ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 09 | September - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

PREVALENCE OF COGNITIVE IMPAIRMENT IN PATIENTS WITH HEART FAILURE

General Medicine

Dr. Naineesh Rajnikant Gaikwad M.D.Medicine, Senior Resident , Department of Medicine, Bharati Vidyapeeth (Deemed to be University) Medical College, Pune, Maharashtra, India. ORCID:0009-0007-1976-7577

Dr. Nitin Manohar Gadkari Professor and Department of Medicine, Bharati Vidyapeeth (Deemed to be University) Medical College, Pune, Satara Road, Dhankawadi, Pune, Maharashtra 411043, India. ORCID: 0000-0003-3636-8379

Dr. Sukanya Swapankumar Dasgupta* M.D. Medicine, Associate Professor, Department of Medicine, Bharati Vidyapeeth (Deemed to be University) Medical College, Pune, Satara Road, Dhankawadi, Pune, Maharashtra 411043, India. *Corresponding Author ORCID- 0000-0002-6229-3852

Dr.(BRIG)Shankar P Gorthi D.M. Neurology, Professor and HOD Department of Neurology, Bharati Vidyapeeth (Deemed to be University) Medical College, Pune, Satara Road, Dhankawadi, Pune, Maharashtra 411043, India. ORCID-0000-0003-3460-8682

Dr. Supriya Salil Barsode M.D. Medicine,Professor and HOD Department of Medicine, Bharati Vidyapeeth (Deemed to be University) Medical College, Pune, Satara Road, Dhankawadi, Pune, Maharashtra 411043, India. ORCID: 0000-0003-0950-2392

Dr. Srijan Ghosh MBBS, Junior Resident in Medicine, Department of Medicine, Bharati Vidyapeeth (Deemed to be University) Medical College, Pune, Maharashtra, India. ORCID-0009-0002-0801-5461

ABSTRACT

Background And Purpose: Heart failure (HF) is a global health problem with increasing prevalence. Cognitive impairment (CI) is a frequent comorbidity, affecting ~41% of HF patients worldwide and 44% in South Asia. CI contributes to poor self-care, frequent hospitalizations, reduced quality of life, and higher mortality. Despite this burden, data from India remain scarce. **Methods:** This cross-sectional study was conducted over 24 months at Bharati Hospital and Research Centre, Pune. Adults (≥18 years) with Stage C or D HF, as per ACCF/AHA criteria, were included. Patients with dementia, psychiatric illness, epilepsy, or recent CNS infection were excluded. After clinical stabilization, 100 patients underwent cognitive assessment using the Rapid Cognitive Screen (RCS), which evaluates recall, clock drawing, and story recall. Clinical and echocardiographic data were also collected. **Results:** The mean age was 55.7 ± 14.3 years, and 72% were male. CI was present in 50% of the cohort. Female patients had a significantly higher prevalence of CI than males (68% vs. 43%, $p = 0.03$). Recall impairment was universal among patients with CI, while clock drawing impairment showed the strongest statistical association ($p = 0.001$). Story recall was also significantly associated ($p = 0.047$). CI prevalence varied across ejection fraction (EF) groups-47.7% in preserved EF, 45.5% in mildly reduced EF, and 55.9% in reduced EF-but was not statistically significant ($p = 0.69$). **Conclusions:** Cognitive impairment is highly prevalent among Indian HF patients, with women disproportionately affected. Routine cognitive screening should be integrated into HF care to improve outcomes.

KEYWORDS

Cognitive impairment, Rapid Cognitive Screen, Heart Failure, Ejection Fraction

INTRODUCTION -

Heart failure (HF) is a growing public health concern with a rising global prevalence, affecting approximately 64 million people worldwide [1]. In India, the estimated burden ranges from 8 to 10 million individuals, constituting 1–2% of the adult population[2]. HF arises from diverse etiologies including hypertensive heart disease, ischemic cardiomyopathy, valvular heart disease, and chronic pulmonary conditions, with risk factors such as advancing age, hypertension, and diabetes mellitus contributing to its progression.[2]

Cognitive impairment (CI) is a well-documented, multifactorial complication of HF, reported in approximately 41% of HF patients globally and up to 44% in South Asian populations [3] . The proposed mechanisms include cerebral hypoperfusion, systemic inflammation, arterial hypotension, neurohormonal dysregulation, and coexisting depression [4,5]. CI in HF is associated with adverse outcomes such as poor treatment adherence, diminished self-care capacity, frequent hospitalizations, and increased mortality [6,7].

Despite its significant clinical implications, CI remains underdiagnosed in HF patients, especially in India where epidemiological data are limited[8]. Standard cognitive assessment tools like the Mini-Mental State Examination (MMSE) and Montreal Cognitive Assessment (MoCA) are effective but time-intensive. The Rapid Cognitive Screen (RCS), a brief tool derived from the Saint Louis University Mental Status (SLUMS) instrument, offers a practical alternative suitable for high-volume settings [9].

This study was undertaken to determine the prevalence of cognitive impairment in heart failure patients using the RCS and to assess its association with ejection fraction (EF), thereby addressing a critical gap in the Indian healthcare context.

MATERIALS AND METHODS

Study Design And Study Population :- A **cross sectional** study was conducted at Bharati Hospital and Research centre, Pune, in the Department of Medicine and Neurology, over 24 months, following approval from the Institutional Ethics Committee.

Inclusion Criteria

The study included individuals aged 18 years and above who were diagnosed with Stage C or Stage D heart failure, as defined by the ACCF/AHA guidelines.

Exclusion Criteria:

Patients with a history of Alzheimer's disease or any dementia were excluded. Also excluded were patients with known psychiatric illness, a history of epilepsy, or recent meningitis (less than 1 year prior).

Sample size: The target sample size for the study was calculated to be **96 patients** . This calculation was based on the formula $n = Z^2 P(100-P)/d^2$, where Z=1.96, P=50 (taken as the estimated prevalence), and d=10 (representing 20% of the prevalence) . While a reference article reported a prevalence of 44%, a prevalence of 50% was used for this study's sample size calculation as the scales for measuring CI were

different . The study ultimately included a total of **100 individuals**.

Data Collection

Patients diagnosed with heart failure and admitted to the male and female medical wards, High Dependency Units (HDU), and Intensive Care Units (ICU) were screened for eligibility. Informed written consent was obtained from all participants who met the inclusion criteria. Patients were enrolled once they were clinically stabilized, defined as requiring no or minimal oxygen support and being able to speak a full sentence in a single breath. A detailed medical history was obtained, followed by a comprehensive clinical examination. Relevant physical, haematological, biochemical, and radiological investigations conducted during hospitalization were documented. In particular, serum B-type natriuretic peptide (BNP) levels and 2D-Echocardiography (2D-ECHO) findings were noted. Basic epidemiological, haematological, and biochemical data were also collected. The investigator then administered the Rapid Cognitive Screen (RCS) to assess cognitive function, and the findings were documented accordingly.

Cognitive Assessment

Cognitive function was evaluated using the Rapid Cognitive Screen (RCS), a brief, validated tool designed for use in clinical settings. The RCS assesses three key cognitive domains—recall, clock drawing (executive and visuo-spatial functions), and story recall (attention and analytical ability)—and categorizes impairment as mild, moderate, or severe. The Rapid Cognitive Screen (RCS) is a brief, validated tool designed to screen for cognitive impairment. It can be completed in approximately three to five minutes, making it particularly suitable for use in busy primary health care settings. RCS classifies cognitive impairment into three categories: mild, moderate, or severe. It comprises three components adapted from the Veterans Affairs Saint Louis University Mental Status (SLUMS) examination:

1-**Recall of five words** (maximum 5 points),

2-**Clock drawing** (maximum 4 points; 2 points for correct hour markers and 2 points for accurate time representation),

3-**Story recall and location recognition** (maximum 1 point). The total score ranges from 0 to 10. Based on the scoring thresholds, a score of 8–10 indicates normal cognitive function, 6–7 suggests mild cognitive impairment, and 0–5 indicates moderate to severe cognitive impairment.

Case Definitions:

Heart failure was defined as the inability of the heart to effectively pump blood, leading to symptoms and signs from a problem affecting the heart's structure or function, including issues with filling or ejecting blood .

Stages C and D of heart failure, as per the 2022 ACCF/AHA guidelines, were included in the study.

Symptomatic HF (Stage C): Individuals with previous or current symptoms of HF who also have structural heart disease.

Advanced HF (Stage D): Patients experiencing severe HF symptoms that significantly impact daily life and necessitate frequent hospitalizations, despite receiving all recommended medical treatments.

Data Analysis

All collected data were initially entered into Microsoft Excel spreadsheets for organization and preliminary review. Data cleaning was performed to check for completeness, accuracy, and consistency prior to statistical analysis. Subsequent statistical analysis was conducted using **IBM SPSS Statistics software, version 26**. Descriptive statistics were employed to summarize the demographic and clinical characteristics of the study population. Continuous variables such as age were expressed as **mean ± standard deviation (SD)**, while categorical variables such as gender and cognitive impairment status were presented as **frequencies and percentages**. To assess the association between categorical variables—such as gender, cognitive impairment, and domain-specific deficits—**Chi-square tests (χ^2)** were used. A **p-value < 0.05** was considered statistically significant. The relationship between **ejection fraction categories (preserved, mildly reduced, reduced)** and cognitive impairment levels, as well as the involvement of specific cognitive domains across ejection fraction grades, was also evaluated using **Chi-square tests**. All statistical results were interpreted in the context of clinical relevance, and findings were represented using appropriate tables and charts to enhance clarity and understanding.

RESULTS:-

Study Population

A total of 100 patients diagnosed with heart failure (HF) were enrolled. The mean age of the participants was **55.66 ± 14.33 years**. The majority were male (**72%**, n = 72), and females comprised **28%** (n = 28), indicating a higher prevalence of HF in men in this cohort.

Prevalence Of Cognitive Impairment

Cognitive impairment (CI) was present in **50%** of the study population (n = 50), based on Rapid Cognitive Screen (RCS) scoring, while the remaining 50% had normal cognitive function.

Association Between Gender And Cognitive Impairment

Among male participants, **43% (n = 31)** had CI, while **68% (n = 19)** of females were cognitively impaired. This gender difference was **statistically significant (p = 0.03)**, suggesting that female HF patients may be at a higher risk for CI.

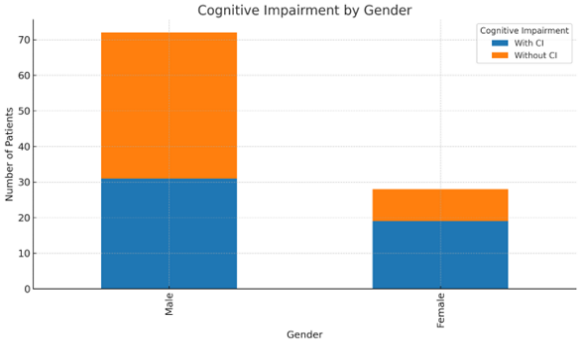

Figure 1 illustrates the distribution of cognitive impairment among male and female heart failure patients. It shows that while the absolute number of male participants was higher, the proportion of females with cognitive impairment (68%) was substantially greater than that of males (43%). This gender-based difference was statistically significant (**p = 0.03**), suggesting a potentially higher vulnerability to cognitive decline among female HF patients.

Cognitive Domain Impairment

Of the 50 individuals with CI:

- **Recall impairment** was present in **100%**. Among non-CI participants, 45 had recall impairment, while 5 did not (**p = 0.02**).
- **Clock drawing impairment** was found in **80%** of CI patients, but only **2** in the non-CI group had this deficit. This showed the strongest statistical association with CI (**p = 0.001**).
- **Story recall impairment** was seen in **16%** of CI patients, and only **2** of the non-CI participants, also statistically significant (**p = 0.047**).

Though recall impairment was most common, clock drawing (representing executive and visuo-spatial function) showed the strongest statistical link.

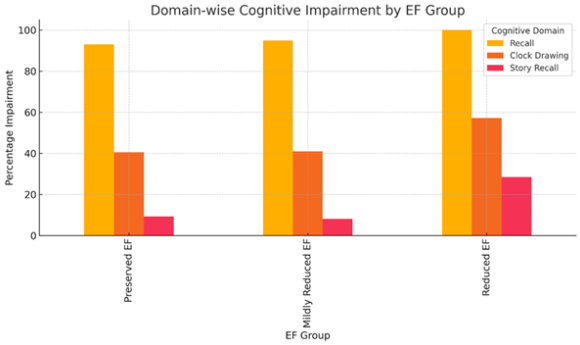

Figure 2 compares the number of patients with and without cognitive impairment across three domains tested by the Rapid Cognitive Screen: recall, clock drawing, and story recall. All patients with CI exhibited recall impairment (100%), but **clock drawing** showed the strongest statistical association with CI (**p = 0.001**), followed by **recall** (**p = 0.02**) and **story recall** (**p = 0.047**). This highlights that while recall

is commonly affected, executive and visuo-spatial dysfunction (assessed through clock drawing) may be more specific indicators of CI in HF.

Association Between Ejection Fraction And Cognitive Impairment

Participants were categorized into three groups based on ejection fraction (EF):

- **Preserved EF (>50%)** – 44 patients
- **Mildly Reduced EF (41–49%)** – 22 patients
- **Reduced EF (<40%)** – 34 patients

The prevalence of CI in each group was:

- **47.72%** in Preserved EF
- **45.45%** in Mildly Reduced EF
- **55.88%** in Reduced EF

Although CI was highest in the Reduced EF group, the association between EF and CI was **not statistically significant (p = 0.69)**.

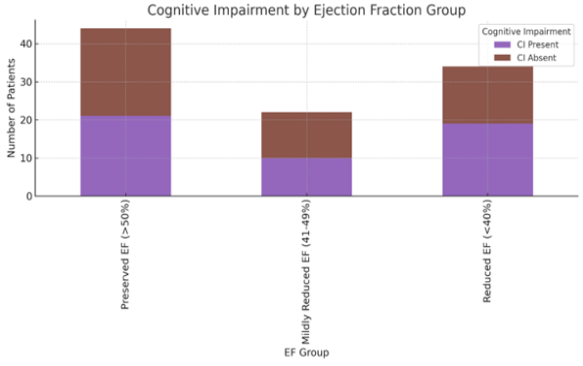

Figure 3 shows the distribution of cognitive impairment across three categories of ejection fraction: preserved EF (>50%), mildly reduced EF (41–49%), and reduced EF (<40%). While the highest percentage of CI was observed in the **reduced EF group (55.88%)**, the differences across groups were **not statistically significant (p = 0.69)**. This suggests that
while EF may influence CI prevalence, it may not be an independent predictor in this study population.

Cognitive Domain Impairment Across EF Grades

The percentage of domain impairment by EF group was as follows:

- **Recall impairment:** 93% (HFpEF), 95% (HFmrEF), 100% (HFrEF)
- **Clock drawing impairment:** 40.62% (HFpEF), 40.98% (HFmrEF), 57.14% (HFrEF)
- **Story recall impairment:** 9.37% (HFpEF), 8.19% (HFmrEF), 28.57% (HFrEF)

Although impairment was most pronounced in the Reduced EF group, none of the associations across EF grades were statistically significant (Recall: p = 0.79; Clock Drawing: p = 0.70; Story Recall: p = 0.23).

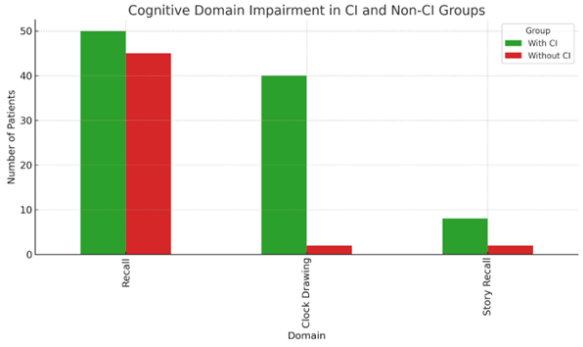

Figure 4 presents the percentage of patients with impairment in each cognitive domain (recall, clock drawing, and story recall) across EF categories. Although **recall impairment** was nearly universal across all EF groups, **clock drawing** and **story recall impairments** were more frequent in the **reduced EF group**. However, these trends were **not statistically significant**. The figure emphasizes that cognitive domain involvement may increase with declining EF, even if statistical confirmation was not reached.

DISCUSSION

The current study set out to determine the prevalence of CI in this population and investigate the association between ejection fraction and CI levels, given the noteworthy burden of cognitive impairment among heart failure patients. The findings show significant correlations between heart failure and cognitive impairment and offer insightful information about the clinical and demographic features of the study population.

The study included 100 heart failure patients with a mean age of 55.66 ± 14.33 years. This finding aligns with Niu Q [10] et al. and Yap NLX [11] et al., who also reported a similar mean age Of 55.66 for their cohorts. In contrast, other studies have focused on older populations, such as Dodson JA [12] et al., who reported a mean age of 80 ± 8.0 years, and another study where Participants had a mean age of 76.11 ± 13.38 years. This variance highlights differences in patient demographics across studies, with some focusing on younger heart failure patients and others on an older demographic.

According to the gender distribution, men were more likely than women to have heart failure (72% vs. 28%), which is consistent with previous research Regitz-Zagrosek V. and Azad N, Kathiravelu A [13,14] showing that men are more likely than women to have heart failure.

The current study found a significant link between sex and cognitive impairment, with a p-value of 0.03, indicating that females are more likely to experience cognitive impairment. This finding aligns with the results of Leto L and Feola M. [15], who also reported that 50% of females had cognitive impairment. Additionally, Tirziu D [16] et al. found that among 23 female patients (15.6% of the total), 15 were affected by cognitive impairment, representing 71.42% of the female cohort.

Prevalence Of Cognitive Impairment:

Although the severity of the heart failure varied, 50% of the patients had CI , highlighting the high prevalence of cognitive dysfunction in this population.

The fact that cognitive impairment is present in 50% of the heart failure individuals highlights a significant association between the two conditions. This prevalence aligns with existing literature which often reports high rates of cognitive impairment in individuals with heart failure. As observed in study by Yap NLX [11] et al. with CI prevalence of 41.42%, the current study's 50% prevalence of cognitive impairment among heart failure (HF) patients is comparable.

Dodson JA [12] et al. reported a 46.8% prevalence in older adults hospitalized for heart failure, Soares VL [17] et al., who found that hospitalized HF patients had a 53.5% CI prevalence, which is comparable to the current study. According to research by Niu Q [10] et al., 81% of Chinese heart failure (HF) patients have cognitive impairment. This study shows a markedly high prevalence. This may be due to- older population 76.11 +_ 13.38 years, more sensitive screening tools used such as MMSE And MoCA which were time consuming ,lower cut off MocA and MMSE signifying CI (.e., MoCA < 25, MMSE < 25, MMSE < 28, or both MoCA < 25 and MMSE < 28).

In one study done by Vogels RL [5] et al. which was a systematic review, although they did not mention prevalence, the HF patients performed neuropsychologically significantly worse than controls, and their odds ratio for CI was 1.62. Thus a robust correlation between HF and cognitive impairment is confirmed by both the studies. While Vogels RL [5] et al. stressed the importance of thorough neuropsychological and neuro-imaging investigations, the current study concentrated on clinical and demographic traits, identifying noteworthy correlations between gender and CI in addition to prior cardiac illness. According to Debette S. et al. [18]. Prevalence of CI 61% of patients hospitalized for decompensation of chronic heart failure (CHF) had an MMSE score of ≤28, and 31% scoring <24, According to Futami S [19] et al., the prevalence CI was 66.7% among elderly patients admitted to a geriatric hospital who used the MMSE (MMSE ≤23). In Gure TR [20] et al. study reported that among older adults with HF, there was a 24% prevalence of mild cognitive impairment and a 15% prevalence of dementia. (Total CI -39%)

The above studies discussed and emphasized the critical need for routine cognitive evaluations in the management of heart failure (HF)

patients. They underscore the increased rates of cognitive impairment among these patients and the necessity for specialized cognitive assessments. Identifying and addressing cognitive impairment in HF patients is essential for improving patient care, as it significantly affects their quality of life, treatment adherence, and overall health outcomes.

Heart Failure Grades and CI:

The study categorised HF patients in Preserved EF(>50%), Mildly reduced EF(41-49%), Reduced EF(<40%) with 44%vs 22%vs34%.

The prevalence of CI cases in these grades of HF was 47.72%,45.45 %, and 55.88% of the group respectively.

This data shows that maximum prevalence of CI was in Reduced EF category.

However, there is no statistically significant association in the distribution. of the CI across the different heart failure grades as indicated by p-value of 0.69.

One study has suggested varying impacts of heart failure severity on cognitive function. For instance, Vogels [5] et al. highlighted that HF patients generally exhibit diminished neuropsychological performance compared to controls, emphasizing a potential link to ejection fraction disparities but unlike our study, this research did not study CI as per different HF grades.

In contrast, Zuccalà G [21] et al. identified more direct correlations where lower ejection fractions were associated with poorer cognitive performances, particularly in more severely affected HF groups. This suggests that while our study found no significant statistical association across ejection fraction categories, the broader literature indicates that lower ejection fractions might indeed exacerbate cognitive deficits. (although more percentage of Reduced EF HF patients had CI as compared to preserved and mildly reduced).

This result is in contrast to other research that found a stronger correlation. For instance, a review by Goh FQ [22] et al. found a correlation between lower ejection fractions and worse cognitive performances, especially on the Mini Mental Status Examination.

Additionally, Xu C [23] et al. brought attention to the fact that decreased cerebral blood flow-a common problem in heart failure patients with lower ejection fractions-is linked to cognitive deficits, supporting the idea that cerebral blood flow plays a mediating role in the heart-brain axis.

These discrepancies underscore the complexity of HF-related cognitive impairment and suggest that factors beyond ejection fraction-such as underlying cardiovascular pathology, comorbid conditions, and the chronicity of heart failure-may play critical roles. This finding raises the possibility that diminished cardiac function is linked to cognitive decline All of these findings point to the possibility that, even though ejection fraction may not always be directly Linked with cognitive outcomes in heart failure individuals , the general state of reduced cardiac output and its effect on cerebral circulation may have a major impact on cognitive health.

Overall, the discussion around heart failure and cognitive impairment remains vibrant and suggests a multifactorial relationship that warrants further investigation, particularly in how different HF classifications interact with cognitive health over time. The need for more detailed and segmented research, perhaps focusing on specific HF classifications or broader patient demographics, is apparent to better tailor interventions and improve outcomes for these patients.

To completely grasp the implications for patient care and management, this intricate interaction needs more research.

Domain Involved:

In patients with CI, although recall domain is the most common domain to be affected (100% vs 80% vs 16%) however the most strong statistical association is between CI and Clock drawing ability which involves executive and visuo-spatial domain (p value 0.001>0.02>0.047).These findings correlate well with the study of Soares VL [17] et al., who found that hospitalized HF patients had most affected domain with recall memory (p value <0.001).

In a study by Göpfert D [24] et al A total of 55 HF patient (37.4%) had attention deficit and 50 patient (37.2%) had all domains of cognition affeceted negatively. According to studies by Tirziu D [16] et al.

A pooled meta-analysis involving over 8,000 patients with heart failure and effect size data for 20 neuropsychological domains reported that patients with heart failure show the largest differences compared to heart failure-free controls in executive functioning, global cognition, complex psychomotor speed, and verbal memory. However, the study did not investigate which specific domain was the most affected.

The above articles concur with our findings and thus signifying that for evaluation of CI in HF executive function and recall must be check on regular basis, worsening in score of above mention domain should prompt physician regarding worsening of CI .

CONCLUSION

This study demonstrates that cognitive impairment is highly prevalent among patients with heart failure, affecting 50% of the study population. Notably, female patients exhibited a significantly higher prevalence of cognitive dysfunction compared to males. Among the cognitive domains assessed, recall was universally affected in those with CI; however, clock drawing, reflecting visuo-spatial and executive function, showed the strongest statistical association. Although a higher proportion of patients with reduced ejection fraction had cognitive impairment, no statistically significant relationship was established between EF categories and CI or domain-specific deficits. These findings highlight the critical need for routine cognitive screening in heart failure management and support a multidisciplinary approach that addresses both cardiac and cognitive health in these patients.

Limitations

1. Use of a brief screening tool: The Rapid Cognitive Screen (RCS), though practical and validated, may lack the sensitivity of comprehensive neuropsychological assessments such as the MMSE or MoCA, potentially leading to underestimation of cognitive impairment.

2. No adjustment for educational level: The study did not incorporate educational background into cognitive scoring, which may have biased results, particularly in participants with limited formal education.

3. Cross-sectional design: The observational nature of the study limits conclusions about causality between heart failure severity and cognitive impairment.

4. Single-center study with a modest sample size: Conducted at a single tertiary care center with 100 participants, the findings may not be generalizable to broader populations or different healthcare settings.

5. Potential selection bias: Patients were enrolled only after clinical stabilization, potentially excluding those with more severe illness who may be at greater risk for cognitive dysfunction.

Future Research Avenues

To build upon the findings of this study, the following directions are proposed for future research:

- **Longitudinal follow-up**: A prospective cohort design to evaluate the progression of cognitive impairment over time and its impact on clinical outcomes such as rehospitalization and mortality.
- **Use of comprehensive cognitive assessments**: Incorporation of detailed tools like MoCA or MMSE, along with functional imaging or biomarkers, to validate and deepen understanding of cognitive deficits in HF.
- **Multicenter, larger-sample studies**: To enhance generalizability and explore demographic and regional variations in CI among HF patients across India.
- **Intervention trials**: To evaluate whether cognitive rehabilitation, caregiver training, or tailored HF management plans can mitigate the effects of CI and improve adherence and quality of life.

Declaration Of Funding And Conflicts Of Interest

The research did not receive specific grants from any funding agencies and the authors have no potential conflicts of interest to disclose.

REFERENCES

1. .Lippi G, Sanchis-Gomar F. Global epidemiology, and future trends of heart failure. AME Med J. 2020 Jun 25;5(15):1-6.
2. Chaturvedi V, Parakh N, Seth S, Bhargava B, Ramakrishnan S, Roy A, et al. Heart failure

in India: the INDUS (India Ukieri study) study. Journal of the Practice of Cardiovascular Sciences. 2016;2(1):28-35.
3. Dong Y, Teo SY, Kang K, Tan M, Ling LH, Yeo PS, et al. Cognitive impairment in Asian patients with heart failure: prevalence, biomarkers, clinical correlates, and outcomes. European journal of heart failure. 2019 May;21(5):688-90
4. Leto L, Feola M. Cognitive impairment in heart failure patients. J Geriatr Cardiol. 2014 Dec;11(4):316-28.
5. Vogels RL, Scheltens P, Schroeder-Tanka JM, Weinstein HC. Cognitive impairment in heart failure: a systematic review of the literature. European journal of heart failure. 2007 May;9(5):440-9.
6. Alosco ML, Spitznagel MB, van Dulmen M, Raz N, Cohen R, Sweet LH et al. Cognitive function and treatment adherence in older adults with heart failure. Psychosom Med. 2012 Nov-Dec;74(9):965-73
7. Dickson VV, Tkacs N, Riegel B. Cognitive infuences on self-care decision making in persons with heart failure. Am Heart J. 2007; 154(3):424–431.
8. Gaviria M, Pliskin N, Kney A. Cognitive impairment in patients with advanced heart failure and its implications on decision-making capacity. Congestive heart failure. 2011 Jul;17(4):175-9.9.
9. Malmstrom TK, Voss VB, Cruz-Oliver DM, Cummings-Vaughn LA, Tumosa N, Grossberg GT, et al. The Rapid Cognitive Screen (RCS): a point-of-care screening for dementia and mild cognitive impairment. J Nutr Health Aging. 2015 Aug;19(7):741-4
10. Niu Q, Liu W, Wang F, Dong Y. Prevalence and factors associated with cognitive impairment in Chinese heart failure patients: A pilot study. Front Cardiovasc Med. 2022 Sep 23;9:978432Dodson JA, Truong TT, Towle VR, Kerins G, Chaudhry SI. Cognitive impairment in older adults with heart failure: prevalence, documentation, and impact on outcomes. Am J Med. 2013 Feb;126(2):120-6.
11. Yap NLX, Kor Q, Teo YN, Teo YH, Syn NL, Evangelista LKM, et al. Prevalence and incidence of cognitive impairment and dementia in heart failure - A systematic review, meta-analysis and meta-regression. Hellenic J Cardiol. 2022 Sep-Oct;67:48-58.
12. Dodson JA, Truong TT, Towle VR, Kerins G, Chaudhry SI. Cognitive impairment in older adults with heart failure: prevalence, documentation, and impact on outcomes. Am J Med. 2013 Feb;126(2):120-6.
13. Regitz-Zagrosek V. Sex and Gender Differences in Heart Failure. Int J Heart Fail. 2020 Apr 13;2(3):157-181.
14. Azad N, Kathiravelu A, Minoosepeher S, Hebert P, Fergusson D. Gender differences in the etiology of heart failure: A systematic review. J Geriatr Cardiol. 2011 Mar;8(1):15-23
15. Feola M. Cognitive impairment in heart failure patients. Journal of geriatric cardiology: JGC. 2014 Dec;11(4):316
16. Tirziu D, Michalina Kołodziejczak, Grubman D, Carrión CI, Driskell LD, Ahmad Y, et al. Impact and Implications of Neurocognitive Dysfunction in the Management of Ischemic Heart Failure. Journal of the Society for Cardiovascular Angiography & Interventions. 2023 Nov 1;2(6):101198–8.
17. Soares VL, Pereira C, Carvalho AC, Mota TP, Groehs RV, Bacal F et al. Prevalence and Association Between Cognition, Anxiety, and Depression in Patients Hospitalized with Heart Failure. Int J Cardiovasc Sci. 2023; 36: e20210226
18. Debette S, Bauters C, Leys D, Lamblin N, Pasquier F, de Groote P. Prevalence and determinants of cognitive impairment in chronic heart failure patients. Congest Heart Fail. 2007 Jul-Aug;13(4):205-8.
19. Futami S, Ishikawa J, Jubishi C, Shimizu R, Murata T, Aoyama R et al. Prevalence and Determinants of Cognitive Impairment in Elderly Patients with Heart Failure - Pilot Study in a Geriatric Hospital. Circ Rep. 2020 Mar 26;2(5):265-270.
20. Gure TR, Blaum CS, Giordani B, Koelling TM, Galecki A, Pressler SJ, et al. Prevalence of cognitive impairment in older adults with heart failure. J Am Geriatr Soc. 2012 Sep;60(9):1724-9
21. Zuccalà G, Onder G, Marzetti E, Monaco MR, Cesari M, Cocchi A, et al; GIFA Study Group. Use of angiotensin-converting enzyme inhibitors and variations in cognitive performance among patients with heart failure. Eur Heart J. 2005 Feb;26(3):226-33.
22. Goh FQ, Kong WKF, Wong RCC, Chong YF, Chew NWS, Yeo TC et al. Cognitive Impairment in Heart Failure-A Review. Biology (Basel). 2022 Jan 23;11(2):179.
23. Xu C, Tao X, Ma X, Zhao R, Cao Z. Cognitive Dysfunction after Heart Disease: A Manifestation of the Heart-Brain Axis. Oxid Med Cell Longev. 2021 Aug 18;2021:4899688
24. Göpfert D, Traub J, Sell R, Homola GA, Vogt M, Pham M, et al. Profiles of cognitive impairment in chronic heart failure-A cluster analytic approach. Front Hum Neurosci. 2023 Apr 20;17:1126553.