Japanese Journal of Comprehensive Rehabilitation Science (2023)

Original Article

Effect of cognitive impairment at admission on activities of daily living at discharge in older patients with heart failure

Yuki Nonaka, PT, MS,[1,2] Ren Fujii, PT, PhD,[2] Shinichiro Tanaka, MD,[2] Kazuyuki Tabira, PT, PhD[1]

[1]Graduate School of Health Science, Kio University, Koryo, Nara, Japan
[2]Musashigaoka Clinical Research Center, Medical Corporation Tanakakai, Musashigaoka Hospital, Kumamoto, Kumamoto, Japan

ABSTRACT

Nonaka Y, Fujii R, Tanaka S, Tabira K. Effect of cognitive impairment at admission on activities of daily living at discharge in older patients with heart failure. Jpn J Compr Rehabil Sci 2023; 14: 78−83.

Objective: Hasegawa's Dementia Scale-Revised (HDS-R) is widely used as a screening test for cognitive function in older adults. In this study, we examined the effect of cognitive impairment (CI) at admission on activities of daily living (ADL) at discharge in older patients with heart failure (HF).

Methods: This retrospective observational study included 394 patients hospitalized for acute decompensated HF between April 2016 and December 2022. Data on age, sex, body mass index, length of hospital stay, initiation of rehabilitation, New York Heart Association (NYHA) class, Charlson Comorbidity Index, medication, brain natriuretic peptide levels, left ventricular ejection fraction, renal function, hemoglobin level, serum albumin level, Geriatric Nutritional Risk Index (GNRI), Barthel Index (BI), and HDS-R score were analyzed using the χ^2 test, unpaired *t* test, Mann—Whitney *U* test, and multiple linear regression.

Results: Among 394 patients, 102 who met the final inclusion criteria were included in the study. Based on previous studies, patients were divided into a high BI group ($N = 44$) and a low BI group ($N = 58$). Multiple linear regression analysis showed that CI at admission independently affected BI at discharge even after adjusting for confounding effects of age, NYHA class, GNRI, and BI at admission.

Conclusions: Our study showed that the presence or absence of CI may influence ADL improvement in rehabilitation interventions aimed at improving ADL in older patients with HF.

Key words: heart failure, older adults, activities of daily living, cognitive impairment

Correspondence: Yuki Nonaka, PT, MS
Musashigaoka Clinical Research Center, Medical Corporation Tanakakai Musashigaoka Hospital, 7−15−1 Kusunoki, Kita-ku, Kumamoto, Kumamoto 861−8003, Japan.
E-mail: y.nonaka0129@gmail.com
Accepted: October 6, 2023.
Conflict of interest: There are no conflicts of interest to disclose in this study.

Introduction

Japan has the highest life expectancy in the world and a low birth rate, resulting in an aging population. Thus, the number of patients with heart failure (HF) and dementia is increasing and has become a public health concern. HF is a leading cause of hospitalization and death among older adults worldwide, and the number of patients with HF in Japan is expected to reach 1.28 million by 2025 [1, 2]. Patients with HF in Japan are characterized by advanced age, dementia, multiple comorbidities, impaired physical function and activities of daily living (ADL), and repeated hospitalizations and discharges within a short period of time [3, 4].

As of 2013, the prevalence of dementia in the Japanese population was between 2.9 and 12.5% and is expected to increase in the future; however, data on the exact prevalence in recent years are not available [5]. Over the next 25 years, the prevalence of dementia among Japanese seniors aged 65 years and older is expected to exceed 25% [6]. Recent advances in the treatment of HF have resulted in an aging population of patients with HF, and cognitive impairment (CI) in these patients is a growing concern. Patients with HF are considered to be more likely to have CI [1, 7−10]. However, the incidence of cognitive dysfunction in patients with HF has been reported to be 25−80%, indicating there is no consensus [10−15]. Several reasons may account for this, including the methods used to assess cognitive function, the state of HF at the time of measurement (e.g., history and severity of

doi.org/10.11336/jjcrs.14.78

illness), and the effect of comorbidities. However, having CI may lead to a lack of self-care and inadequate self-management, such as medication administration and salt restriction, which may result in early readmission after discharge from hospital. Therefore, assessing cognitive function in patients with HF is important, and providing appropriate support based on cognitive function after it has been assessed during hospitalization is desirable.

One of the goals of cardiac rehabilitation (CR) is to improve ADL because ADL independently affects the risk of readmission in older patients with HF [3]. Therefore, maintaining and improving ADL during hospitalization by performing CR during hospitalization is extremely important. A previous study reported that a low Short Physical Performance Battery (SPPB) score is strongly associated with lower ADL in the future [16]. In contrast, CI is a risk factor for ADL decline in older adults [17]; however, the relationship between CI and ADL in older patients with HF is unclear. Furthermore, it is unclear to what extent the presence or absence of CI affects ADL improvement during hospitalization in patients with HF, although it has been reported that patients with HF had more CI than healthy individuals even after adjusting for age, sex, comorbidities, and other factors [18]. A previous report showed an association between the 6-minute walk distance and cognitive function in patients with HF [19]. Furthermore, cognitive function in patients with HF is associated with adverse outcomes such as hospital readmission and death [20], and cognitive decline may also affect ADL improvement.

This study investigated the effect of CI at admission on ADL at discharge in hospitalized older patients with HF. We hypothesized that the presence or absence of CI at admission influences whether older patients with HF are independent in ADL at discharge.

Methods

1. Study design and participants

This retrospective study included 394 HF patients with acute decompensated HF (ADHF) admitted to a community-based hospital in Kumamoto, Japan, between April 2016 and December 2022. ADHF was diagnosed by an experienced physician based on the Framingham criteria and Japanese guidelines [21]. The criteria for inclusion in the study were (1) age 65 years or older and (2) ability to walk independently or with assistance. Exclusion criteria were (1) missing data, (2) death during hospitalization, and (3) not requiring rehabilitation during hospitalization.

Rehabilitation was started when the patient's general condition was stabilized by HF treatment and the rehabilitation order was issued by the attending physician and was performed by physiotherapists and occupational therapists, focusing on resistance training, aerobic exercise, and ADL training. Exercise intensity and stopping criteria were determined by the attending physicians and cardiologists according to the Japanese guidelines for CR [22].

2. Ethics approval

In accordance with the Declaration of Helsinki, this study was conducted with approval by the Ethics Committee of Medical Corporation Tanakakai Musashigaoka Hospital (approval number: 2022-6).

3. Variables

Age, sex, body mass index, length of hospital stay, initiation of rehabilitation, New York Heart Association (NYHA) class, Charlson Comorbidity Index, medication, brain natriuretic peptide (BNP), left ventricular ejection fraction (LVEF), creatinine, hemoglobin, serum albumin, and blood urea nitrogen levels, estimated glomerular filtration rate, Geriatric Nutritional Risk Index (GNRI), Barthel Index (BI), and Hasegawa's dementia Scale-Revised (HDS-R) score were collected from medical records. The NYHA class was determined by an experienced cardiologist and certified physiotherapist Registered Instructor of Cardiac Rehabilitation. Admission and discharge data were used to determine the BI, and other variables were obtained from the admission data. Assessment of cognitive function was measured at the time of initiation of rehabilitation after treatment for ADHF.

4. Statistical analysis

Patient characteristics and clinical parameters are presented as mean ± standard deviation or median [interquartile range] according to the Shapiro—Wilk test results. Medications are expressed as numbers (percentages), and sex, NYHA class, and CI are expressed as numbers. Patients were divided into two groups based on the BI score cutoff used in previous studies [24], and patient characteristics and clinical parameters were compared between the two groups using the χ^2 test, unpaired *t* test, and Mann—Whitney *U* test. Multiple linear regression analysis was then performed to determine whether CI at admission was independently associated with the BI score at discharge. Covariates selected to adjust for bias were age, sex, GNRI, NYHA class, and admission BI score.

All statistical analyses were performed with R-2.8.1. For all analyses, p values < 0.05 indicated a statistically significant difference.

Results

1. Baseline characteristics

Among 394 patients admitted with ADHF during the study period, 228 met the inclusion criteria. Based on exclusion criteria, 126 patients were excluded because of failure to consent to the study (N = 1), transfer to another hospital or death during hospitalization (N = 44), missing data (N = 75), and no prescribed rehabilitation during hospitalization (N = 6). Data of 102 patients were finally included in the analysis (Figure 1).

The median age of all participants was 87.0 [82−87] years, and 52.0% were female. Based on the findings of previous studies [24], participants were divided into two groups: those who were independent in ADL at discharge (independent group [BI ≥ 85]: N = 44) and those who were not independent in ADL at discharge (non-independent group [BI < 85]: N = 58). Discharge criteria were determined by the treating physician, who judged that the patient's general condition had stabilized after HF treatment and that the patient could be discharged. The baseline characteristics of the independent and non-independent groups are shown in Table 1. At discharge, 43.1% of all patients were independent in ADL (male: 18, female: 26).

The non-independent group was older than the independent group (p < 0.001), had higher NYHA class severity (p < 0.001), worse nutritional status on admission (albumin: p < 0.001, GNRI: p = 0.003), lower HDS-R score on admission, and lower BI scores on admission and discharge (all p < 0.001). In addition, CI based on HDS-R cutoffs was significantly more frequent in the non-independent group (p < 0.001). There were no significant differences in BNP level or LVEF between the two groups (BNP: p = 0.084, LVEF: p = 0.598).

2. Relationship between CI and ADL

The results of the multiple linear regression analysis are shown in Table 2. Multiple linear regression analysis was performed to determine whether CI at admission was independently associated with BI score at discharge. Covariates selected to adjust for bias were age, sex, GNRI, NYHA class, and BI score at admission. The analysis showed that CI at admission was independently associated with BI score at discharge, even after accounting for the effects of age, NYHA class, nutrition, and ADL at admission (B = −6.949; 95% confidence interval, −12.962 to −0.936; β = −0.158, p = 0.023).

Discussion

To the best of our knowledge, this is the first study to report that the presence or absence of CI at admission affects ADL independence at discharge in older patients with HF. The main study finding was that the presence or absence of CI at admission was independently associated with ADL independence at discharge in hospitalized older patients with HF even after adjusting for multiple factors such as age, sex, NYHA class, GNRI, and BI score at admission. The study results highlight the importance of considering the presence or absence of CI in treatment strategies and discharge support for older patients with HF.

In this study, CI was found in 39.2% of the participants. This result is similar to the findings of previous studies and suggests the validity of our study [15]. CI is an important comorbidity in patients with HF and an independent prognostic factor for adverse events [23]. A multicenter study in Japan showed that patients with HF who had both CI and a decline in physical function, as determined by SPPB score, gait speed, and grip strength, had a 1.55-fold increased risk of events such as readmission and death within 1 year [20]. CI has also been reported to be associated with decreased instrumental ADL in patients with HF [24]. In addition, it has been reported that CI in patients with HF undergoing CR impairs the improvement of exercise tolerance [25]. Considering the results of this

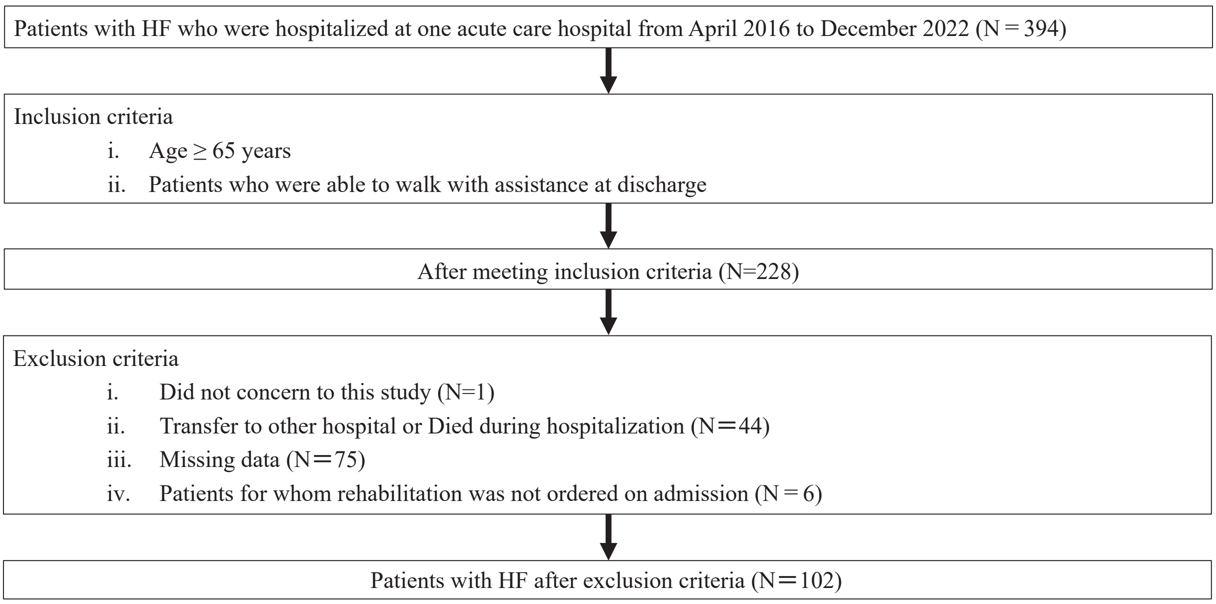

Figure 1. Flowchart of the patient selection.

Table 1. Patient characteristics stratified by ADL independence or non-independence at discharge.

Variables	Overall (*n*=102)	BI≥85 (*n*=44)	BI<85 (*n*=58)	*P* Value
Clinical parameter				
Age, (yr)	87.0 [82–90]	83.5 [79–88]	88 [84–91]	< 0.001
Sex (male/female)	49/53	18/26	31/27	0.235
BMI, (kg/m2)	22.8 [19.8–26.3]	23.9 [19.9–27.0]	22.5 [19.1–24.5]	0.145
Length of hospital stay, (d)	23 [17–38]	22 [16–30]	27 [18–40]	0.334
Initiation of rehabilitation, (d)	4 [2–7]	4 [2–6]	5 [3–7]	0.168
NYHA class (I/II/III/IV)	0/55/47/0	0/39/23/0	0/16/24/0	< 0.001
Comorbidity				
CCI	2 [2−3]	2 [2−3]	2 [2−3]	0.104
Medication				
β-Blocker	51 (50.0)	21 (47.7)	30 (51.7)	0.842
ACE-I/ARB	42 (41.2)	18 (40.9)	24 (41.4)	> 0.999
Diuretic	80 (78.4)	33 (75.0)	47 (81.0)	0.477
Cardiac function				
LVEF, (%)	64.0 [56.0–73.0]	64.0 [56.0–70.5]	64.0 [55.0–73.0]	0.598
Laboratory data				
BNP, (pg/mL)	310.0 [163.0–483.0]	274.0 [152.0–404.0]	333.0 [187.0–540.0]	0.084
Cr, (g/dL)	1.1 [0.7–1.4]	1.0 [0.7–1.2]	1.0 [0.8–1.5]	0.463
BUN, (g/dL)	20.8 [16.0–28.3]	19.0 [15.7–24.7]	22.4 [16.0–30.7]	0.186
eGFR, (mL/min/1.73 m2)	44.3 ± 18.5	45.3 ± 19.5	43.4 ± 18.0	0.612
Hb, (g/dL)	11.4 ± 1.7	11.6 ± 2.1	11.3 ± 1.4	0.271
Nutrition				
Alb, (g/dL)	3.4 ± 0.5	3.6 ± 0.5	3.3 ± 0.5	< 0.001
GNRI	90.0 ± 8.8	92.9 ± 8.0	87.8 ± 8.9	0.003
ADL and cognitive function				
BI score at admission	48.4 ± 23.5	64.9 ± 18.9	35.9 ± 18.3	< 0.001
BI score at discharge	80 [60–90]	95 [90–100]	60 [50–75]	< 0.001
HDS-R score	20.8 ± 6.4	23.7 ± 4.1	18.7 ± 7.1	< 0.001
CI at admission	40	8	32	< 0.001

Data are presented as mean ± standard deviation or median [25–75 percentile (inter- quartile range, IQR)] or number (percentage).
ACE-I, angiotensin-converting enzyme inhibitor; Alb, albumin; ARB, angiotensin receptor blocker; BI, Barthel index; BMI, body mass index; BNP, brain natriuretic peptide; BUN, blood urea nitrogen; CCI, Charlson comorbidity index; CI, cognitive impairment; Cr, creatinine; eGFR, estimated glomerular filtration rate; GNRI, geriatric nutritional risk index; Hb, hemoglobin; HDS-R, revised hasegawa dementia scale; LVEF, left ventricular ejection fraction; NYHA, New York Heart Association

Table 2. Examining factors associated with ADL at discharge using multiple liner regression analysis.

Variables	B	95% Confidence Interval	SE	β	*P* Value
Age, (yr)	−0.569	−1.007, −0.132	0.220	−0.183	0.011
Sex, (male/female)	−0.037	−5.982, 5.907	2.994	0.0004	0.990
NYHA	−9.664	−15.712, −3.616	3.046	−0.241	0.002
GNRI	0.439	0.106, 0.772	0.167	0.181	0.010
BI score at admission	0.406	0.271, 0.542	0.068	0.442	<0.001
CI at admission	−6.949	−12.962, −0.936	3.028	−0.158	0.023

adjusted R^2: 0.564, P<0.001
BI, Barthel index; CI, cognitive impairment; GNRI, geriatric nutritional risk index; NYHA, New York Heart Association.

study, it is necessary to evaluate CI at the time of admission and provide discharge support, considering that the patient may be less likely to benefit from CR because the presence of CI affects the CR-induced improvement of physical function and ADL, as well as prognostic parameters including readmission rate and mortality.

Recently, the relationship between mild cognitive impairment (MCI), a prodromal symptom of CI, and physical function has attracted attention. Yokota et al. reported that CR for patients with HF improved BI, SPPB, and exercise tolerance independent of the presence of MCI [26]. Considering the findings of previous reports and the results of this study, it is considered necessary to provide appropriate intervention at the time of MCI, i.e., before CI, to maintain physical function and ADL in patients with HF. However, the effect of aging cannot be excluded because in previous studies, the changes in physical function and ADL over time and the effect of cognitive function over time were unknown. Therefore, further research on the relationship among physical function, ADL, and cognitive function in older patients with HF is important from the perspective of medical costs and healthy life expectancy in Japan, the country with the longest life expectancy in the world.

The main study finding was that CI at admission affected ADL independence at discharge, even after adjusting for various factors. Previous studies have shown that factors influencing ADL at discharge include age and ADL ability at admission [27, 28]. In addition, NYHA class has been shown to be associated with exercise tolerance and prognosis [29]. In the present study, these factors were adjusted for in the analysis. Multivariate analysis showed that CI at admission affected ADL independence at discharge, even after adjustment for various confounders. Although CI is a risk factor for ADL decline in older adults [17], the relationship between cognitive function and ADL in patients with HF has only been partially reported and remains unclear. CI in patients with HF may be affected by hypoperfusion due to decreased cardiac output, but there is no consensus [30]. The prevalence of CI is higher in older patients with HF than in those without HF [18]. Therefore, addressing both physical and cognitive function in patients with HF may be important. Furthermore, exercise therapy improves cognitive function in older adults, and combining exercise training with cognitive training positively affects cognitive function [31, 32]. However, it is unclear whether similar interventions can improve cognitive function in patients with HF; further research is needed to determine whether specific interventions for cognitive function may be useful as a treatment for patients with HF.

This study had several limitations. First, this was an observational study conducted at a single center with a small number of patients, and so the results may not be generalizable. Second, CI in this study was defined based on the HDS-R score. In addition, detailed assessments such as brain imaging were not available. Therefore, we cannot exclude the possibility that the results of this study were affected by the assessment tools used. Third, we could not exclude the possibility that the prevalence of CI in this study was due to cerebrovascular disease because we did not exclude patients with pre-existing cerebrovascular disease. Fourth, it was unclear whether the BI is appropriate for assessing ADL of patients with CI. Fifth, there were no accurate data on participants' ADL before admission, and the non-independent group may have had a lower BI score before admission, which may have affected the results of this study. However, this bias may have been minimized by the inclusion criterion "ability to walk." Finally, it was not possible to examine whether CR improved CI. All participants underwent CR during hospitalization, but cognitive assessment at discharge was not used in this study due to many missing data. The importance of cognitive training for patients with HF has been demonstrated as improved cognitive function may be beneficial in improving medication management in HF [33]. In addition, there are individual differences in the amount and frequency of CR that we were not able to account for in our analysis of the data. Further studies are needed to clarify the mechanisms of CI in patients with HF, whether CR can have a positive effect on cognitive function, and the effectiveness of specific interventions on cognitive function.

Conclusion

In conclusion, this study demonstrated that the presence or absence of CI at admission affects ADL independence at discharge in older patients with HF, even after adjusting for multiple factors such as age, NYHA class, GNRI, and BI score at admission. Further studies are needed to determine whether CI is a target for therapeutic intervention in older patients with HF and how CI is affected by CR.

Acknowledgements

The authors thank the rehabilitation staff of Musashigaoka Hospital for assistance in data collection in this study and the Tabira Laboratory, Graduate School of Kio University for their advice in writing this manuscript.

References

1. Butrous H, Hummel SL. Heart failure in older adults. Can J Cardiol 2016; 32: 1140−7.
2. Okura Y, Ramadan MM, Ohno Y, Mitsuma W, Tanaka K, Ito M, et al. Impending epidemic: future projection of heart failure in Japan to the year 2055. Circ J 2008; 72: 489−91.
3. Kitamura M, Izawa KP, Taniue H, Mimura Y, Imamura K, Nagashima H, et al. Relationship between Activities of Daily Living and readmission within 90 days in hospitalized elderly patients with heart failure. BioMed Res Int 2017; 2017: 7420738.
4. Nonaka Y, Oike T, Tanaka S, Tabira T. Characteristics of older patients with heart failure readmitted due to acute exacerbations within the past year. Phys Ther Res 2023; 26: 17−23.
5. Okamura H, Ishii S, Ishii T, Eboshida A. Prevalence of dementia in Japan: a systematic review. Dement Geriatr Cogn Diord 2013; 36: 111−8.
6. Nakahori N, Sekine M, Yamada M, Tatsuse T, Kido H, Suzuki M. Future projections of the prevalence of

dementia in Japan: results from the Toyama Dementia Survey. BMC Geriatr 2021; 21: 602.
7. Harkness K, Heckman GA, McKelvie RS. The older patient with heart failure: high risk for frailty and cognitive impairment. Expert Rev Cardiovasc Ther 2012; 10: 779–95.
8. Heckman GA, McKelvie RS, Rockwood K. Individualizing the care of older heart failure patients. Curr Opin Cardiol 2018; 33: 208–16.
9. Hajduk AM, Kiefe CI, Person SD, Gore JG, Saczynski JS. Cognitive change in heart failure: a systematic review. Circ Cardiovasc Qual Outcomes 2013; 6: 451–60.
10. Hill E, Taylor J. Chronic heart failure care planning: considerations in older patients. Card Fail Rev 2017; 3: 46–51.
11. Sze S, Zhang J, Pellicori P, Morgan D, Hoye A, Clark AL. Prognostic value of simple frailty and malnutrition screening tools in patients with acute heart failure due to left ventricular systolic dysfunction. Clin Res Cardiol 2017; 106: 533–41.
12. Cameron J, Gallagher R, Pressler SJ. Detecting and managing cognitive impairment to improve engagement in heart failure self-care. Curr Heart Fail Rep 2017; 14: 13–22.
13. Ampadu J, Morley JE. Heart failure and cognitive dysfunction. Int J Cardiol 2015; 178: 12–23.
14. González-Moneo MJ, Sánchez-Benavides G, Verdu-Rotellar JM, Cladellas M, Bruguera J, Quiñones-Ubeda S, et al. Ischemic aetiology, self-reported frailty, and gender with respect to cognitive impairment in chronic heart failure patients. BMC Cardiovasc Disord 2016; 16: 163.
15. Matsue Y, Kamiya K, Saito H, Saito K, Ogasahara Y, Maekawa E, et al. Prevalence and prognostic impact of the coexistence of multiple frailty domains in elderly patients with heart failure: the FRAGILE-HF cohort study. Eur J Heart Fail 2020; 22: 2112–9.
16. Wang DXM, Yao J, Zirek Y, Reijnierse EM, Maier AB. Muscle mass, strength, and physical performance predicting activities of daily living: a meta-analysis. J Cachexia Sarcopenia Muscle 2020; 11: 3–25.
17. Provencher V, Sirois MJ, Ouellet MC, Camden S, Neveu X, Allain-Boul N, et al. Decline in activities of daily living after a visit to a Canadian emergency department for minor injuries in independent older adults: are frail older adults with cognitive impairment at greater risk? J Am Geriatr Soc 2015; 63: 860–8.
18. Cannon JA, Moffitt P, Perez-Moreno AC, Walters MR, Broomfield NM, McMurray JJV, Quinn TJ. Cognitive impairment and heart failure: systematic review and meta-analysis. J Card Fail 2017; 23: 464–75.
19. Baldasseroni S, Mossello E, Romboli B, Orso F, Colombi C, Fumagalli S, et al. Relationship between cognitive function and 6-minute walking test in older outpatients with chronic heart failure. Aging Clin Exp Res 2010; 22: 308–13.
20. Yamamoto S, Yamasaki S, Higuchi S, Kamiya K, Saito H, Saito K, et al. Prevalence and prognostic impact of cognitive frailty in elderly patients with heart failure: sub-analysis of FRAGILE-HF. ESC Heart Fail 2022; 9: 1574–83.
21. Tsutsui H, Isobe M, Ito H, Ito H, Okumura K, Ono M, et al. JCS 2017/JHFS 2017 guideline on diagnosis and treatment of acute and chronic heart failure- digest version. Circ J 2019; 83: 2084–184.
22. Makita S, Yasu T, Akashi YJ, Adachi H, Izawa H, Ishihara S, et al. Corrigendum: JCS/JACR 2021 Guideline on rehabilitation in patients with cardiovascular disease. Circ J 2023; 87: 937.
23. Liori S, Melainis AA, Bistola V, Polyzogopoulou E, Parissis J. Cognitive impairment in heart failure: clinical implications, tools of assessment, and therapeutic considerations. Heart Fail Rev 2022; 27: 993–9.
24. Alosco ML, Spitznagel MB, Cohen R, Sweet LH, Colbert LH, Josephson R, et al. Cognitive impairment is independently associated with reduced instrumental ADLs in persons with heart failure. J Cardiovasc Nurs 2012; 27: 44–50.
25. Caminiti G, Ranghi F, Benedetti SD, Battaglia D, Arisi A, Franchini A, et al. Cognitive impairment affects physical recovery of patients with heart failure undergoing intensive cardiac rehabilitation. Rehabil Res Pract 2012; 2012: 218928.
26. Yokota J, Takahashi R, Chiba T, Matsushima K. Mild cognitive impairment in patients with acute heart failure does not limit the effectiveness of early phase ii cardiac rehabilitation. Eur J Phys Rehabil Med 2022; 58: 470–7.
27. Kitamura M, Izawa KP, Ishihara K, Yaekura M, Nagashima H, Yoshizawa T, et al. Predictors of activities of daily living at discharge in elderly patients with heart failure with preserved ejection fraction. Heart Vessels 2021; 36: 509–17.
28. Katano S, Hashimoto A, Ohori K, Watanabe A, Honma R, Yanase R, et al. Nutritional status and energy intake as predictors of functional status after cardiac rehabilitation in elderly inpatients with heart failure— a retrospective cohort study. Circ J 2018; 82: 1584–91.
29. Makita, S, Yasu, T, Akashi YJ, Adachi H, Izawa H, Ishihara S, et al. JCS/JACR 2021 Guideline on rehabilitation in patients with cardiovascular disease. Circ J 2022; 87: 155–235.
30. Ovsenik A, Podbregar M, Fabjan A. Cerebral blood flow impairment and cognitive decline in heart failure. Brain Behav 2021; 11: e02176.
31. Huang X, Zhao X, Li B, Cai Y, Zhang S, Wan Q, et al. Comparative efficacy of various exercise interventions on cognitive function in patients with mild cognitive impairment or dementia: a systematic review and network meta-analysis. J Sport Health Sci 2022; 11: 212–23.
32. Karssemeijer EGA, Aaronson JA, Bossers WJ, Smits T, Olde Rikkert MGM, Kessels RPC. Positive effects of combined cognitive and physical exercise training on cognitive function in older adults with mild cognitive impairment or dementia: a meta-analysis. Ageing Res Rev 2017; 40: 75–83.
33. Mene-Afejuku TO, Pernia M, Ibebuogu UN, Chaudhali S, Mushiyev S, Visco F, et al. Heart failure and cognitive impairment: clinical relevance and therapeutic considerations. Curr Cardiol Rev 2019; 15: 291–303.