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ORIGINAL RESEARCH

Self-Management Task Performance and Its Association with Biomarkers in Elderly Patients with Chronic Heart Failure: A Cross-Sectional Analysis

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Purpose: This study aimed to investigate the relationship between self-management task performance and key heart failure biomarkers (NT-proBNP and uric acid) in elderly patients with chronic heart failure (CHF), and to explore the mediating role of disease severity in this relationship.

Design Patients and Methods: A total of 103 elderly CHF patients were recruited. And cross-sectional study conducted at two tertiary hospitals. Self-management task performance was assessed using a validated six-task evaluation scale. Clinical data, including NT-proBNP, uric acid, and other laboratory markers, were collected. Participants were stratified into low and high task performance groups based on the median score. Data were analyzed using partial correlation analysis, logistic regression, and restricted cubic spline analysis.

Results: Patients with higher task performance were significantly younger ($p < 0.001$). Task performance was negatively correlated with NT-proBNP ($r = -0.337$, $p < 0.001$) and uric acid ($r = -0.279$, $p = 0.005$), indicating that lower performance was associated with higher biomarker levels, reflecting more severe disease progression. A non-linear decreasing trend in both NT-proBNP and uric acid levels was observed as task performance increased. Among the self-management tasks, medication-related tasks had the lowest success rates, while tasks related to oedema and dietary management showed higher performance rates.

Conclusion: Lower self-management task performance is significantly associated with elevated NT-proBNP and uric acid levels in elderly CHF patients, suggesting that poorer performance may indicate more advanced disease progression. These findings highlight the importance of targeted interventions to enhance self-management skills, particularly in medication adherence and disease monitoring, to improve patient outcomes. Future research should investigate the long-term clinical impact of improving task performance in CHF patients.

Keywords: chronic heart failure, task performance, disease management, elderly patients

Introduction

Chronic heart failure (CHF) is a prevalent chronic progressive disease among the elderly, characterized by high morbidity, hospitalization rates, and mortality, posing a significant threat to patients' health and quality of life.[1] While substantial efforts have focused on pharmacological and device-based interventions, increasing attention has been directed to the role of patient self-management in delaying disease progression and reducing adverse outcomes.[2] Self-management, defined as a patient's ability to monitor symptoms, adhere to medications, and adjust lifestyle behaviors, is considered a cornerstone of heart failure care. Effective self-management can reduce the risk of acute exacerbations and hospital readmissions.[3] Despite growing evidence of its clinical value, self-management in elderly CHF patients is often suboptimal due to age-related functional and cognitive decline, which impairs their ability to execute key daily tasks. Task performance, in this context, refers to a patient's actual ability to carry out disease-specific management behaviors, which include weight monitoring, identifying high-salt diets, detecting edema, and adjusting medications. Inadequate Task Performance may lead to delayed disease progression, resulting in poorer health outcomes, including higher rehospitalization rates and increased mortality risk.[4] Importantly, Task

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Performance may also be reflected in key heart failure biomarkers, such as NT-proBNP (N-terminal pro-B-type natriuretic peptide) and uric acid, which are widely used in clinical practice to assess disease severity, predict acute episode risks, and monitor treatment efficacy[5] (Nair & Gongora, 2018). For instance, elevated NT-proBNP levels are often correlated with worsening heart failure symptoms and may indicate greater challenges in self-management tasks.[6] Similarly, abnormal uric acid levels may be linked to heart failure-related cardiac dysfunction,[7] offering valuable biological insights into patients' task execution abilities and disease management.

Despite the increasing body of research emphasizing the importance of self-management abilities and heart failure biomarkers individually, the association between them remains unclear. Therefore, this study aims to investigate the correlation between self-management Task Performance and heart failure biomarkers in elderly CHF patients, with the goal of providing evidence to enhance patient self-management and clinical intervention strategies. The significance of this study lies in quantifying self-management Task Performance and integrating it with heart failure biomarkers, potentially offering new perspectives and theoretical support for personalized interventions in elderly CHF patients. This approach could further optimize chronic disease management, improve patient quality of life, reduce medical costs, and provide theoretical support for the development of more precise clinical management measures.

Materials and Methods

Study Design and Participants

This study employed a convenience sampling method to recruit elderly patients with CHF hospitalized in the cardiology departments of two tertiary hospitals in Zhejiang Province between August and December 2024. All eligible patients were diagnosed with CHF based on the European Society of Cardiology (ESC) criteria and had been diagnosed for at least three months. The inclusion criteria were as follows: (1) aged ≥60 years; (2) previously hospitalized for CHF; (3) clear consciousness and ability to complete questionnaire assessments and task execution evaluations; (4) willingness and ability to manage their disease independently. Exclusion criteria included: (1) requiring assistance in performing three or more basic activities of daily living (bathing, dressing, transferring from a chair, using the toilet, feeding, and grooming) before admission; (2) Moderate to severe cognitive impairment, defined as a Chinese Mini Mental Status Examination (CMMSE) score below education-adjusted cutoffs (<17 for illiterate, <20 for primary school, <24 for junior high or above; (3) patients transferred from nursing homes, as they are typically not responsible for their own self-care or treatment management.

The required sample size was estimated using Kendall's formula, which suggests a sample size of 5 to 10 times the number of independent variables in the questionnaire. This study included seven demographic variables and six variables derived from the Task Performance scale, leading to a total of 13 independent variables. Considering a 10% rate of invalid questionnaires, the minimum required sample size was 71 participants. Ultimately, 103 participants were enrolled in the study. All participants provided informed consent before enrollment. The study was approved by the Ethics Committee of Sir Run Run Shaw hospital, Zhejiang University School of Medicine; and was conducted in accordance with the principles outlined in the Declaration of Helsinki.

Study Variable

Baseline data were collected using a structured questionnaire developed by the research team. Data collection was performed by trained research nurses or physicians. The following variables were recorded: (1) Demographic and Sociodemographic Characteristics: Sex, age, marital status, living situation, education level, economic burden, and smoking history. (2) Body composition and Clinical Characteristics: Body weight, body mass index (BMI), baseline blood pressure, and New York Heart Association (NYHA) functional classification. The presence of chronic comorbidities, including hypertension and diabetes mellitus, was documented. (3) Laboratory Biomarkers: Serum levels of NT-proBNP, C-reactive protein (CRP), white blood cell count (WBC), hemoglobin, uric acid, and glycated hemoglobin (HbA1c) were collected from laboratory reports. (4) Echocardiographic Parameters: Left ventricular ejection fraction (LVEF) was assessed through echocardiography. All variables were extracted from patients' medical records at admission. These parameters were selected based on their relevance in assessing heart failure severity, self-management capacity, and clinical outcomes.

Task Performance Assessment

Self-management Task Performance was evaluated using a validated six-task assessment scale developed by Vidan et al[4] specifically designed for CHF patients. This tool was developed by a multidisciplinary team of cardiologists, geriatricians, and nursing experts in heart failure management. The scale comprises simple, reproducible tasks with good feasibility, and its internal consistency reliability (Cronbach's α coefficient) was reported as 0.58. In the preliminary assessment phase of this study, evaluations were conducted independently by both the head nurse and a specialized heart failure nurse, yielding an intra-class correlation coefficient of 0.88 (95% CI: 0.76–0.97), ensuring inter-rater reliability.

The six tasks assessed were: (I) Standing on a scale independently until a stable weight measurement was obtained and Reading and writing the measured weight correctly. (II) Recording of inputs and outputs correctly. (III) Identifying the prescribed diuretic from a medication box containing the patient's regular CHF medications. (IV) Recognizing high-salt foods to be avoided from a standardized list, which included cheese, cured ham, salty snacks, olives, boiled rice, apples, and canned food. (V) Performing a self-examination of both ankles and correctly identifying the presence or absence of edema. (VI) Adjusting the prescribed diuretic dose based on a predefined rule according to weight changes, as stated in the patient's medical records. For standardization, all patients were provided with the same type of weighing scale to ensure consistency in weight measurement. Medication boxes were shown to patients to facilitate diuretic identification. The high-salt food recognition task was assessed using standardized food images. The edema assessment required patients to physically examine their ankles and report whether swelling was present. Diuretic dose adjustment was evaluated based on the standard written guidelines recorded in the patient's medical documentation. Each correctly completed task was scored as 1 point, whereas failure to complete or requiring assistance was scored as 0 points. The total score ranged from 0 to 6, with higher scores indicating greater Task Performance in self-management. To facilitate interpretation and comparability, the raw score was converted to a percentage scale using the formula: (total score / 6) × 100. This standardization allowed the Task Performance to be expressed on a 0–100 scale, with higher values representing better performance. This assessment provided an objective measure of CHF patients' self-management execution ability, allowing for further analysis of its correlation with clinical outcomes.

Data Collection and Quality Control

To ensure data accuracy and reliability, all research personnel underwent standardized training before data collection. Screening of eligible CHF patients was conducted in collaboration with ward nurses. Data were collected following informed consent procedures. Baseline clinical assessments, including blood pressure and body weight, were completed within 24 hours of admission. Laboratory biomarkers, including NT-proBNP, C-reactive protein, white blood cell count, hemoglobin, uric acid, glycated hemoglobin, and left ventricular ejection fraction, were obtained from the first laboratory tests performed upon admission. Self-management Task Performance assessments were conducted by a specialized heart failure nurse using the validated six-task scale. NYHA functional classification was recorded at the time of Task Performance assessment. To ensure inter-rater reliability, a preliminary assessment was conducted in the first 10 patients. Both the head nurse and a specialized heart failure nurse performed independent evaluations to compare scoring consistency. Inter-observer agreement was analyzed, and adjustments were made as needed to optimize feasibility and validity in the study population.

Statistical Analysis

Statistical analyses were performed using SPSS 26.0 and RStudio 2024. Categorical variables were presented as frequencies and percentages. Continuous variables with a normal distribution were expressed as mean ± standard deviation (SD), while non-normally distributed continuous variables were reported as median and interquartile range (M [P25, P75]). The normality of continuous variables was assessed using the Shapiro–Wilk test. Comparisons between groups were conducted using independent samples *t*-tests for normally distributed continuous variables, and Mann–Whitney *U*-tests for non-normally distributed continuous variables. Chi-square tests or Fisher's exact tests were applied to analyze categorical variables. Differences among multiple stratified groups were assessed using the Kruskal–Wallis *H*-test. Partial correlation analysis was conducted to assess the association among age, Task Performance, and NT-

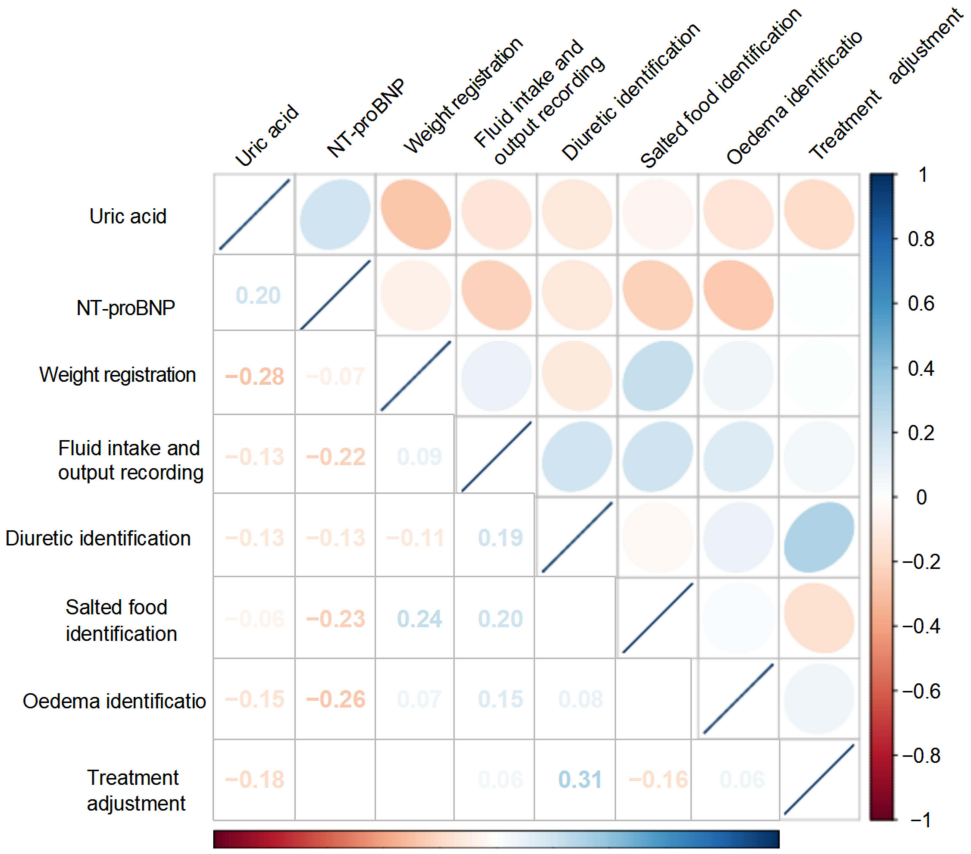

Figure 1 Correlation matrix of task execution ability and heart failure-related biomarkers. Spearman rank-order correlation coefficients are displayed. A higher correlation is represented by lower transparency and narrower ellipses. Blue indicates a positive correlation, while red indicates a negative correlation. NT-proBNP and uric acid show negative correlations with multiple task execution indicators, suggesting that higher biomarker levels are associated with poorer self-management performance.
Abbreviation: NT-proBNP, N-terminal pro-B-type natriuretic peptide.

proBNP levels, adjusting for potential confounders such as sex and education level. In addition, bivariate Spearman correlation analysis was performed to examine the associations between individual task performance items, uric acid, and NT-proBNP levels, as illustrated in Figure 1. A restricted cubic spline (RCS) analysis was applied to assess the trend of Task Performance changes with age and to identify potential inflection points. The number of knots and boundary percentiles was determined according to Akaike Information Criterion (AIC) and visual inspection. Data visualization was conducted using the ggplot2 package in R, generating scatter plots and trend curves to illustrate the relationship between Task Performance and heart failure biomarkers such as NT-proBNP and uric acid. Fitted curves were used to further validate the observed correlations. All statistical tests were two-tailed, with a significance level set at $P < 0.05$.

Results

Baseline Characteristics

A total of 103 elderly patients with chronic heart failure (CHF) were included in the study. Based on the median Task Performance score (16.7), participants were classified into two groups: low Task Performance (<16.7, n=57) and high Task Performance (≥16.7, n=46). Patients in the high Task Performance group were significantly younger than those in the low execution ability group ($p < 0.001$). NYHA classification was also significantly associated with Task Performance ($p = 0.005$), with patients in the higher execution ability group demonstrating better functional status. NT-proBNP and uric acid levels were significantly lower in the high execution ability group ($p = 0.01$ and $p = 0.006$, respectively). There were no significant differences between the two groups in terms of sex, BMI, blood pressure, diabetes, hypertension, or other laboratory biomarkers ($p > 0.05$). See Table 1.

Table 1 Baseline Characteristics of Study Participants Stratified by Task Execution Ability

Characteristics	Overall	Low Task Execution Ability (<Median)	High Task Execution Ability (≥Median)	p-value
	n=103	57	46	
Sex = Male (%)	66 (64.10)	36 (63.20)	30 (65.20)	0.992
Age [years, (mean ± SD)]	73.67 (8.78)	76.56 (9.57)	70.09 (6.08)	<0.001*
Living alone = Yes (%)	5 (4.90)	2 (3.50)	3 (6.50)	0.806
Marital status = Married (%)	90 (87.40)	50 (87.70)	40 (87.00)	>0.99
Heavy economic burden (%)	46 (44.70)	25 (43.9)	21 (45.70)	>0.99
Education level				0.732
Middle school	27 (26.20)	14 (24.60)	13 (28.30)	
Primary school or below	57 (55.30)	31 (54.40)	26 (56.50)	
High school or above	19 (18.40)	12 (21.1)0	7 (15.20)	
NYHA Classification (%)				0.005*
II	45 (43.70)	29 (50.90)	16 (34.80)	
III	41 (39.80)	15 (26.3)0	26 (56.50)	
IV	17 (16.50)	13 (22.80)	4 (8.70)	
Comorbidities ≥3 (%)	18 (17.50)	8 (14.00)	10 (21.70)	0.446
Respiratory disease (%)	18 (17.50)	13 (22.80)	5 (10.90)	0.185
BMI, [kg/m² (mean±SD]	23.14 (3.86)	23.44 (3.74)	22.78 (4.01)	0.39
SBP [mmhg, (mean± SD)]	128.60 (23.05)	130.04 (20.63)	126.83 (25.87)	0.485
Diabetes (%)	20 (19.40)	10 (17.50)	10 (21.70)	0.776
Hypertension (%)	43 (41.70)	26 (45.60)	17 (37.00)	0.493
Heart age [years, (mean ± SD)]	18.72 (3.21)	19.19 (3.45)	18.13 (2.83)	0.095
Smoking (%)	27 (26.20)	17 (29.80)	10 (21.70)	0.483
CRP, [mg/dL (mean ± SD)]	11.11 (25.86)	10.29 (28.24)	12.13 (22.83)	0.721
WBC10^3/μL (mean±SD)	6.86 (2.34)	6.83 (2.27)	6.89 (2.46)	0.903
Hemoglobin, [g/L, (mean ± SD)]	118.75 (38.17)	120.21 (41.59)	116.95 (33.82)	0.669
NT-pro BNP (median [IQR])	1800.00 [569.50, 4373.50]	2730.00 [755.00, 8216.00]	886.50 [483.75, 2914.00]	0.01*
Uric acid, [μmol/L, (median [IQR])]	391.30 [287.50, 481.55]	422.10 [321.50, 519.60]	330.90 [268.78, 417.35]	0.006*
Albumin [g/L, (mean ± SD)]	31.69 (42.17)	31.32 (48.29)	32.14 (33.59)	0.922
Glycated hemoglobin, [%, (mean ± SD)]	6.38 (1.15)	6.42 (1.03)	6.33 (1.30)	0.683
PF (median [IQR])	368.00 [299.50, 402.50]	368.00 [299.00, 395.00]	367.00 [300.00, 410.00]	0.695
LVEF, [%, (mean ± SD)]	53.34 (14.97)	54.32 (13.74)	52.12 (16.45)	0.461

Notes: Table 1 presents the baseline characteristics of study participants stratified by task execution ability. Continuous variables are expressed as mean ± SD or median \[IQR], and categorical variables as n (%). p-values were calculated using the *t*-test or Mann–Whitney *U*-test for continuous variables and chi-square or Fisher's exact test for categorical variables. Values approximating 1.000 are presented as "> 0.99". * indicates $p < 0.05$, considered statistically significant.

Abbreviations: NYHA, New York Heart Association classification; BMI, body mass index; SBP, systolic blood pressure; SD, standard deviation; IQR, interquartile range; CRP, C-reactive protein; WBC, white blood cell count; NT-proBNP, N-terminal pro-B-type natriuretic peptide; PF, physical function; LVEF, left ventricular ejection fraction.

Task-Specific Performance in CHF Self-Management

Among the six evaluated self-management tasks, treatment adjustment had the lowest performance rate (8%), followed by diuretic identification (14%) and recording of inputs and outputs (18.7%). In contrast, oedema identification and salted food identification had the highest performance rates (41%), suggesting better patient awareness of dietary restrictions and fluid retention monitoring. These findings indicate that CHF patients struggle the most with medication management tasks, emphasizing the need for targeted interventions in this domain (Figure 2).

Correlation Between Task Performance and Heart Failure Biomarkers

Partial correlation analysis revealed a significant negative correlation between Task Performance and NT-proBNP levels ($r = -0.337$, $p < 0.001$), suggesting that lower Task Performance is associated with higher NT-proBNP levels. Similarly, Task Performance was negatively correlated with uric acid levels ($r = -0.279$, $p = 0.005$), indicating that patients with

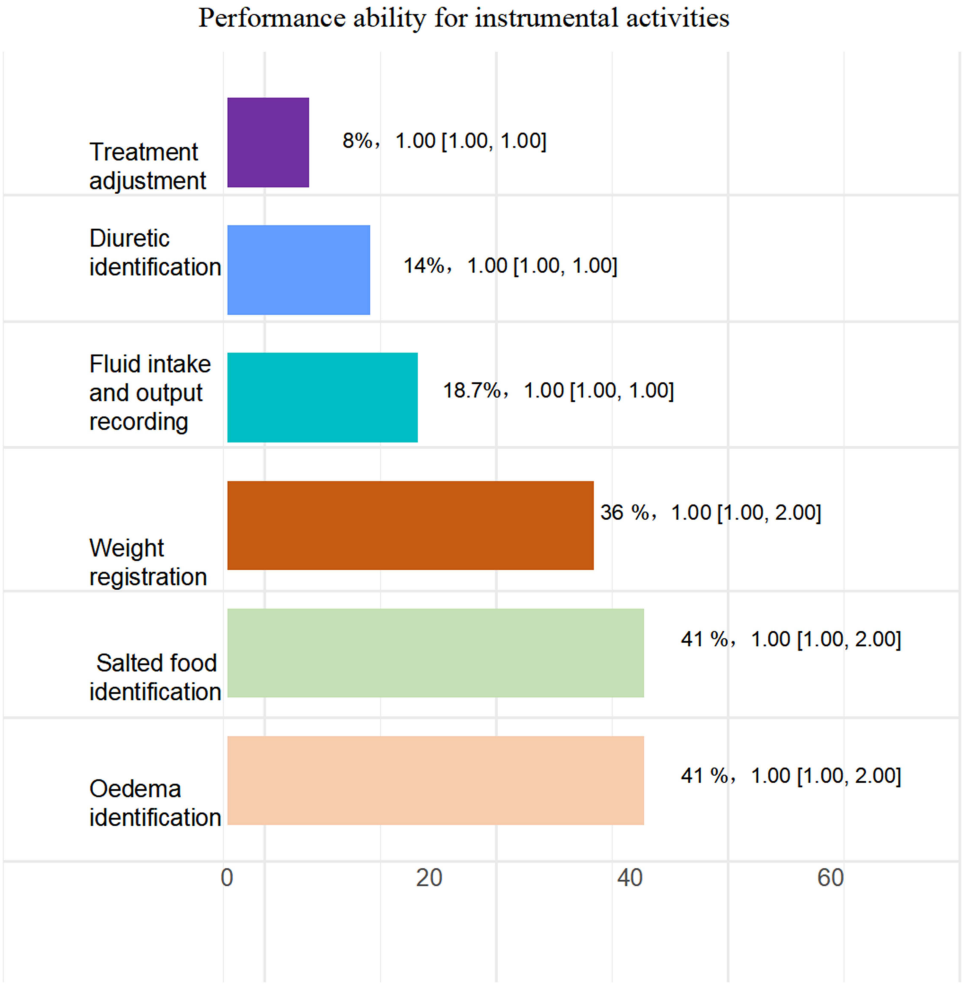

Figure 2 This bar chart illustrates the performance ability for six essential self-management tasks in patients with chronic heart failure (CHF). Each task is evaluated based on the percentage of patients who successfully completed it and the median [IQR] score for task execution.

poorer self-management ability exhibited higher uric acid levels. However, no significant correlation was observed between uric acid and NT-proBNP levels (r = 0.024, p = 0.404). The correlation matrix (Figure 1) further illustrated the relationships between specific self-management tasks and heart failure biomarkers. NT-proBNP was negatively correlated with several self-management tasks, including recording of inputs and outputs, oedema identification, and salted food identification, suggesting that higher NT-proBNP levels are associated with poorer task execution. Uric acid also showed a negative correlation with weight registration, indicating that higher uric acid levels may be related to difficulty in self-monitoring weight. These results emphasize the importance of Task Performance as a potential indicator of disease severity in CHF patients (Table 2 and Figure 1).

Table 2 Partial Correlation Analysis Between Uric Acid, Task Execution Ability, and NT-proBNP

Variable Pair	Partial Correlation Coefficient	p-value	Significance
Task Execution Ability ~ NT-proBNP	−0.337	< 0.001*	Significant
Task Execution Ability ~ Uric acid	−0.2790802	0.005*	Significant
Uric acid ~ NT-proBNP	0.024	0.404	Not Significant

Notes: Partial correlation analysis between Uric Acid, Task Execution Ability, and NT-proBNP. Significant negative correlations were observed between Task Execution Ability and NT-proBNP, as well as Task Execution Ability and Uric Acid. No significant correlation was found between Uric Acid and NT-proBNP. *$p < 0.05$, considered statistically significant.

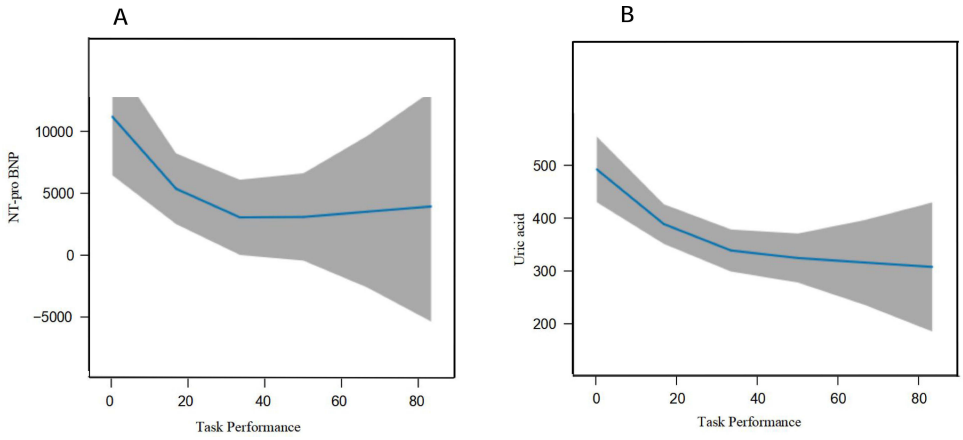

Figure 3 Trends of NT-proBNP (**A**) Levels Across Task Execution Ability. The plots display the relationship between task execution ability and biomarker levels using a smoothed trend line with a 95% confidence interval (shaded area). NT-proBNP and uric acid levels show a decreasing trend as task execution ability increases, indicating that patients with lower self-management performance tend to have higher biomarker levels. NT-proBNP, N-terminal pro-B-type natriuretic peptide (**B**) and Uric Acid.

Restricted cubic spline analysis demonstrated a downward trend in NT-proBNP and uric acid levels as Task Performance increased. Patients with lower execution ability exhibited substantially higher biomarker levels, particularly those with NT-proBNP exceeding 10,000 pg/mL. The trend stabilized at moderate-to-high execution ability levels, suggesting a non-linear relationship between self-management ability and biomarker levels. See Figure 3.

Discussion

This study investigated the relationship between self-management task performance and heart failure biomarkers (NT-proBNP and uric acid) in elderly patients with CHF. Our findings suggest that patients with lower Task Performance exhibit significantly higher NT-proBNP and uric acid levels, indicating a potential link between self-management capacity and clinical outcomes in CHF patients. From a gerontological and pathophysiological perspective, functional and cognitive impairments may act as mediating factors in the relationship between aging and poor task performance, further limiting patients' ability to engage in effective self-management. Studies have shown that cognitive impairment and physical frailty often coexist, leading to a compounded effect on functional decline. This dual burden significantly increases the risk of disability in activities of daily living (ADLs) and instrumental activities of daily living (IADLs), which are crucial for self-care.[8,9] Moreover, the presence of cognitive deficits in elderly CHF patients is independently associated with reduced ability to perform essential self-care tasks, such as medication management and recognizing symptoms of fluid overload.[4,10] This is compounded by the fact that many elderly patients with CHF lack the necessary skills for effective self-care, which correlates with higher mortality and readmission rates.[4] The relationship between cognitive impairment and self-care difficulties underscores the need for comprehensive geriatric assessments that include evaluations of both cognitive and physical capacities to identify those at greatest risk for functional decline.[8,11]

Moreover, Task Performance was negatively correlated with both NT-proBNP ($r = -0.337$, $p < 0.001$) and uric acid levels ($r = -0.279$, $p = 0.005$), suggesting that lower Task Performance is associated with higher biomarker levels. These findings are associative and do not imply causality, given the cross-sectional nature of our study design. Longitudinal or interventional research is warranted to evaluate whether improvements in self-management can lead to favorable changes in biomarker levels and patient outcomes.

Effective self-management is critical for improving prognosis and reducing hospital readmission in CHF patients.[12,13] However, our study revealed significant variability in patients' ability to perform self-management tasks, with medication-related tasks (treatment adjustment and diuretic identification) having the lowest success rates (8% and 14%, respectively). These findings align with previous studies indicating that CHF patients often struggle with medication adherence and dosage adjustments due to cognitive decline, lack of health literacy, and insufficient patient education.[14] Conversely, tasks related to oedema and dietary management (salted food identification, oedema identification) had relatively higher success rates, suggesting that patients are more aware of dietary restrictions and fluid retention

monitoring than medication adjustments. This disparity underscores the need for targeted interventions to enhance medication self-management skills, particularly in elderly CHF patients.[15]

Our study revealed a significant inverse correlation between Task Performance and NT-proBNP levels ($r = -0.337$, $p < 0.001$), indicating that patients with diminished self-management proficiency exhibit more severe cardiac dysfunction. This finding aligns with previous research, which suggests that patients with elevated NT-proBNP levels are more prone to frequent exacerbations and hospitalizations, consequently impairing their capacity to perform self-care tasks.[16] Furthermore, restricted cubic spline analysis revealed a non-linear relationship, with NT-proBNP levels decreasing as Task Performance improved, but stabilizing at moderate to high execution ability levels. This suggests that while better self-management can contribute to improved clinical outcomes, the complexity of managing CHF increases as the disease progresses, requiring a multifaceted approach that includes both medical interventions and substantial caregiver involvement. Caregivers play a crucial role in managing the daily needs of patients, which range from assisting with medication adherence to providing emotional support and coordinating healthcare appointments. The burden on caregivers can be substantial, impacting their physical, emotional, and financial well-being.[17] Patients with advanced CHF may require additional medical and caregiver support to compensate for their functional limitations.

Similarly, uric acid has emerged as a relevant biomarker in CHF, with studies linking hyperuricemia to oxidative stress, endothelial dysfunction, and poor cardiovascular outcomes.[7] In our study, uric acid levels were negatively correlated with Task Performance ($r = -0.279$, $p = 0.005$), particularly with weight registration, implying that patients with elevated uric acid levels struggle with weight monitoring. Hyperuricemia has been implicated in oxidative stress, endothelial dysfunction, and worse cardiovascular outcomes, and may serve as a marker of frailty. Patients with elevated uric acid may struggle with daily weight monitoring—a crucial behavior in early fluid retention detection. Prior research has also suggested that high uric acid levels are associated with reduced functional capacity and frailty in CHF patients,[18] which may further impair their ability to manage their disease effectively.

The observed associations between Task Performance and heart failure biomarkers highlight the need for integrating self-management assessment into routine CHF care. Given that patients with lower execution ability have worse biomarker profiles, clinical interventions should prioritize enhancing self-care proficiency through structured educational programs, cognitive training, and caregiver involvement. To address these challenges, routine clinical assessments of task execution ability could be integrated into discharge evaluations or outpatient visits, particularly for elderly or high-risk patients. Standardized screening tools that capture both cognitive and functional dimensions of task performance may help clinicians identify individuals requiring additional support. Feasible implementation strategies include brief structured checklists, scenario-based evaluations, and interdisciplinary follow-up interventions combining education, caregiver involvement, and digital reminders. Such approaches may enable timely interventions, improve biomarker control, and ultimately enhance long-term outcomes in CHF populations. Additionally, since medication-related tasks posed the greatest challenge for patients, efforts should be made to simplify medication regimens, improve patient-provider communication, and incorporate digital health tools to support adherence.[19] Future research should explore longitudinal associations between Task Performance and clinical outcomes[20] and examine whether improving execution ability through targeted interventions leads to better biomarker profiles and disease control. Moreover, further studies should investigate the role of cognitive function, social support, and psychological factors in influencing self-management performance in CHF patients.

Several limitations should be considered in interpreting our findings. First, this study used a cross-sectional design, limiting the ability to infer causality between Task Performance and biomarker levels. Second, self-management behaviors were assessed through direct task performance rather than real-world adherence, which may not fully capture patients' long-term self-care behaviors. Third, the sample size was relatively small, and future studies with larger cohorts are needed to validate these findings and explore potential subgroup differences. Finally, the use of convenience sampling from two tertiary hospitals may introduce selection bias, limiting the generalizability of our results to broader CHF populations.

Conclusion

This cross-sectional study identified significant associations between lower task execution performance and elevated NT-proBNP and uric acid levels in elderly patients with chronic heart failure, suggesting that impaired self-management ability may reflect more severe disease status. The findings also revealed age-related decline in task performance, underscoring the vulnerability of older adults in managing complex heart failure regimens. Given the observational nature of this study, these results should be interpreted as associative rather than causal. Future research should employ longitudinal or randomized controlled designs to determine whether targeted interventions aimed at improving self-management performance can translate into improved biomarker profiles and clinical outcomes. Meanwhile, integrating routine assessments of task execution ability into heart failure care, especially for high-risk or cognitively impaired patients—may help identify those needing additional support and inform the development of individualized care strategies.

Data Sharing Statement

All data supporting the findings of this study are included in the article. No additional data are available.

Ethics Approval and Consent to Participate

The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was conducted in accordance with the Declaration of Helsinki (as revised in 2013), and the study protocol was approved by the ethics committee of Sir Run Run Shaw hospital, Zhejiang university school of medicine (Approval No. 2024-Y0468). Additionally, this study was registered under the clinical record number MR-33-24-058353. Informed consent was obtained from all participants before survey initiation.

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Author Contributions

HX Z and XX H conceived and designed the study. HX Z organized project administration and drafted the manuscript, with critical revisions provided by RT W. JX C and JN D performed data analysis. YW contributed to the visualization by creating the figures. XX H, and YW were responsible for investigation and data curation. All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article, gave final approval of the version to be published, have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors have no conflicts of interest to declare.

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