frailty Index. Loneliness, depression, and satisfaction were measured using the UCLA Loneliness Scale, Centre for Epidemiological Studies Depression Scale, and Satisfaction with Life Scale, respectively. We used multinomial logistic regression to compare the variables between frail and robust participants. **Results:** Among 862 study participants (mean age, 73.62 years; 65.5% women), the mean PSS-10 score was 15.26, 10.8% were frail, 22.4% were pre-frail, and 66.8% were robust. Perceived stress was significantly associated with pre-frailty (crude odds ratio [OR]=1.147; 95% confidence interval [CI], 1.093–1.204) and frailty (crude OR=1.417; 95% CI, 1.322–1.520). After adjusting for sociodemographic factors, we examined the associations between perceived stress and prefrailty (adjusted OR=1.140; 95% CI, 1.084–1.199) and frailty (adjusted OR=1.409; 95% CI, 1.308–1.518). After adjusting for all variables, including loneliness, depression, and satisfaction, perceived stress was significantly associated with frailty (adjusted OR=1.172; 95% CI, 1.071–1.283), however, insufficient statistical evidence was observed for pre-frailty (adjusted OR=1.022; 95% CI, 0.961–1.086). **Conclusion:** Higher levels of perceived stress were associated with frailty in older adults. Stress management efforts may help improve frailty in this population.

**Key Words:** Frailty, Psychological stress, Cross-sectional studies, Aged

## INTRODUCTION

Frailty is a clinical syndrome that is associated with aging. It is characterized by the deterioration of multiple physiological functions with marked vulnerability to endogenous and exogenous stresses. Frail individuals are susceptible to adverse health outcomes, including disability, prolonged hospital stay, and mortality.<sup>1-3)</sup> Although no definitive criteria exist for evaluating frailty, previous studies have verified multiple factors. Physical assessments include conventional approaches, such as grip strength, walking

speed, and weight loss.<sup>4)</sup> Additionally, a psychological correlation with frailty was recently reported. Adverse psychological outcomes, such as depression or anxiety, could worsen frailty status in older adults.<sup>5)</sup> In addition, many interventions to improve psychological outcomes have been attempted, with limited effectiveness.<sup>6,7)</sup>

As frail individuals are susceptible to adverse stress events, measuring perceived stress may help predict their frailty status. Perceived stress is the subjective concept of feelings or thoughts about one's ability to cope with problems or difficulties. Despite similar

negative life events, perceived stress can differ depending on factors such as coping resources and personality.<sup>8)</sup> Perceived stress is commonly measured using the Perceived Stress Scale,<sup>9)</sup> which is one of the most verified measurements and has been translated into various languages, including Korean.

Most previous studies focused on the symptoms of depression or anxiety. Few studies have examined the association between stress and frailty, especially in Korea. Since South Korea is transitioning into a super-aged society with concurrent stress-laden systems, adapting to these circumstances has become demanding. Therefore, this study examined the association between perceived stress and frailty among older adults in South Korea.

## MATERIALS AND METHODS

This cross-sectional, observational study recruited participants between September 2021 and January 2022. A total of 1,064 participants were enrolled from 30 senior community centers in South Korea. Each participant completed a questionnaire supervised by well-trained interviewers to collect demographic data (age, sex, highest educational level, marital status, working status, place of residence, and cohabitation status). Education level was categorized as lower than middle school and higher than high school graduation; residences as urban, suburban, and rural areas; cohabitation status as either alone or not alone, which indicated living with someone else; marital status as married or unmarried and included single, divorced, separated, and bereaved; working status as working or nonworking. The interviewers received a manual for each questionnaire and underwent training sessions before survey initiation.

We also measured perceived stress, frailty, loneliness, depression, and life satisfaction. We utilized the Korean version of the Perceived Stress Scale-10 (PSS-10),<sup>10)</sup> which comprises 10 questions, with a total score of 40. The scores for four questions are reversed, with a higher score corresponding to a greater perception of stress. We assessed frailty status using the Korean Frailty Index (KFI),<sup>11)</sup> a multidomain phenotype consisting of seven self-reported questions and one physical measurement. The participants were classified as robust (KFI score of 0–1), pre-frail (KFI score of 2–3), or frail (KFI score of  $\geq 4$ ). Participants with missing data were selectively included if the frailty status could be determined based on the answered questions, regardless of the score of the unanswered questions. We evaluated social isolation using the Korean version of the revised UCLA Loneliness Scale (ULS).<sup>12)</sup> The ULS consists of 20 questions, each with 1–4 possible points. The scores of nine questions are reversed, with a higher score indicating a feeling of being more socially disconnected. We assessed depression using

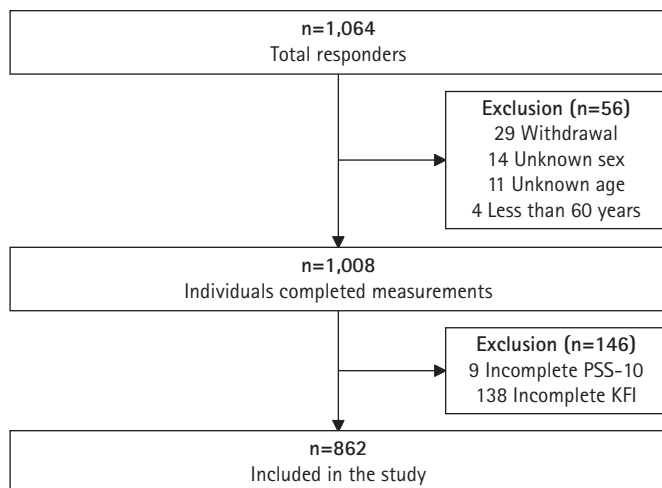
the Korean version of the Center for Epidemiological Studies Depression Scale (CES-D).<sup>13,14)</sup> The CES-D consists of 11 items, each scoring 0–3 points. The scores for the two items are reversed. A cutoff score of 9 points was used to identify individuals at risk of depression. We obtained the cognitive evaluations of personal life satisfaction using the Satisfaction with Life Scale (SWLS).<sup>15,16)</sup> The SWLS consists of five items, each scored from 1–5 points. Higher scores on the assessment are associated with higher levels of life satisfaction.

After data collection, we examined the sociodemographic characteristics and measurements. Baseline variables were summarized according to the robust, pre-frail, and frail groups using the chi-square test for categorical variables and analysis of variance (ANOVA) for continuous variables. We applied multinomial logistic regression to compare the variables of frail or pre-frail participants with those of robust participants. First, we used univariate logistic analysis to calculate the crude odds ratio (OR) for the association between frailty status and perceived stress. Next, we constructed adjusted models by sequentially adding significant variables and obtaining adjusted ORs. We calculated the ORs and 95% confidence intervals (CIs) for the pre-frailty and frailty groups. IBM SPSS Statistics for Windows, version 29.0 (IBM, Armonk, NY, USA) was used for the statistical analyses. Statistical significance was set at  $p < 0.05$ . This study was approved by the Institutional Review Board of Kyung Hee University (No. KHGIRB-21-389); and complied with the tenets of the Declaration of Helsinki and the ethical guidelines for authorship and publishing in the *Annals of Geriatric Medicine and Research*.<sup>17)</sup> Written informed consent was obtained from each participant before or at registration.

## RESULTS

A total of 1,064 participants were recruited, of which 56 were excluded because of dropouts or missing age and sex data. The subsequent exclusion of 146 participants because of incomplete PSS-10 or KFI resulted in the inclusion of 862 participants in the final analysis (Fig. 1). The mean age of these participants was  $73.62 \pm 5.867$  years and 65.5% ( $n = 565$ ) were women. The mean PSS-10 score was  $15.26 \pm 3.991$ . Among the participants, 10.8% ( $n = 93$ ) were frail, 22.4% ( $n = 193$ ) were pre-frail, and 66.8% ( $n = 576$ ) were robust. Additional descriptive data are presented in Table 1.

Perceived stress was significantly associated with pre-frailty (crude OR = 1.147; 95% CI, 1.093–1.204) and frailty (crude OR = 1.417; 95% CI, 1.322–1.520). After adjusting for sex, age, education, residence, cohabitation, marital status, and working status, the associations between perceived stress and pre-frailty (ad-



**Fig. 1.** Inclusion criteria of participants. PSS-10, Perceived Stress Scale-10; KFI, Korean Frailty Index.

justed OR = 1.140; 95% CI, 1.084–1.199) and frailty (adjusted OR = 1.409; 95% CI, 1.308–1.518) were statistically significant. Furthermore, after adjusting for all variables, including loneliness, depression, and satisfaction, perceived stress was significantly associated with frailty (adjusted OR = 1.172; 95% CI, 1.071–1.283). However, insufficient statistical evidence was observed between perceived stress and pre-frailty (adjusted OR = 1.022; 95% CI, 0.961–1.086) (Table 2).

## DISCUSSION

Our findings demonstrated that perceived stress was associated with frailty. Frail individuals were more likely to experience higher levels of perceived stress than individuals with pre-frailty. Frailty and pre-frailty were significantly associated with age, low educa-

**Table 1.** Descriptive cross-sectional analysis of baseline variables

	Total (n = 862)	Robust (n = 576)	Pre-frail (n = 193)	Frail (n = 93)	p-value
Age (y)	73.62 ± 5.867	72.92 ± 5.835	74.58 ± 5.491	75.96 ± 5.993	< 0.001
Sex					0.315
Male	297 (34.5)	204 (35.4)	58 (30.1)	35 (37.6)	
Female	565 (65.5)	372 (64.6)	135 (69.9)	58 (62.4)	
Education <sup>a)</sup>					< 0.001
Low	376 (43.6)	219 (38.0)	107 (55.4)	50 (53.8)	
High	474 (55.0)	350 (60.8)	82 (42.5)	42 (45.2)	
Missing	12 (1.4)	7 (1.2)	4 (2.1)	1 (1.0)	
Residence					0.822
Urban	471 (54.6)	314 (54.5)	109 (56.5)	48 (51.6)	
Suburban	267 (31.0)	183 (31.8)	55 (28.5)	29 (31.2)	
Rural	124 (14.4)	79 (13.7)	29 (15.0)	16 (17.2)	
Cohabitation					< 0.001
Alone	349 (40.5)	186 (32.3)	107 (55.4)	56 (60.2)	
Not alone	510 (59.2)	388 (67.4)	85 (44.1)	37 (39.8)	
Missing	3 (0.3)	2 (0.3)	1 (0.5)	0 (0)	
Marital status					< 0.001
Married	444 (51.5)	347 (60.2)	71 (36.8)	26 (28.0)	
Unmarried <sup>b)</sup>	410 (47.6)	223 (38.7)	120 (62.2)	67 (72.0)	
Missing	8 (0.9)	6 (1.1)	2 (1.0)	0 (0)	
Working status					0.010
Working	253 (29.4)	176 (30.6)	62 (32.2)	15 (16.1)	
Not working	601 (69.7)	394 (68.4)	129 (66.8)	78 (83.9)	
Missing	8 (0.9)	6 (1.0)	2 (1.0)	0 (0)	
PSS-10	15.26 ± 3.991	14.34 ± 3.529	16.04 ± 3.750	19.30 ± 4.336	< 0.001
ULS	38.90 ± 11.282	36.29 ± 10.137	41.60 ± 10.217	49.78 ± 12.483	< 0.001
Missing	35 (4.1)	21 (3.6)	9 (4.7)	5 (5.4)	
CESD	5.21 ± 4.777	3.82 ± 3.606	6.9 ± 4.923	10.34 ± 6.086	< 0.001
Missing	18 (2.1)	10 (1.7)	7 (3.6)	1 (1.1)	
SWLS	16.74 ± 4.426	17.65 ± 4.080	15.55 ± 4.410	13.57 ± 4.514	< 0.001
Missing	7 (0.8)	4 (0.7)	2 (1.0)	1 (1.1)	

Values are presented as mean ± standard deviation or number (%).

PSS-10, Perceived Stress Scale-10; ULS, UCLA Loneliness Scale; CESD, Centre for Epidemiological Studies Depression; SWLS, Satisfaction with Life Scale.

<sup>a)</sup>Low education level refers to an educational attainment not exceeding middle school, and a high education level indicates achievement at or above high school level.

<sup>b)</sup>Unmarried includes single, divorced, separated, widowed.

p-values obtained by chi-square test for categorical variables and ANOVA (analysis of variance) for continuous variables.

**Table 2.** Adjusted odds ratio (OR) between perceived stress and frailty status

	Pre-frailty vs. robust		Frailty vs. robust	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Crude OR	1.147 (1.093, 1.204)	< 0.001	1.417 (1.322, 1.520)	< 0.001
Model-1 adjusted OR	1.143 (1.089, 1.201)	< 0.001	1.427 (1.327, 1.533)	< 0.001
Model-2 adjusted OR	1.140 (1.084, 1.199)	< 0.001	1.409 (1.308, 1.518)	< 0.001
Model-3 adjusted OR	1.022 (0.961, 1.086)	0.494	1.172 (1.071, 1.283)	< 0.001

Model-1, age and sex adjusted; Model-2, Model-1 + education, residence, cohabitation, marital status and working status adjusted; Model-3, Model-2 + UCLA Loneliness Scale (ULS), Satisfaction with Life Scale (SWLS), and Centre for Epidemiological Studies Depression (CESD) adjusted; CI, confidence interval.

tional level, living alone, being unmarried, currently working, loneliness, depression, and low life satisfaction. Although sex and residence were not significantly associated with frailty, we also considered these variables in our analysis because of their clinical significance. After adjusting for confounders, perceived stress remained associated with frailty.

Depression, anxiety, loneliness, and low life satisfaction are significantly related to frailty.<sup>5,18-21</sup> Furthermore, individuals with frailty have higher levels of perceived stress and stress-related symptoms, although the exact mechanism remains uncertain.<sup>22</sup>

Theoretically, frail older adults are more likely to deteriorate after experiencing stressful events because of decreased resilience and homeostatic reserve.<sup>23</sup> Unlike robust individuals, those with frailty have a lower capacity to adapt; therefore, they do not return to homeostasis and manifest functional dependency. The homeostatic function of the endocrine system such as the hypothalamic-pituitary axis is reduced during aging.<sup>24</sup> Thus, the pattern of cortisol secretion, an essential biomarker of stress, may be altered. Specifically, lower morning and higher evening salivary cortisol levels are associated with frailty.<sup>25,26</sup> The empirical observation of dysregulation may provide a plausible biological background for a decreased capacity to cope with stress.

The reported associations of psychological problems with frailty suggest the need for the proper management of difficulties to improve patient resilience.<sup>27</sup> The results of the present study suggest that perceived stress is an important management target. Further clinical studies are required to identify effective treatment methods.

Regarding limitations of this study, the first was measurement errors resulting from self-reported assessment methods. Second was a possible selection bias owing to the exclusion of participants with missing data or those who dropped out during the study. Third, the causal relationship between frailty and perceived stress was nuanced. Frailty itself increased perceived stress, or a bidirectional interplay might exist. Longitudinal studies are required to assess the potential long-term outcomes and causal relationships. Fourth, data regarding chronic diseases and other medical indica-

tors were not collected. Fifth, the generalizability of the findings to broader populations was limited. Therefore, follow-up studies using data from other communities with varying psychological outcomes are warranted.

In conclusion, higher levels of perceived stress were associated with frailty in older adults. Stress management efforts may help improve frailty in this population.

## ACKNOWLEDGMENTS

### CONFLICT OF INTEREST

The researchers claim no conflicts of interest.

### FUNDING

None.

### AUTHOR CONTRIBUTIONS

Conceptualization, SHL, JS, JKC; Data curation, SU, HRS, YSK; Investigation, SU, HRS, YSK; Methodology, SHL, JKC; Supervision, JKC; Writing-original draft, SHL, JKC; Writing-review & editing, SHL, JS, JKC.

## REFERENCES

- Walston J, Hadley EC, Ferrucci L, Guralnik JM, Newman AB, Studenski SA, et al. Research agenda for frailty in older adults: toward a better understanding of physiology and etiology: summary from the American Geriatrics Society/National Institute on Aging Research Conference on Frailty in Older Adults. *J Am Geriatr Soc* 2006;54:991-1001.
- Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. *Lancet* 2013;381:752-62.
- Won CW. Frailty: its scope and implications for geriatricians. *Ann Geriatr Med Res* 2019;23:95-7.
- Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001;56:M146-56.

5. Ni Mhaolain AM, Fan CW, Romero-Ortuno R, Cogan L, Cunningham C, Kenny RA, et al. Frailty, depression, and anxiety in later life. *Int Psychogeriatr* 2012;24:1265-74.
6. Tao A, Ho KH, Yang C, Chan HY. Effects of non-pharmacological interventions on psychological outcomes among older people with frailty: a systematic review and meta-analysis. *Int J Nurs Stud* 2023;140:104437.
7. Borges MK, Aprahamian I, Romanini CV, Oliveira FM, Mingardi SV, Lima NA, et al. Depression as a determinant of frailty in late life. *Aging Ment Health* 2021;25:2279-85.
8. Lazarus RS, Folkman S. *Stress, coping and adaptation*. New York (NY): Springer; 1984.
9. Cohen S. Perceived stress in a probability sample of the United States. In: Spacapan S, Oskamp S, editors. *The social psychology of health*. Newbury Park (CA): Sage Publications; 1984. p. 31-67.
10. Lee J, Shin C, Ko YH, Lim J, Joe SH, Kim S, et al. The reliability and validity studies of the Korean version of the perceived stress scale. *Korean J Psychosom Med* 2012;20:127-34.
11. Hwang HS, Kwon IS, Park BJ, Cho B, Yoon JL, Won CW. The validity and reliability of Korean frailty index. *J Korean Geriatr Soc* 2010;14:191-202.
12. Kim OS. Korean version of the revised UCLA loneliness scale: reliability and validity test. *J Nurs Acad Soc* 1997;27:871-9.
13. Kohout FJ, Berkman LF, Evans DA, Cornoni-Huntley J. Two shorter forms of the CES-D (Center for Epidemiological Studies Depression) depression symptoms index. *J Aging Health* 1993;5:179-93.
14. Cho MJ, Kim KH. Diagnostic validity of the CES-D (Korean version) in the assessment of DSM-III-R major depression. *J Korean Neuropsychiatr Assoc* 1993;32:381-99.
15. Won HJ. The effects of leisure participation of Seoul metropolitan area's senior residents on their loneliness, leisure satisfaction, and life satisfaction. *J Korea Gerontol Soc* 1994;14:90-104.
16. Kobau R, Sniezek J, Zack MM, Lucas RE, Burns A. Well-being assessment: an evaluation of well-being scales for public health and population estimates of well-being among US adults. *Appl Psychol Health Well Being* 2010;2:272-97.
17. Noh JH, Jung HW, Ga H, Lim JY. Ethical guidelines for publishing in the *Annals of Geriatric Medicine and Research*. *Ann Geriatr Med Res* 2022;26:1-3.
18. Hoogendijk EO, van Hout HP, Heymans MW, van der Horst HE, Frijters DH, Broese van Groenou MI, et al. Explaining the association between educational level and frailty in older adults: results from a 13-year longitudinal study in the Netherlands. *Ann Epidemiol* 2014;24:538-44.
19. Soysal P, Veronese N, Thompson T, Kahl KG, Fernandes BS, Prina AM, et al. Relationship between depression and frailty in older adults: a systematic review and meta-analysis. *Ageing Res Rev* 2017;36:78-87.
20. Gale CR, Westbury L, Cooper C. Social isolation and loneliness as risk factors for the progression of frailty: the English Longitudinal Study of Ageing. *Age Ageing* 2018;47:392-7.
21. Qin W, Xu L, Sun L, Li J, Ding G, Wang Q, et al. Association between frailty and life satisfaction among older people in Shandong, China: the differences in age and general self-efficacy. *Psychogeriatrics* 2020;20:172-9.
22. Desrichard O, Vallet F, Agrigoroaei S, Fagot D, Spini D. Frailty in aging and its influence on perceived stress exposure and stress-related symptoms: evidence from the Swiss Vivre/Leben/Vivere study. *Eur J Ageing* 2018;15:331-8.
23. Bergman H, Ferrucci L, Guralnik J, Hogan DB, Hummel S, Karunanathan S, et al. Frailty: an emerging research and clinical paradigm: issues and controversies. *J Gerontol A Biol Sci Med Sci* 2007;62:731-7.
24. Lamberts SW. The endocrinology of aging and the brain. *Arch Neurol* 2002;59:1709-11.
25. Varadhan R, Walston J, Cappola AR, Carlson MC, Wand GS, Fried LP. Higher levels and blunted diurnal variation of cortisol in frail older women. *J Gerontol A Biol Sci Med Sci* 2008;63:190-5.
26. Johar H, Emeny RT, Bidlingmaier M, Reincke M, Thorand B, Peters A, et al. Blunted diurnal cortisol pattern is associated with frailty: a cross-sectional study of 745 participants aged 65 to 90 years. *J Clin Endocrinol Metab* 2014;99:E464-8.
27. Ki S, Yun JH, Lee Y, Won CW, Kim M, Kim CO, et al. Development of guidelines on the primary prevention of frailty in community-dwelling older adults. *Ann Geriatr Med Res* 2021;25:237-44.