European Journal of Cardiovascular Nursing (2025) **00**, 1–10
https://doi.org/10.1093/eurjcn/zvaf112

ORIGINAL RESEARCH

Affective symptoms, cognitive function and self-care behaviours in adults with heart failure according to ejection fraction phenotype

Maria Jędrzejczyk[1], Christopher S. Lee[2], Quin E. Denfeld [3], Remigiusz Szczepanowski[4,5], Bernadetta Żółkowska[1], Michał Czapla [6,7,8]*, Ercole Vellone [1,9], Marta Wleklik[1], Magdalena Lisiak[1,6], and Izabella Uchmanowicz[1,10]

[1]Division of Research Methodology, Department of Nursing, Faculty of Nursing and Midwifery, Wroclaw Medical University, Wroclaw 51-618, Poland; [2]William F. Connell School of Nursing, Boston College, Chestnut Hill, MA, USA; [3]School of Nursing and Knight Cardiovascular Institute, Oregon Health and Science University, Portland, OR, USA; [4]Department of Computer Science and Systems Engineering, Wroclaw University of Science and Technology, Wroclaw, Poland; [5]The J. Gromkowski Provincial Specialist Hospital, Wroclaw, Poland; [6]Institute of Heart Diseases, University Hospital, Wroclaw, Poland; [7]Department Division of Scientific Research and Innovation in Emergency Medical Service, Department of Emergency Medical Service, Faculty of Nursing and Midwifery, Wroclaw Medical University, Parkowa 34, Wroclaw 51-618, Poland; [8]Group of Research in Care (GRUPAC), Faculty of Health Science, University of La Rioja, Logroño, Spain; [9]Department of Biomedicine and Prevention, University of Rome Tor Vergata, Rome, Italy; and [10]Centre for Cardiovascular Health, Edinburgh Napier University, Sighthill Campus, Edinburgh EH11 4DN, UK

Received 10 December 2024; revised 9 March 2025; accepted 7 June 2025; published 16 June 2025

Aims

The aim of this study was to compare affective symptoms, cognitive dysfunction, and self-care behaviours among different heart failure (HF) phenotypes and to explore their interrelationships, particularly examining how cognitive and affective factors influence self-care practices.

Methods and results

This cross-sectional study involved 250 older adults hospitalized for acute decompensated HF, categorized into three groups based on left ventricular ejection fraction (EF): HF with reduced EF (HFrEF), mildly reduced EF (HFmrEF), and preserved EF (HFpEF). Affective symptoms were assessed using the Hospital Anxiety and Depression Scale and Patient Health Questionnaire-9 (PHQ-9), while cognitive function was evaluated with the Montreal Cognitive Assessment (MoCA) and Mini-Mental State Examination (MMSE). Self-care behaviours were measured using the European Heart Failure Self-Care Behavior Scale. Among participants, 42% had HFrEF, 18.4% had HFmrEF, and 39.6% had HFpEF. Cognitive dysfunction was more pronounced in HFpEF patients (MMSE median = 28.0, IQR = 26.0–29.0) compared with those with HFrEF (median = 28.0, IQR = 27.0–29.0) or HFmrEF (median = 29.0, IQR = 27.3–29.0, $P = 0.008$). Higher MMSE scores were significantly associated with better self-care behaviours in HFpEF patients (Spearman's $r = -0.299$, $P = 0.003$) but not in the other groups. Significant differences were found in specific self-care behaviours, including contacting healthcare providers and adherence to a low-sodium diet.

Conclusion

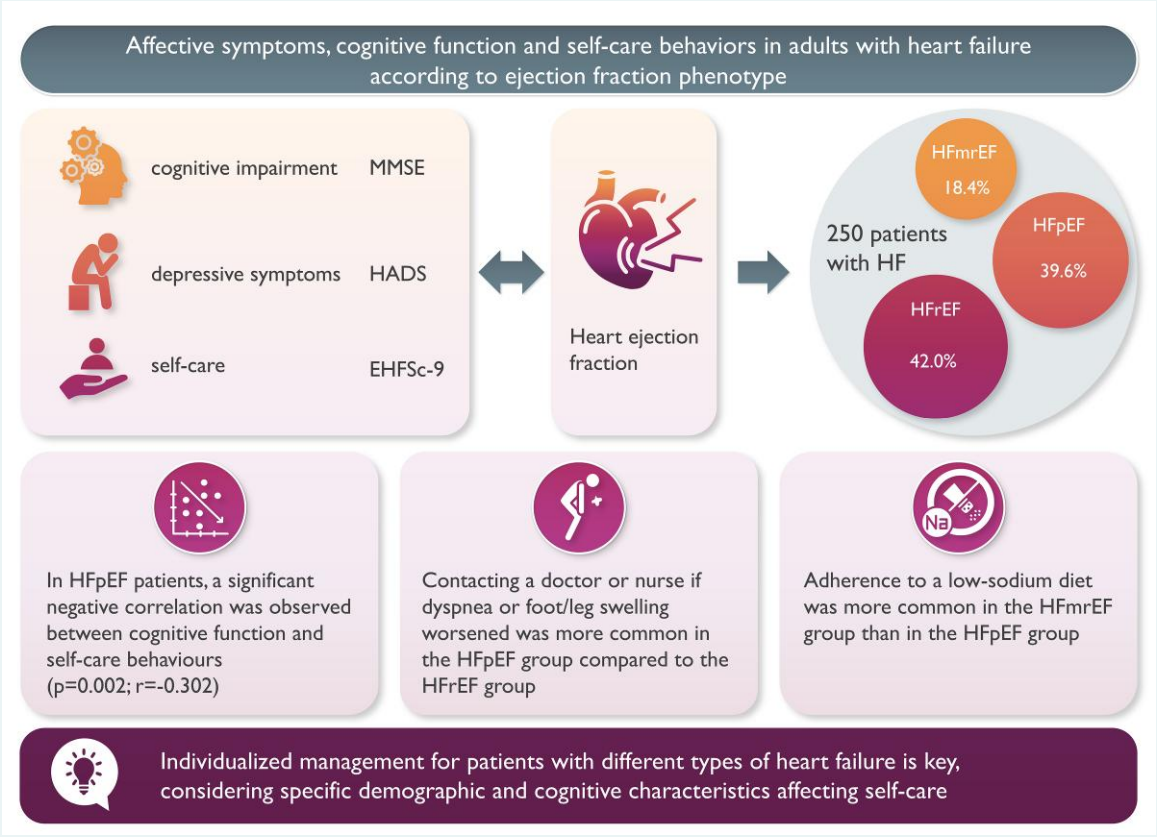
Although variations in cognitive function and self-care behaviors were observed across HF phenotypes, these differences were not statistically significant after adjusting for demographic and clinical factors. Tailored interventions should be based on a comprehensive assessment of cognitive and emotional health, rather than HF phenotype alone.

* Corresponding author. Tel: 71 346 82 75, Email: michal.czapla@umw.edu.pl

© The Author(s) 2025. Published by Oxford University Press on behalf of the European Society of Cardiology.
This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial License (https://creativecommons.org/licenses/by-nc/4.0/), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact reprints@oup.com for reprints and translation rights for reprints. All other permissions can be obtained through our RightsLink service via the Permissions link on the article page on our site—for further information please contact journals.permissions@oup.com.

Downloaded from https://academic.oup.com/eurjcn/advance-article/doi/10.1093/eurjcn/zvaf112/8163918 by University of Rome II Tor Vergata user on 01 July 2025

Graphical Abstract



Keywords Affective symptoms • Cognitive function • Ejection fraction phenotype • Heart failure • Self-care behaviours

Novelty

- This study provides new insights into the association between cognitive dysfunction and self-care behaviours in heart failure (HF), focusing specifically on the HF with preserved EF (HFpEF) phenotype, which has been underexplored in this context.
- It reveals that cognitive dysfunction is more prominent in HFpEF patients compared with other HF phenotypes, advancing our understanding of the unique challenges faced by this subgroup.
- The research highlights the critical role of cognitive function in shaping self-care behaviours, suggesting the need for targeted cognitive support in the management of HFpEF.
- By emphasizing phenotype-specific approaches, the study contributes to the development of tailored interventions aimed at improving self-care and health outcomes in HF patients.

Introduction

Heart failure (HF) is a major public health challenge worldwide. In Europe, more than 15 million people live with HF.[1] Due to demographic changes, longer life expectancy, improved survival rates for patients with acute cardiac conditions, and advances in HF diagnostics, it is expected that the number of HF patients will invariably increase. Older adults with HF are particularly at risk for persistent poor clinical outcomes and delayed recovery.[2] Affective symptoms and cognitive dysfunction are common and known barriers to effective self-care behaviours, especially among older adults with HF.[3,4] Studies have shown that adults with HF have a higher risk of cognitive dysfunction compared with those without HF, even after controlling for age and comorbidities.[5] As an example, older adults with HF commonly exhibit deficits in memory, executive function, attention, and psychomotor speed.[6] HF frequently presents concomitantly with mood disorders such as depression and anxiety and high levels of anxiety and depressive symptoms are common in those with and without mood disorders.[7] The prevalence of depression and anxiety are approximately 31% and 33%, respectively, among adults with chronic cardiovascular diseases such as HF.[8] Moreover, depression is known to impair cognitive function, affecting areas such as attention, executive function, memory,

Downloaded from https://academic.oup.com/eurjcn/advance-article/doi/10.1093/eurjcn/zvaf112/8163918 by University of Rome II Tor Vergata user on 01 July 2025

and processing speed.[9–11] That is, cognitive dysfunction and affective symptoms can have multiplicative complicating effects in HF.[12] Consequently, cognitive and affective challenges can hinder effective self-care and in turn negatively influence clinical outcomes.[13]

In 2021, the universal definition and classification of HF changed to accommodate distinct clinical phenotypes identified by ranges of left ventricular ejection fraction: HF with reduced EF (HFrEF), HF with mildly reduced EF (HFmrEF), and HF with preserved EF (HFpEF).[8] There is evidence that patterns of cognitive dysfunction vary among there three clinical phenotypes of HF.[14] It also has been shown by others that depression is more prevalent in HFrEF compared with HFpEF.[7] Although self-care recommendations are generally similar for patients with HFrEF and HFpEF, we have no such information on patients with HFmrEF or any data on how cognitive dysfunction and affective symptoms may influence self-care differently by clinical phenotype.[4] Understanding cognitive and affective influences of self-care by clinical phenotype is important because self-care behaviours are crucial for maintaining health, reducing disease complications, and enhancing the quality of life for patients with HF.[15,16] The primary objective of this study was to compare affective symptoms, cognitive dysfunction, and self-care behaviours among older adults categorized by HF phenotype. The secondary objective was to examine associations between both cognitive dysfunction and affective symptoms and self-care among the three HF phenotypes.

Patients and methods

Participants

The study involved 250 patients with HF who were hospitalized with a primary diagnosis of acute decompensated HF. Participants were eligible if they were aged ≥ 60 years, had a diagnosis of HF (ESC guidelines),[17] HF duration ≥ 6 months, NYHA class II-IV, and were hospitalized for acute decompensated HF. Cognitive impairment (MMSE < 24) and active treatment for major depressive disorder were exclusion criteria. All participants provided written informed consent.

Data collection

Participants were recruited from the Institute of Heart Diseases at the University Hospital in Wroclaw, Poland, between September of 2022 and June of 2023. Data collection took place during hospitalization after clinical stabilization, typically within 48 h prior to discharge. Patients were approached at a time when they were deemed clinically stable by the treating physician to ensure reliability of cognitive and self-care assessments. Patients were categorized into three groups based on left ventricular ejection fraction: HFrEF: EF ≤ 40%, HFmrEF: EF 41–49% and HFpEF: EF ≥ 50%. STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines were followed.

Research instruments

Cognitive function

We assessed cognitive function using two measures: the Mini-Mental State Examination (MMSE), and the Montreal Cognitive Assessment (MoCA). The MMSE was developed in 1975 by Folstein et al.[18] The MMSE is a widely used tool for assessing cognitive function. The highest possible score is 30, and scores below 24 indicate potential dementia. The Polish version of the MMSE, developed by Stanczak was used in this study.[19,20] The second measure of cognitive function was the MoCA. Work on the MoCA scale was started in 1996 by neurologist Dr Z. Nasreddine, who identified the need for a tool to quickly and comprehensively test cognitive function. The test was finally validated to help diagnose mild cognitive dysfunction and early signs of dementia, such as Alzheimer's disease.[21] The highest possible score on the MoCA is 30, and a score of <26 in people without functional impairment suggests mild cognitive dysfunction; those with <12 years of formal education receive an additional 1 point.[22] A Polish version of MoCA was used in the study.[23] Both the MMSE and MoCA were used to assess cognitive function, as MMSE is a well-established screening tool for global cognitive impairment, while MoCA provides greater sensitivity in detecting mild cognitive dysfunction.

Affective symptoms

Two measures of affective symptoms were used in this study: the Hospital Anxiety and Depression Scale (HADS) and the Patient Health Questionnaire-9 (PHQ-9). The HADS was developed to assess the levels of anxiety and depressive symptoms in individuals affected by illness. This psychometric tool includes 14 items, divided into two subscales: one for anxiety (HADS-A) and one for depression (HADS-D), each consisting of seven items. Patients assess their symptoms over the past week using a 4-point scale, ranging from zero (no symptoms) to three (severe symptoms). The scores for each subscale range from 0 to 21, with higher scores indicating more severe anxiety or depressive symptoms.[24] The Polish version of the HADS validated by Mihalca and Pilecka, was used.[25] The PHQ-9 is a widely recognized self-administered questionnaire designed to evaluate the severity of depressive symptoms. Although it is commonly used to identify individuals at risk for depression, it is not intended as a diagnostic instrument. Developed by Kroenke and Spitzer, it is a reliable and valid measure of depressive symptoms across various settings including primary care and specialized medical practices.[26] The tool consists of nine core items supplemented by an additional question, offering a thorough assessment of depressive states. Respondents rate the extent to which they have been bothered by specific problems in the past 2 weeks, using a scale ranging from 'not at all' to 'nearly every day.' Each item is scored between 0 and 3, resulting in a maximum total score of 27. Scores are interpreted as follows: severe depressive symptoms (20 + points), moderate depressive symptoms (15–19), mild to moderate depressive symptoms (10–14), and mild depressive symptoms (5–9).[26] This study utilized the Polish adaptation of the PHQ-9, validated by Kokoszka *et al.*[27] The use of both HADS and PHQ-9 allowed for a comprehensive assessment of depressive symptoms, with HADS focusing on symptom severity in somatic illness and PHQ-9 complementing the HADS in the evaluation of depressive symptom severity.

Self-care behaviours

Self-care behaviours were assessed using the European Heart Failure Self-Care Behavior Scale (EHFSc-9), a tool widely recognized for its reliability in evaluating self-care among HF patients. Originally developed by Jaarsma *et al.*[28,29] in 2003 and revised in 2009 to a nine-item format, the scale focuses on practical aspects of HF management. The EHFSc-9 includes nine statements addressing self-care behaviours, with five items focused on specific practices such as weight monitoring, fluid restriction, adherence to a low-salt diet, medication compliance, and physical activity. The other four items evaluate the presence of symptoms—shortness of breath, fatigue, swelling in the lower limbs, and significant weight gain over a week—that may signal disease progression and the need for medical attention. Respondents rate their agreement with each statement on a five-point Likert scale, ranging from 1 ('strongly agree') to 5 ('strongly disagree'). The total score, ranging from 9 to 45, is obtained by summing the responses; higher scores indicate lower self-care capacity. The Polish adaptation of the EHFSc-9, validated by Uchmanowicz *et al.*,[30] was used in this study to ensure cultural relevance and reliability within the local context. In the analysis, both the total score and individual items of the scale were examined to provide a more detailed insight into specific self-care behaviours.

Downloaded from https://academic.oup.com/eurjcn/advance-article/doi/10.1093/eurjcn/zvaf112/8163918 by University of Rome II Tor Vergata user on 01 July 2025

Ethical consideration

This study was conducted in accordance with the Declaration of Helsinki and approved by the Bioethics Committee of the Wroclaw Medical University (No. KB-651/2022). Written informed consent was obtained from all participants prior to their inclusion in the study. All patient data were anonymized to ensure confidentiality.

Statistical methods

Descriptive statistics, such as median, quartiles, frequencies, and percentages, were used to describe the sample. Comparisons of categorical data across groups were made using the chi-square test (with Yates correction for 2 × 2 tables) or Fisher's exact test when the assumptions of the χ^2 test were not met. Comparison of continuous data across groups was performed using the Kruskal–Wallis test and, when statistically significant differences between groups were detected, the Dunn's post-hoc test. Before conducting multiple linear regression, assumptions of linearity, normality, homoscedasticity, and independence of residuals were checked. Multiple linear regression was used to adjust comparisons for variables that significantly differed between HF phenotypes, with questionnaire scores (EHFSc-9, HADS, PHQ-9, MoCA, and MMSE) as the dependent variables in separate models. Independent variables included HF phenotype (HFpEF, HFmrEF, or HFrEF) and all covariates that showed significant differences between phenotypes, specifically age, sex, BMI, haemoglobin (Hgb), blood urea nitrogen (BUN), NT-proBNP, estimated glomerular filtration rate (eGFR), creatinine, use of corticosteroids and diuretics, prior myocardial infarction, and coronary artery disease. The regression parameters, alongside the 95% confidence intervals, were presented. Spearman's correlation coefficient was used to assess nonparametric associations between variables, including cognitive function and self-care behaviours, as the data contained ordinal variables and the questionnaire scores were not normally distributed. Significance level was set to 0.05. All the analyses were conducted in R software, version 4.3.2.[31]

Results

The demographic characteristics of the sample (n = 250) are shown in *Table 1*. There were 105 patients with HFrEF (42.0%), 99 patients with HFpEF (39.6%), and 46 patients with HFmrEF (18.4%). Patients with HFpEF were older than patients with HFmrEF and HFrEF. The percentage of women was the highest in the HFpEF group and lowest in the HFrEF group. BMI was the highest in the HFpEF group compared with the two other phenotypes. The duration of hospitalization was longer for patients with HFrEF than patients with HFpEF. Patients with HFrEF were more likely to report a history of heart attack and coronary artery disease than patients with HFpEF and HFmrEF.

Statistical analysis revealed that cognitive dysfunction according to MMSE was significantly less severe in HFmrEF and HFrEF compared with HFpEF (*Table 2*).

Multiple linear regression was performed on differences in EHFSc-9, HADS, PHQ-9, MoCA, and MMSE scales among patients by HF phenotype. No significant differences were observed (*Table 3*).

Correlations between self-care behaviours, cognitive function, and affective symptoms were examined within each HF phenotype group (*Table 4*). There were not significant correlations between both cognitive function and affective symptoms and self-care among patients with HFrEF of HFmrEF. Among patients with HFpEF, however, a significant negative correlation was observed between MMSE scores and EHFcBS-9 meaning that better cognitive function was associated significantly with better self-care behaviours ($r = -0.299$, $P = 0.003$).

Statistical analysis showed that, in patients with different HF phenotypes, there were significant differences in self-care behaviours (*Table 5*). Specifically, contacting a doctor or nurse when breathlessness or foot/leg swelling worsened were more common in the HFpEF group compared with the HFrEF group, while adherence to a low-sodium diet was more common in the HFmrEF group compared with the HFpEF group.

Discussion

This study compared affective symptoms, cognitive dysfunction and self-care behaviours, and examined associations between both cognitive dysfunction and affective symptoms and self-care behaviours among older adults ($n = 250$) categorized by HF phenotype: 105 (42.0%) with HFrEF, 99 (39.6%) with HFpEF, and 46 (18.4%) with HFmrEF. The three HF phenotypes differed significantly by age, gender, body mass, duration of hospitalization, and history of heart attack and coronary artery disease as well as cognitive function, with patients with HFpEF having significantly worse cognitive function as measured by the MMSE. Finally, in patients with HFpEF, better cognitive function was associated significantly with better self-care. While demographic, clinical, and behavioural differences by clinical phenotype are relevant, they should not be considered the sole determinant of cognitive dysfunction and/or self-care behaviours. Instead, a more holistic approach that takes into account all relevant factors in care including cognitive function, affective symptoms, and comorbidities, is essential for improving outcomes.

In this study, patients with HFpEF were older than patients with HFmrEF and HFrEF and the proportion of women was the highest in adults with HFpEF. Previous studies also have shown that patients with HFpEF are older and more adults with HFpEF are women.[32–34] It was noted in a previous study that the duration of hospitalization for acute decompensated HF does not differ significantly by HF phenotype.[34] In our study, the duration of hospitalization was longer in patients with HFrEF compared with other HF phenotype groups. This difference in hospitalization duration may be attributed to the severity of symptoms and comorbid conditions often associated with HFrEF, necessitating more intensive management and prolonged care. Moreover, the higher prevalence of chronic conditions the HFrEF group could also contribute to extended hospital stays based on overall care complexity. The increased burden of comorbidities in patients with HFrEF highlights the necessity of a comprehensive treatment approach that addresses both immediate cardiac care and the management of coexisting chronic conditions. Despite this higher burden of comorbidities, our findings suggest that cognitive function was not significantly worse in this group when adjusting for demographic and clinical factors, reinforcing previous research by Faulkner *et al.*[35] that suggests cognitive impairment is not solely dependent on HF phenotype.

Patients with HF suffer from multiple comorbidities. In this study, patients with HFrEF were more likely to report a history of myocardial infarction and ischaemic heart disease compared with the other phenotypes. In prior studies, patients with HFrEF more commonly have a history of hypertension, peripheral vascular disease, coronary artery disease, and a history of myocardial infarction.[32,33] Differences in medical history underscores the importance of tailored treatment strategies for different HF phenotypes, given their distinct clinical profiles and aetiology.

It has been shown by others that after accounting for age, gender, and other existing health conditions, individuals with HF are more likely to experience cognitive dysfunction compared with those without HF.[5] Faulkner *et al.*[35] showed that scores on tests of attention, language, executive function, and general cognitive function were worse in participants with HFpEF than in those without HF; but that neurocognitive test scores are not significantly different between adults with HFpEF and HFrEF. Our unadjusted analysis showed that cognitive dysfunction, as measured by the MMSE test, was significantly less severe in patients

Downloaded from https://academic.oup.com/eurjcn/advance-article/doi/10.1093/eurjcn/zvaf112/8163918 by University of Rome II Tor Vergata user on 01 July 2025

Table 1 Demographic and clinical characteristics of patients by heart failure phenotype

Parameter		HFrEF (*N* = 105) – A	HFmrEF (*N* = 46) – B	HFpEF (*N* = 99) – C	Total (*N* = 250)	*P* value
Age, years	Median (IQR)	71 (65–75)	73 (66.25–77)	74 (69–78)	73 (67–76)	0.015* C > A
Education period, years	Median (IQR)	12 (10–14)	11.5 (10–13)	11 (10–14)	11 (10–14)	0.77
Sex	Woman	16 (15.24%)	13 (28.26%)	48 (48.48%)	77 (30.80%)	<0.001*
	Man	89 (84.76%)	33 (71.74%)	51 (51.52%)	173 (69.20%)	
Marital status	Single	33 (31.43%)	14 (30.43%)	38 (38.38%)	85 (34.00%)	0.49
	In a relationship	72 (68.57%)	32 (69.57%)	61 (61.62%)	165 (66.00%)	
Current place of residence	City	73 (69.52%)	37 (80.43%)	78 (78.79%)	188 (75.20%)	0.21
	Village	32 (30.48%)	9 (19.57%)	21 (21.21%)	62 (24.80%)	
Professional status	Professionally active	17 (16.19%)	7 (15.22%)	7 (7.07%)	31 (12.40%)	0.12
	Retired pensioner	88 (83.81%)	39 (84.78%)	92 (92.93%)	219 (87.60%)	
BMI, kg/m^2	Median (IQR)	27.2 (24.61–31.02)	27.58 (24.14–32.38)	29.39 (26.15–34.33)	28.02 (24.84–32.56)	0.01* C > B,A
Central obesity	No (Waist circumference <94 cm for men or <80 cm for women)	20 (19.05%)	12 (26.09%)	12 (12.12%)	44 (17.60%)	0.11
	Yes (Waist circumference ≥ 94 cm for men or ≥ 80 cm for women)	85 (80.95%)	34 (73.91%)	87 (87.88%)	206 (82.40%)	
HR, bpm	Median (IQR)	75 (66–87)	73 (67.25–80)	78 (66–85)	75.5 (66.25–85)	0.73
SBP, mmHg	Median (IQR)	130 (115–141)	130 (118.25–149.75)	132 (120.5–147)	131 (117–144)	0.17
DBP, mmHg	Median (IQR)	78 (70–85)	80 (69.25–85)	78 (70–86.5)	78 (70–86)	0.94
NYHA class	II	45 (42.86%)	23 (50.00%)	41 (41.41%)	109 (43.60%)	0.39
	III	37 (35.24%)	19 (4 130%)	43 (43.43%)	99 (39.60%)	
	IV	23 (21.90%)	4 (8.69%)	15 (15.15%)	42 (16.80%)	
LOHS, days	Median (IQR)	5 (5–7)	5 (5–5)	5 (5–5)	5 (5–6)	0.03* A > C
Hgb, g/dL	Median (IQR)	14.1 (12.6–15.2)	13.95 (12.75–14.67)	13.4 (12.25–14.5)	13.9 (12.5–14.8)	0.06
hsCRP, mg/L	Median (IQR)	3.5 (1.79–8.7)	3.33 (1.61–5.58)	3.53 (1.27–6.41)	3.46 (1.56–7.08)	0.39
BUN, mg/dL	Median (IQR)	48 (39.75–72.25)	40 (33–47.75)	44 (36.25–63)	45 (36–63)	0.001* A,C > B
NT-proBNP, pg/mL	Median (IQR)	3568.2 (1350.4–7631.6)	1157.55 (802.12–3514.2)	958.7 (545.45–3509.85)	1653.8 (753.75–4910.6)	<0.001* A > B,C
eGFR, mL/min/1.73 m^2	Median (IQR)	62 (49–79)	79 (57.25–92)	63 (50.5–82)	66.5 (51–84)	0.012* B > C,A
Creatinine, mg/dL	Median (IQR)	1.13 (0.95–1.44)	0.88 (0.79–1.24)	1.06 (0.82–1.31)	1.07 (0.86–1.35)	0.002* A > C,B
Medications taken**	ACEI/ARB	105 (100.00%)	45 (97.83%)	96 (96.97%)	246 (98.40%)	0.19
	Calcium antagonists	19 (18.10%)	13 (28.26%)	29 (29.29%)	61 (24.40%)	0.14
	Alpha blockers	9 (8.57%)	4 (8.70%)	7 (7.07%)	20 (8.00%)	0.87
	Beta-blockers	104 (99.05%)	46 (100.00%)	99 (100.00%)	249 (99.60%)	1.00
	Mineralocorticosteroids	92 (87.62%)	33 (71.74%)	66 (66.67%)	191 (76.40%)	0.001*
	Diuretics	102 (97.14%)	36 (78.26%)	90 (90.91%)	228 (91.20%)	0.001*

Continued

Downloaded from https://academic.oup.com/eurjcn/advance-article/doi/10.1093/eurjcn/zvaf112/8163918 by University of Rome II Tor Vergata user on 01 July 2025

Table 1 ***Continued***

Parameter		HFrEF (*N* = 105) – A	HFmrEF (*N* = 46) – B	HFpEF (*N* = 99) – C	Total (*N* = 250)	*P* value
	Statins	90 (85.71%)	44 (95.65%)	87 (87.88%)	221 (88.40%)	0.21
	Anticoagulants	71 (67.62%)	25 (54.35%)	67 (67.68%)	163 (65.20%)	0.23
	Antiplatelet drugs	46 (43.81%)	26 (56.52%)	39 (39.39%)	111 (44.40%)	0.15
Alcohol consumption	No	99 (94.29%)	45 (97.83%)	97 (97.98%)	241 (96.40%)	0.41
	Yes	6 (5.71%)	1 (2.17%)	2 (2.02%)	9 (3.60%)	
Pack-years of smoking	Never smoked	39 (37.14%)	15 (32.61%)	51 (51.52%)	105 (42.00%)	0.09
	1–9 pack years	3 (2.86%)	3 (6.52%)	8 (8.08%)	14 (5.60%)	
	10–19 pack-years	11 (10.48%)	5 (10.87%)	5 (5.05%)	21 (8.40%)	
	20–29 pack-years	18 (17.14%)	11 (23.91%)	7 (7.07%)	36 (14.40%)	
	30–39 pack-years	13 (12.38%)	6 (13.04%)	15 (15.15%)	34 (13.60%)	
	40–49 pack-years	10 (9.52%)	2 (4.35%)	4 (4.04%)	16 (6.40%)	
	50 or more pack-years	11 (10.48%)	4 (8.70%)	9 (9.09%)	24 (9.60%)	
Tobacco smoking	No	39 (37.14%)	15 (32.61%)	51 (51.52%)	105 (42.00%)	0.09
	Formerly	45 (42.86%)	23 (50.00%)	38 (38.38%)	106 (42.40%)	
	Yes	21 (20.00%)	8 (17.39%)	10 (10.10%)	39 (15.60%)	
Number of hospitalizations in the last year	No hospitalizations	2 (1.90%)	1 (2.17%)	4 (4.04%)	7 (2.80%)	0.57
	1 hospitalization	24 (22.86%)	11 (23.91%)	30 (30.30%)	65 (26.00%)	
	2 hospitalizations	29 (27.62%)	15 (32.61%)	21 (21.21%)	65 (26.00%)	
	3 hospitalizations	16 (15.24%)	7 (15.22%)	20 (20.20%)	43 (17.20%)	
	More than 3 hospitalizations	34 (32.38%)	12 (26.09%)	22 (22.22%)	68 (27.20%)	
	No data	0 (0.00%)	0 (0.00%)	2 (2.02%)	2 (0.80%)	
Comorbidities**	Previous heart attack	54 (51.43%)	21 (45.65%)	24 (24.24%)	99 (39.60%)	<0.001*
	Diabetes	61 (58.10%)	23 (50.00%)	53 (53.54%)	137 (54.80%)	0.62
	COPD/asthma	17 (16.19%)	9 (19.57%)	19 (19.19%)	45 (18.00%)	0.83
	Coronary artery disease	76 (72.38%)	30 (65.22%)	53 (53.54%)	159 (63.60%)	0.019*
	Hypertension	91 (86.67%)	41 (89.13%)	90 (90.91%)	222 (88.80%)	0.62
	Cardiovascular diseases in the family	27 (25.71%)	17 (36.96%)	25 (25.25%)	69 (27.60%)	0.29
	Kidney diseases	44 (41.90%)	19 (41.30%)	38 (38.38%)	101 (40.40%)	0.87
	Stroke/cerebrovascular disease	14 (13.33%)	8 (17.39%)	11 (11.11%)	33 (13.20%)	0.58
	Connective tissue diseases	18 (17.14%)	12 (26.09%)	26 (26.26%)	56 (22.40%)	0.23
	Cancer	13 (12.38%)	11 (23.91%)	19 (19.19%)	43 (17.20%)	0.18
	Peptic ulcer disease	14 (13.33%)	6 (13.04%)	11 (11.11%)	31 (12.40%)	0.88
	Liver diseases	15 (14.29%)	5 (10.87%)	5 (5.05%)	25 (10.00%)	0.083

Quantitative variables: Kruskal–Wallis test + post-hoc analysis (Dunn's test).

ACEI, angiotensin converting enzyme inhibitors; ARB, angiotensin receptor antagonists; BMI, body mass index; BUN, blood urea nitrogen; COPD, chronic obstructive pulmonary disease; CRP, C-reactive protein; DBP, diastolic blood pressure; eGFR, estimated glomerular filtration rate; HFmrEF, heart failure with mildly reduced ejection fraction; HFpEF, heart failure with preserved ejection fraction; HFrEF, heart failure with reduced ejection fraction; Hgb, haemoglobin; HR, heart rate; IQR, interquartile range; LOHS, length of hospital stay; NT-proBNP, N-terminal prohormone of brain natriuretic peptide; NYHA, New York Heart Association; P, Qualitative variables: chi-square test or Fisher's exact test.; SBP, systolic blood pressure.

*Statistically significant difference ($P < 0.05$).

**Multiple choice question—percentages do not add up to 100.

Downloaded from https://academic.oup.com/eurjcn/advance-article/doi/10.1093/eurjcn/zvaf112/8163918 by University of Rome II Tor Vergata user on 01 July 2025

Table 2 Differences in European heart failure self-care behaviour scale, hospital anxiety and depression scale, patient health questionnaire, Montreal cognitive assessment, and Mini-mental state examination in patients with heart failure

Parameter		HFrEF ($N = 105$) – A	HFmrEF ($N = 46$) – B	HFpEF ($N = 99$) – C	*P* value
EHFSc-9, points	Median (IQR)	25.0 (21.0–33.0)	28.0 (21.5–33.0)	30.0 (21.0–35.0)	0.25
HADS: anxiety, points	Median (IQR)	2.0 (1.0–5.0)	2.0 (1.0–5.0)	3.0 (1.0–5.0)	0.80
HADS: depression, points	Median (IQR)	1.0 (0.0–5.0)	2.0 (0.0–4.0)	1.0 (0.0–4.0)	0.97
PHQ-9, points	Median (IQR)	5.0 (1.0–9.0)	5.0 (2.25–8.0)	5.0 (3.0–8.0)	0.79
MoCA, points	Median (IQR)	26.0 (24.0–28.0)	27.0 (24.0–28.0)	25.0 (23.0–28.0)	0.15
MMSE, points	Median (IQR)	28.0 (27.0–29.0)	29.0 (27.25–29.0)	28.0 (26.0–29.0)	0.008* B,A > C

EHFSc-9, European Heart Failure Self-Care Behaviour Scale; HADS, Hospital Anxiety and Depression Scale; HF, heart failure; HFmrEF, heart failure with mildly reduced ejection fraction; HFpEF, heart failure with preserved ejection fraction; HFrEF, heart failure with reduced ejection fraction; IQR, interquartile range; MMSE, Mini-Mental State Examination; MoCA, Montreal Cognitive Assessment; P, Kruskal-Wallis test + post-hoc analysis (Dunn's test); PHQ-9, Patient Health Questionnaire-9.
*Statistically significant relationship ($P < 0.05$).

Table 3 Differences in European heart failure self-care behaviour scale, hospital anxiety and depression scale, patient health questionnaire, Montreal cognitive assessment, and Mini-mental state examination in patients by heart failure phenotype

Parameter	HFrEF	HFmrEF	HFpEF
EHFSc-9, points	ref.	0.102 (−2.972; 3.175), $P = 0.948$	1.18 (−1.334; 3.695), $P = 0.359$
HADS: anxiety, points	ref.	−0.503 (−1.78; 0.773), $P = 0.441$	−0.067 (−1.111; 0.977), $P = 0.9$
HADS: depression, points	ref.	−0.784 (−2.111; 0.544), $P = 0.248$	−0.615 (−1.701; 0.471), $P = 0.268$
PHQ-9, points	ref.	−0.287 (−2.201; 1.627), $P = 0.769$	0.157 (−1.409; 1.723), $P = 0.844$
MoCA, points	ref.	0.545 (−0.884; 1.975), $P = 0.455$	−0.873 (−2.042; 0.296), $P = 0.145$
MMSE, points	ref.	0.297 (−0383; 0976), $P = 0.393$	−0.514 (−1,07; 0042), $P = 0.071$

EHFSc-9, European Heart Failure Self-Care Behaviour Scale; HADS, Hospital Anxiety and Depression Scale; HFmrEF, heart failure with mildly reduced ejection fraction; HFpEF, heart failure with preserved ejection fraction; HFrEF, heart failure with reduced ejection fraction; MMSE, Mini-Mental State Examination.; MoCA, Montreal Cognitive Assessment; PHQ-9, Patient Health Questionnaire-9.

Table 4 Influence of cognitive function and affective symptoms on the level of self-care in patients by heart failure phenotype

Parameter	EHFSc-9 [points] Spearman's correlation coefficient		
	HFrEF	HFmrEF	HFpEF
HADS: anxiety, points	$r = 0.086$, $P = 0.382$	$r = 0.116$, $P = 0.442$	$r = -0.051$, $P = 0.619$
HADS: depression, points	$r = 0.024$, $P = 0.81$	$r = -0.141$, $P = 0.35$	$r = 0.024$, $P = 0.817$
PHQ-9, points	$r = 0.047$, $P = 0.636$	$r = -0.025$, $P = 0.871$	$r = -0.007$, $P = 0.943$
MoCA, points	$r = -0.152$, $P = 0.122$	$r = 0.139$, $P = 0.355$	$r = -0.16$, $P = 0.113$
MMSE, points	$r = -0.125$, $P = 0.203$	$r = -0.06$, $P = 0.692$	$r = -0.299$, $P = 0.003$*

EHFSc-9, European Heart Failure Self-Care Behaviour Scale; HADS, Hospital Anxiety and Depression Scale; HF, heart failure; HFmrEF, heart failure with mildly reduced ejection fraction; HFpEF, heart failure with preserved ejection fraction; HFrEF, heart failure with reduced ejection fraction; MMSE, Mini-Mental State Examination; MoCA, Montreal Cognitive Assessment; PHQ-9, Patient Health Questionnaire-9.
*Statistically significant relationship ($P < 0.05$).

with HFmrEF and HFrEF compared with patients with HFpEF. However, after adjusting for demographic and clinical variables, these differences were no longer statistically significant, suggesting that cognitive impairment may be influenced by factors beyond HF phenotype alone. Importantly, within the HFpEF group, individuals with better cognitive function exhibit significantly better self-care behaviours. This suggests that cognitive ability plays a more pronounced role in self-care management among HFpEF patients. In contrast, patients with HFrEF,

Downloaded from https://academic.oup.com/eurjcn/advance-article/doi/10.1093/eurjcn/zvaf112/8163918 by University of Rome II Tor Vergata user on 01 July 2025

Table 5 Differences in self-care behaviours in patients according to heart failure phenotype

Parameter		HFrEF (*N* = 105) – A	HFmrEF (*N* = 46) – B	HFpEF (*N* = 99) – C	*P* value
Weighing yourself	Median (IQR)	4.0 (2.0–5.0)	5.0 (3.0–5.0)	4.0 (2.0–5.0)	0.42
Contact your doctor or nurse if your shortness of breath gets worse	Median (IQR)	2.0 (1.0–5.0)	3.0 (1.0–5.0)	5.0 (1.0–5.0)	0.007* C > A
Contacting your doctor or nurse if the swelling in your feet/legs is greater than usual	Median (IQR)	1.0 (1.0–5.0)	3.0 (1.0–5.0)	5.0 (1.0–5.0)	<0.001* C > A
Contact your doctor or nurse if your weight increases by 2 kg in a week	Median (IQR)	5.0 (4.0–5.0)	5.0 (4.0–5.0)	5.0 (3.50–5.0)	0.95
Limiting the amount of fluids you drink	Median (IQR)	2.0 (1.0–5.0)	3.0 (1.0–5.0)	2.0 (1.0–5.0)	0.90
Contacting your doctor or nurse during periods of increased fatigue	Median (IQR)	4.0 (1.0–5.0)	4.0 (1.0–5.0)	5.0 (1.50–5.0)	0.29
Following a low-sodium diet	Median (IQR)	1.0 (1.0–4.0)	2.0 (1.0–4.0)	1.0 (1.0–3.0)	0.04* B > C
Taking medications as directed	Median (IQR)	1.0 (1.0–1.0)	1.0 (1.0–1.0)	1.0 (1.0–1.0)	0.97
Regular exercise	Median (IQR)	5.0 (1.0–5.0)	4.0 (1.0–5.0)	4.0 (2.0–5.0)	0.66

HF, heart failure; HFmrEF, heart failure with mildly reduced ejection fraction; HFpEF, heart failure with preserved ejection fraction; HFrEF, heart failure with reduced ejection fraction; IQR, interquartile range; P, Kruskal–Wallis test + post-hoc analysis (Dunn's test).
*Statistically significant relationship ($P < 0.05$).

despite their greater burden of comorbidities, did not exhibit significantly worse cognitive function or self-care deficits. During adjusted analysis, however, no significant differences were observed in scores on the EHFSc-9, HADS, PHQ-9, MoCA, and MMSE scales among patients with different HF phenotypes. These findings align with prior research indicating that factors beyond HF phenotype alone contribute to cognitive and self-care outcomes. Other studies have shown an association between depression and cognitive dysfunction in patients with HF[36,37]; however, our study did not analyze this. In a study by Fino *et al.*[38] worse MoCA and HADS scores were associated with poorer health outcomes in adults with HF. Studying long-term cognitive decline in different phenotypes may be crucial to improving patient management and quality of life.

Recent findings indicate that individuals with HF and mild cognitive dysfunction might encounter increased challenges in managing their self-care. Prior studies have identified that cognitive dysfunction is associated with worse HF self-care.[3,39–42] Our results showed that in HFpEF, better cognition is associated with better self-care but not in the other phenotypes. This finding suggests that in patients with HFpEF self-care behaviours may be more dependent on cognitive function. As such, different interventions may be needed in HFpEF to preserve cognitive function in order to optimize self-care behaviours. One of the key findings of this study is that in HFpEF, better cognitive function was associated with better self-care, a relationship not observed in HFrEF or HFmrEF. This suggests that cognitive capacity plays a crucial role in self-care among HFpEF patients, emphasizing the need for tailored cognitive support interventions in this population. Although no significant differences in self-care behaviours were observed among HF phenotypes, these findings highlight the importance of considering a broader clinical profile, including cognitive and emotional health, when designing interventions.

Another critical aspect of self-care behaviours observed in this study was the difference in communication with healthcare providers. Patients with HFpEF were more likely to contact their physician or nurse in response to worsening symptoms, whereas those with HFrEF were less likely to do so. These findings suggest that self-care interventions should prioritize strategies that enhance symptom recognition and encourage proactive medical engagement, particularly in patients with HFrEF. Similarly, differences in dietary adherence highlight the need for tailored nutritional education, as HFmrEF patients showed poorer adherence to a low-sodium diet compared with HFpEF patients. This underscores the importance of individualized counselling that aligns with the specific behavioural tendencies of each HF phenotype.

Implications for clinical practice

Since self-care behaviours were a primary outcome of this study, it is crucial to consider how multimorbidity influences self-care capacity. Patients with a high comorbidity burden may require tailored interventions, such as structured self-management programmes, multidisciplinary support, and personalized education, to optimize adherence to treatment recommendations. Integrating comorbidity-specific self-care strategies into HF management may help improve patient outcomes and quality of life. Future studies should explore the effectiveness of such tailored interventions.

Limitations

Self-reported data may be subject to recall bias and social desirability bias, particularly in the assessment of self-care behaviours. To minimize these limitations, we used validated instruments with established reliability and provided standardized instructions to participants to enhance response accuracy. Future studies should consider complementing self-reported measures with objective assessments of self-care behaviours. Potential confounders that may have influenced the observed differences between HF phenotypes include medication adherence, socioeconomic status, baseline health literacy, and comorbidities not accounted for in our analyses. Although we adjusted for key demographic and clinical factors, unmeasured variables could still impact the findings. Future research should incorporate a broader range of potential confounders to enhance the robustness of results.

Conclusions

Different HF phenotypes are associated with variations in cognitive function and the associations between cognitive function and self-care behaviours. However, after adjusting for demographic and clinical

Downloaded from https://academic.oup.com/eurjcn/advance-article/doi/10.1093/eurjcn/zvaf112/8163918 by University of Rome II Tor Vergata user on 01 July 2025

factors, no significant differences were observed between the HF phenotypes in cognitive function and self-care behaviours. These findings emphasize the importance of personalized interventions tailored to each patient's broader clinical profile, including cognitive and emotional health, rather than focusing solely on phenotypic characteristics like ejection fraction. Further research is necessary to fully understand the complex relationships between HF phenotype, cognitive function, and self-care behaviours, in order to optimize patient outcomes.

Funding

This research was funded by the National Science Centre (NCN), Poland, Grant number: 2021/41/B/NZ7/01698.

Author contributions

Conceptualization, I.U. and M.J.; methodology, I.U., R.S., and M.J.; software, B.N., M.J., M.L., M.W.; formal analysis, M.J., I.U.; investigation, M.J., B.N., M.L., M.W.; data curation, M.J., B.N.; writing—original draft preparation, M.J., C.L., Q.E.D., R.S., B.N., M.C., E.V., M.W., M.L., I.U.; writing—review and editing, M.J., C.L., Q.D., R.S., B.N., M.C., E.V., M.W., M.L., I.U.; supervision, I.U.; project administration, I.U.; funding acquisition, I.U. All authors have read and agreed to the published version of the manuscript.

Maria Jędrzejczyk (RN (Conceptualization: Lead; Data curation: Lead; Formal analysis: Lead; Investigation: Lead; Methodology: Equal; Software: Lead; Writing—original draft: Equal; Writing—review & editing: Equal)), Christopher S. Lee (Writing—original draft: Equal; Writing—review & editing: Equal), Quin E. Denfeld (Writing—original draft: Equal; Writing—review & editing: Equal), Bernadetta Żółkowska (Data curation: Supporting; Investigation: Supporting; Software: Supporting; Writing—original draft: Equal; Writing—review & editing: Equal), Remigiusz Szczepanowski (Methodology: Equal; Writing—original draft: Equal; Writing—review & editing: Equal), Michał Czapla (Writing—original draft: Equal; Writing—review & editing: Equal), Ercole Vellone (Writing—original draft: Equal; Writing—review & editing: Equal), Marta Wleklik (Investigation: Equal; Software: Equal; Writing—original draft: Equal; Writing—review & editing: Equal), Magdalena Lisiak (Investigation: Equal; Software: Equal; Writing—original draft: Equal; Writing—review & editing: Equal), and Izabella Uchmanowicz (Conceptualization: Lead; Funding acquisition: Lead; Investigation: Supporting; Methodology: Lead; Project administration: Lead; Supervision: Lead; Writing—original draft: Equal; Writing—review & editing: Equal).

Conflict of interest: None declared.

Data availability

Data are available from the authors upon reasonable request.

References

1. Steiner B, Neumann A, Pelz Y, Ski CF, Hill L, Thompson DR, *et al.* Challenges in heart failure care in four European countries: a comparative study. *Eur J Public Health* 2023;**33**:448–454.
2. Díez-Villanueva P, Jiménez-Méndez C, Alfonso F. Heart failure in the elderly. *J Geriatr Cardiol* 2021;**18**:219–232.
3. Lee CS, Gelow JM, Bidwell JT, Mudd JO, Green JK, Jurgens CY, *et al.* Blunted responses to heart failure symptoms in adults with mild cognitive dysfunction. *J Cardiovasc Nurs* 2013;**28**:534–540.
4. Jaarsma T, Hill L, Bayes-Genis A, La Rocca HB, Castiello T, Čelutkienė J, *et al.* Self-care of heart failure patients: practical management recommendations from the heart failure association of the European Society of Cardiology. *Eur J Heart Fail* 2021;**23**:157–174.
5. Cannon JA, Moffitt P, Perez-Moreno AC, Walters MR, Broomfield NM, McMurray JJV, *et al.* Cognitive impairment and heart failure: systematic review and meta-analysis. *J Card Fail* 2017;**23**:464–475.
6. Bauer LC, Johnson JK, Pozehl BJ. Cognition in heart failure: an overview of the concepts and their measures. *J Am Acad Nurse Pract* 2011;**23**:577–585.
7. Celano CM, Villegas AC, Albanese AM, Gaggin HK, Huffman JC. Depression and anxiety in heart failure: a review. *Harv Rev Psychiatry* 2018;**26**:175–184.
8. Karami N, Kazeminia M, Karami A, Salimi Y, Ziapour A, Janjani P. Global prevalence of depression, anxiety, and stress in cardiac patients: a systematic review and meta-analysis. *J Affect Disord* 2023;**324**:175–189.
9. Lee RSC, Hermens DF, Porter MA, Redoblado-Hodge MA. A meta-analysis of cognitive deficits in first-episode Major depressive disorder. *J Affect Disord* 2012;**140**:113–124.
10. McIntyre RS, Xiao HX, Syeda K, Vinberg M, Carvalho AF, Mansur RB, *et al.* The prevalence, measurement, and treatment of the cognitive dimension/domain in major depressive disorder. *CNS Drugs* 2015;**29**:577–589.
11. Millan MJ, Agid Y, Brüne M, Bullmore ET, Carter CS, Clayton NS, *et al.* Cognitive dysfunction in psychiatric disorders: characteristics, causes and the quest for improved therapy. *Nat Rev Drug Discov* 2012;**11**:141–168.
12. Bierman EJM, Comijs HC, Jonker C, Beekman ATF. Effects of anxiety versus depression on cognition in later life. *Am J Geriatr Psychiatry* 2005;**13**:686–693.
13. Uchmanowicz I, Rosano G, Francesco Piepoli M, Vellone E, Czapla M, Lisiak M, *et al.* The concurrent impact of mild cognitive impairment and frailty syndrome in heart failure. *Arch Med Sci* 2023;**19**:912–920.
14. Athilingam P, D'Aoust RF, Miller L, Chen L. Cognitive profile in persons with systolic and diastolic heart failure. *Congest Heart Fail Greenwich Conn* 2013;**19**:44–50.
15. Riegel B, Moser DK, Buck HG, Dickson VV, Dunbar SB, Lee CS, *et al.* Self-care for the prevention and management of cardiovascular disease and stroke: a scientific statement for healthcare professionals from the American Heart Association. *J Am Heart Assoc* 2017;**6**:e006997.
16. Dardiotis E, Giamouzis G, Mastrogiannis D, Vogiatzi C, Skoularigis J, Triposkiadis F, *et al.* Cognitive impairment in heart failure. *Cardiol Res Pract* 2012;**2012**:595821.
17. McDonagh TA, Metra M, Adamo M, Gardner RS, Baumbach A, Böhm M, *et al.* 2021 ESC guidelines for the diagnosis and treatment of acute and chronic heart failure. *Eur Heart J* 2021;**42**:3599–3726.
18. Folstein MF, Folstein SE, McHugh PR. Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res* 1975;**12**:189–198.
19. Stańczak J. *MMSE Polish Standardization*. Laboratory of Psychological Tests of the Polish Psychological Association, 2010. https://scholar.google.com/scholar?hl=pl&as_sdt=0%2C5&q=sta%C5%84czak+J.+MMSE+Polish+standardization&btnG=
20. Creavin ST, Wisniewski S, Noel-Storr AH, Trevelyan CM, Hampton T, Rayment D, *et al.* Mini-mental state examination (MMSE) for the detection of dementia in clinically unevaluated people aged 65 and over in community and primary care populations. *Cochrane Database Syst Rev* 2016;**2016**:CD011145.
21. Nasreddine ZS, Phillips NA, Bédirian V, Charbonneau S, Whitehead V, Collin I, *et al.* The Montreal cognitive assessment, MoCA: a brief screening tool for mild cognitive impairment. *J Am Geriatr Soc* 2005;**53**:695–699.
22. Freitas S, Simões MR, Alves L, Santana I. Montreal Cognitive Assessment: Validation Study for Mild… : Alzheimer Disease & Associated Disorders. Accessed 8 Dec 2024. https://journals.lww.com/alzheimerjournal/abstract/2013/01000/montreal_cognitive_assessment__validation_study.6.aspx
23. Gierus J, Mosiołek A, Koweszko T, Kozyra O, Wnukiewicz P, Łoza B, *et al.* The Montreal cognitive assessment 7.2—Polish adaptation and research on equivalency. *Psychiatr Pol* 2015;**49**:171–179.
24. Bjelland I, Dahl AA, Haug TT, Neckelmann D. The validity of the hospital anxiety and depression scale. An updated literature review. *J Psychosom Res* 2002;**52**:69–77.
25. Mihalca AM, Pilecka W. The factorial structure and validity of the hospital anxiety and depression scale (HADS) in Polish adolescents. *Psychiatr Pol* 2015;**49**:1071–1088.
26. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med* 2001;**16**:606–613.
27. Kokoszka A, Jastrzębski A, Obrębski M. Ocena psychometrycznych właściwości polskiej wersji Kwestionariusza Zdrowia Pacjenta-9 dla osób dorosłych. *Psychiatria* 2016;**13**:187–193.
28. Jaarsma T, Strömberg A, Mårtensson J, Dracup K. Development and testing of the European heart failure self-care behaviour scale. *Eur J Heart Fail* 2003;**5**:363–370.
29. Jaarsma T, Arestedt KF, Mårtensson J, Dracup K, Strömberg A. The European heart failure self-care behaviour scale revised into a nine-item scale (EHFScB-9): a reliable and valid international instrument. *Eur J Heart Fail* 2009;**11**:99–105.
30. Uchmanowicz I, Wleklik M. Polish adaptation and reliability testing of the nine-item European heart failure self-care behaviour scale (9-EHFScBS). *Pol Heart J Kardiologia Pol* 2016;**74**:691–696.
31. R: The R Project for Statistical Computing. Accessed 1 Apr 2024. https://www.r-project.org/
32. Shah KS, Xu H, Matsouaka RA, Bhatt DL, Heidenreich PA, Hernandez AF, *et al.* Heart failure with preserved, borderline, and reduced ejection fraction: 5-year outcomes. *J Am Coll Cardiol* 2017;**70**:2476–2486.
33. Lam CSP, Gamble GD, Ling LH, Sim D, Leong KTG, Yeo PSD, *et al.* Mortality associated with heart failure with preserved vs. Reduced ejection fraction in a prospective international multi-ethnic cohort study. *Eur Heart J* 2018;**39**:1770–1780.
34. Farmakis D, Tromp J, Marinaki S, Ouwerkerk W, Angermann CE, Bistola V, *et al.* Impact of left ventricular ejection fraction phenotypes on healthcare resource utilization in

Downloaded from https://academic.oup.com/eurjcn/advance-article/doi/10.1093/eurjcn/zvaf112/8163918 by University of Rome II Tor Vergata user on 01 July 2025

hospitalized heart failure: a secondary analysis of REPORT-HF. *Eur J Heart Fail* 2023;**25**: 818–828.
35. Faulkner KM, Dickson VV, Fletcher J, Katz SD, Chang PP, Gottesman RF, *et al.* Factors associated with cognitive impairment in heart failure with preserved ejection fraction. *J Cardiovasc Nurs* 2022;**37**:17–30.
36. Garcia S, Spitznagel MB, Cohen R, Raz N, Sweet L, Colbert L, *et al.* Depression is associated with cognitive dysfunction in older adults with heart failure. *Cardiovasc Psychiatry Neurol* 2011;**2011**:368324.
37. Sohani ZN, Samaan Z. Does depression impact cognitive impairment in patients with heart failure? *Cardiol Res Pract* 2012;**2012**:524325.
38. Fino P, Sousa RM, Carvalho R, Sousa N, Almeida F, Pereira VH. Cognitive performance is associated with worse prognosis in patients with heart failure with reduced ejection fraction. *ESC Heart Fail* 2020;**7**:3059–3066.
39. Currie K, Rideout A, Lindsay G, Harkness K. The association between mild cognitive impairment and self-care in adults with chronic heart failure: a systematic review and narrative synthesis. *J Cardiovasc Nurs* 2015;**30**:382–393.
40. Alosco ML, Spitznagel MB, Cohen R, Sweet LH, Colbert LH, Josephson R, *et al.* Cognitive impairment is independently associated with reduced instrumental activities of daily living in persons with heart failure. *J Cardiovasc Nurs* 2012;**27**:44–50.
41. Harkness K, Heckman GA, Akhtar-Danesh N, Demers C, Gunn E, McKelvie RS. Cognitive function and self-care management in older patients with heart failure. *Eur J Cardiovasc Nurs* 2014;**13**:277–284.
42. Hawkins LA, Kilian S, Firek A, Kashner TM, Firek CJ, Silvet H. Cognitive impairment and medication adherence in outpatients with heart failure. *Heart Lung J Crit Care* 2012;**41**: 572–582.

Downloaded from https://academic.oup.com/eurjcn/advance-article/doi/10.1093/eurjcn/zvaf112/8163918 by University of Rome II Tor Vergata user on 01 July 2025