Pak. J. Chest Med. 2024;30(04)

Original Article

journal homepage: https:/www.pjcm.net/

Pakistan Journal of Chest Medicine

Official journal of Pakistan Chest Society

Multidimensional Frailty and its impact on Rehabilitation outcomes in older adults with Chronic Heart Failure and Chronic Obstructive Pulmonary Disease

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Article History:

Received:	May 14, 2024
Revised:	Aug 23, 2024
Accepted:	Oct 25, 2024
Available Online:	Dec 02, 2024

Author Contributions:
SN conceived idea, MA drafted the study, MA collected data, did statistical analysis and interpretation of data, SN critical reviewed manuscript. Both approved final version to be published.

Declaration of conflicting interests:
The authors declare that there is no conflict of interest.

How to cite this article:
Nisar S, Aman M. Multidimensional Frailty and its impact on Rehabilitation outcomes in older adults with Chronic Heart Failure and Chronic Obstructive Pulmonary Disease. Pak J Chest Med. 2024;30(04):478-483.

ABSTRACT

Background: Frailty is a multidimensional syndrome that commonly affects older adults and can significantly influence rehabilitation outcomes. In patients with chronic heart failure (CHF) and chronic obstructive pulmonary disease (COPD), frailty spans physical, cognitive, emotional, nutritional, and social domains. Understanding the impact of frailty on recovery is essential for optimizing care strategies in this vulnerable population.

Objective: To find out the impact of frailty, assessed across physical, cognitive, emotional, nutritional, and social domains, on the rehabilitation outcomes of older patients with CHF and COPD.

Methodology: A prospective observational study was conducted at Peshawar General Hospital, Peshawar, enrolled 60 clinically stable patients aged 65 years or older with CHF or COPD. Baseline and discharge frailty and associated domains were measured using validated instruments. Primary outcomes were physical function and independence improvements; secondary outcomes were mood, cognition, and frailty status.

Results: Both CHF and COPD patients demonstrated large physical performance improvement (SPPB, TUG, 6MWT), mood (PHQ-9, GAD-7), executive function (FAB), and frailty score improvements. Frailty was reduced in 26.6% of patients after rehabilitation. There was slightly better cognitive performance at baseline among the COPD patients and good response among them in subdomains of attention and language. Baseline differences in disease profiles did not prevent benefit from rehabilitation in either group.

Conclusion: Multidimensional rehabilitation significantly improves functional, cognitive, and emotional function in frail older persons with cardiorespiratory disease. Frailty is a reversible syndrome, incorporating vigorous frailty assessments can optimize rehabilitation interventions and facilitate enhanced recovery patterns.

Keywords: Frailty; COPD; CHF; Multidimensional Assessment; Rehabilitation Outcomes

Introductions

Aging population is one of the biggest public health challenges worldwide. As life expectancy rises and medical advances improve management of serious illnesses, more people are living longer. However, this demographic change also brings a growing number of chronic diseases that are not contagious.[1] Conditions affecting the heart and lungs, like chronic obstructive pulmonary disease (COPD) and chronic heart failure (CHF), are particularly concerning. These conditions often lead to problems with memory, emotional distress, lower quality of life, and a gradual decline in physical abilities.[2]
Moreover, since most patients with these conditions are elderly, frailty has become a major concern. Frailty is a complex condition in older adults. It is marked by reduced strength, endurance, and physical function.[3] This condition affects a person's ability to handle stress. It is linked to a higher risk of bad outcomes, such as falls, longer hospital stays, complications from medications, problems after surgery, moving to a care facility, and death. Importantly, frailty differs from both comorbidity and disability.[4] It is seen as a separate predictor of health decline, even when there is no clear disease progression.[5]
Multidisciplinary rehabilitation services, like pulmonary and cardiac rehabilitation, have shown significant benefits in improving clinical outcomes for people with cardiorespiratory diseases. These structured programs aim to improve physical capacity, relieve symptoms such as shortness of breath and fatigue, enhance health-related quality of life, and lower hospital readmissions. Key components usually include supervised exercise training, nutritional counseling, psychological support, and patient education.[6] However, older patients with multiple health issues and reduced physical reserves may have different results from standard rehabilitation protocols.
Recent evidence shows that frailty can significantly change how people respond to rehabilitation treatments. It affects both the level and lasting effects of the benefits.[7] Frail individuals might react differently to standard rehabilitation methods, which means we need customized approaches regarding the intensity, duration, and focus of the interventions.
Despite its potential importance in healthcare, few studies have looked at frailty in older adults who are being treated for cardiorespiratory diseases. Most existing research focuses on only a few aspects of frailty or on small groups of patients, which makes it hard to apply the findings more broadly.[8] There is also ongoing debate about which parts of frailty best predict outcomes in rehabilitation.
This study aims to fill that gap by sharing initial findings from a comprehensive evaluation of frailty and its link to rehabilitation outcomes in older patients with cardiorespiratory diseases. We assessed frailty using standardized tools across five areas: physical function (gait speed, handgrip strength), cognitive function (Mini-Mental State Examination and Addenbrooke's Cognitive Examination III), emotional status (depression and anxiety scales), nutritional status (Mini Nutritional Assessment), and social support (living arrangement, caregiver availability). By examining how these areas interact and affect recovery during rehabilitation, we hope to identify the patient-related factors that most strongly predict success in treatment.

Objective

To find out the impact of frailty, assessed across physical, cognitive, emotional, nutritional, and social domains, on the rehabilitation outcomes of older patients with CHF and COPD.

Methodology

This prospective observational study was conducted at Peshawar General Hospital, Peshawar to assess the correlation of frailty with rehabilitation outcomes in elderly people suffering from cardiorespiratory disease between March 2022 and August 2023. Patients aged 65 years and above with a clinical diagnosis of chronic obstructive pulmonary disease (COPD), heart failure, or ischemic heart disease were enrolled if they were clinically stable and admitted to a regimen rehabilitation program. Patients with severe cognitive impairment, terminal illness, or those unwilling to participate were excluded. A total of 60 patients were enrolled over six months.
Frailty was quantified through a multidimensional method involving physical, cognitive, emotional, and nutritional aspects. Physical frailty was assessed with the Fried Frailty Criteria, gait speed, and the Short Physical Performance Battery (SPPB). Addenbrooke's Cognitive Examination III (ACE III) is a screening test, designed for the early detection of cognitive deterioration, while nutritional status was measured with the Mini Nutritional Assessment (MNA). Emotional status was determined using the Geriatric Depression Scale (GDS-15). Functional independence was measured with the Barthel Index. Social support, comorbidities, and severity of cardiorespiratory disease were also assessed.
All patients received an individualized rehabilitation program consisting of supervised exercise training, respiratory therapy, nutritional education, and psychosocial intervention. Outcome measures were taken on admission and discharge, and primary outcomes were the changes in physical functioning and functional independence. Secondary outcomes were mood improvement and hospital readmission reduction.
Data were analyzed with SPSS version 27. Paired t-tests or their non-parametric equivalents were utilized to determine changes from baseline to discharge. Researchers examined how various components of frailty relate

to rehab outcomes, with statistical significance at $p < 0.05$.

Results

Both groups were predominantly elderly, male, and retired with comparable living arrangements and carer support. However, individuals with lung disease were ill for longer and more likely to have had a history of smoking. These results show the chronicity and lifestyle associations of respiratory diseases (Table 1).

Table 1. Clinical Characteristics of CHF and COPD Groups

Variable	CHF (n = 30)	COPD (n = 30)	p-value
Age (years)	75.3 ± 6.1	74.5 ± 6.0	0.48
Gender (% male)	20 (66.6%)	22 (73.3%)	0.22
Duration of illness (month)	51.7 ± 93.5	115.3 ± 85.7	0.001
Smoking (current or past)	16 (53.3%)	19 (63.3%)	0.05
Retired (%)	23 (76.6%)	24 (80%)	0.29
Living alone (%)	9 (30%)	8 (26.7%)	0.78
Caregiver available (%)	14 (46.6%)	25 (50%)	0.15

Cognitive functioning, as assessed by ACE-III, was significantly improved in the COPD group, particularly in attention/orientation and language subdomains. While COPD patients scored slightly higher on MMSE and FAB, this was not statistically significant. Depression (PHQ-9) and anxiety (GAD-7) symptoms were mild and similar in both groups. Frailty, as measured by a Clinical Frailty Scale score of 5 or above, was also more common in the CHF group (36.7%) than the COPD group (30%), although the difference was not statistically significant. These results indicate that cognitive status was relatively better in COPD patients, and that psychological symptoms and levels of frailty were comparable for both groups (Table 2).

There were significant improvements in cognitive function (FAB), quality of life (EQ-VAS), depression (PHQ-9), anxiety (GAD-7), physical performance (SPPB), mobility (TUG), and walking capacity (6MWT), all with statistically significant p-values ($p \leq 0.001$). This confirms that the intervention was effective across psychological and physical health measures (Table 3).

Frailty decreased in 70% of patients, stayed the same in 26.6%, and increased in 3.33%. The change was statistically significant ($p = 0.028$), showing that the intervention had a significant effect on decreasing frailty (Table 4).

Discussion

The results of the present study highlight the essential role played by frailty in determining outcomes of rehabilitation in older individuals with cardiorespiratory disease. A multidimensional frailty index covering physical function, cognitive status, emotional well-being, and nutritional status is utilized in this study to give a full picture of how multifaceted geriatric syndromes interact with such chronic conditions as COPD and CHF. The improvement seen in more than one area, such as mobility (SPPB, 6MWT, TUG), mood (PHQ-9, GAD-7), and cognitive function (FAB, ACE-III), implies that individualized, goal-directed rehabilitation programs are effective in even those with compromised physiological reserve.

One of the findings of this study is that frailty, generally perceived as a Permanent marker of aging or disease burden, is actually modifiable. As many as 70% of the patients improved their frailty status after a relatively brief rehabilitation intervention. This is consistent with other evidence from studies like the REHAB-HF trial, a study conducted by Chew et al. (2022), where individualized rehabilitation enhanced physical functioning and attenuated frailty in older heart failure patients admitted for care.[9] The same implications were shown by Tsukakoshi et al. (2022) after observing a decline in the frailty scores of CHF patients after structured, multidomain rehabilitation.[10]

A study conducted by Sunayama et al. (2022) reported that Heart failure and frailty tend to exist concurrently among older adults, with aging being a common risk factor.[11] Frailty in heart failure goes beyond physical problems and also affects thinking, feelings, and social life of individuals. Although certain interventions such as exercise have proven to be effective in enhancing

Table 2. Baseline Cognitive, Psychological, and Frailty Profiles

Variable	CHF (n = 30)	COPD (n = 30)	p-value
MMSE*	24.4 ± 2.7	25.2 ± 2.4	0.13
ACE-III Total	88.5 ± 10.2	94.1 ± 6.1	0.04
ACE-III Attention/Orientation	16.5 ± 1.8	17.6 ± 0.8	0.007
ACE-III Language	24.6 ± 2.1	25.7 ± 0.6	0.035
FAB	13.9 ± 2.7	14.6 ± 2.1	0.30
PHQ-9 (depression)	6.2 ± 3.5	6.8 ± 4.2	0.48
GAD-7 (anxiety)	5.1 ± 3.3	5.5 ± 3.6	0.59
Frailty (CFS ≥ 5, %)	11 (36.7%)	9 (30%)	0.37

*Mini-Mental State Examination (MMSE), Addenbrooke's Cognitive Examination-III Total (ACE-III Total), ACE-III Attention/Orientation, ACE-III Language, Frontal Assessment Battery (FAB), Patient Health Questionnaire-9 (PHQ-9, depression), Generalized Anxiety Disorder-7 (GAD-7, anxiety), Frailty (Clinical Frailty Scale ≥ 5, %).

physical and cognitive frailty, approaches aimed at social frailty are not well explored. Due to their close interaction with each other, both conditions ought to be tackled in an integrated fashion to enhance better outcomes in older patients.

In a similar way, a study conducted by Finamore et al. (2021)[12] reported that Frailty is more common among COPD patients in pulmonary rehabilitation and greatly affects functional outcomes with time. It was demonstrated that frail patients had higher increases in 6-minute walk distance (6MWD) during rehabilitation but also the highest decline after program termination. There were no significant differences in V'O2peak or symptom scores (CAT). These observations point out both the potential and susceptibility of frail COPD patients to maintain rehabilitation benefits.

Our study also uncover differences in patients with CHF and COPD. Both groups benefited from rehabilitation,

Table 3. Pre–Post (T0–T1) Comparison for the Whole Sample (n=60)

Variable	T0 Mean ± SD	T1 Mean ± SD	Delta Mean ± SD	p-value
FAB*	14.37 ± 2.42	15.48 ± 2.22	+1.12 ± 1.72	<0.0001
EQ-VAS	59.32 ± 17.90	65.94 ± 16.44	+6.71 ± 16.93	0.001
PHQ-9	6.11 ± 4.04	3.84 ± 3.46	–2.26 ± 3.71	<0.0001
GAD-7	5.02 ± 3.26	3.27 ± 2.88	–1.71 ± 3.02	<0.0001
SPPB	7.17 ± 3.15	9.42 ± 3.33	+2.22 ± 3.53	0.0001
TUG (sec)	14.71 ± 4.87	11.94 ± 4.49	–2.78 ± 3.84	<0.0001
6MWT (meters)	359.43 ± 122.34	398.43 ± 119.73	+39.12 ± 47.82	0.0003

*Frontal Assessment Battery (FAB), EuroQol Visual Analogue Scale (EQ-VAS), Patient Health Questionnaire-9 (PHQ-9), Generalized Anxiety Disorder-7 (GAD-7), Short Physical Performance Battery (SPPB), Timed Up and Go (TUG), 6-Minute Walk Test (6MWT).

Table 4. Frailty Score (CFS) Change from Admission to Discharge

Outcome	Number of Patients	Percentage (%)
Unchanged	16	26.6%
Improved	42	70%
Worsened	2	3.33%
Total	60	100%
p-value (T0 vs T1)		0.028

with the COPD group having superior cognitive function at baseline and more improvement in cognitive subdomains like attention/orientation and language. These may represent variations in disease pathophysiology. For instance, CHF is linked with increased cerebral hypoperfusion and inflammation load, potentially contributing to greater cognitive impairment. While frailty was more prevalent in the CHF group compared to the COPD group, this was not significantly different, indicating that both diseases have a high risk of complications due to frailty. In a same way, a study conducted by Vigorè et al. (2023) and Flint et al., stated that older adults with COPD or CHF significantly gained from personalized rehabilitation with improvement in cognitive function, mood, frailty status, and physical performance.[13,14] With baseline differences, both groups benefitted, an indicator of the efficiency of multidimensional rehabilitation in the management of frailty and improvement in recovery.

Of key importance, the research embraces increasing demands across the literature that a broader and more subtle concept of frailty be applied in clinical environments. Classic assessments tend to concentrate narrowly on physical indicators such as gait speed or grip strength, possibly missing other crucial aspects such as cognition, emotional functioning, and social support. The application of integrative tools in the present study presents a better image of patient vulnerability and responsiveness to treatment, as has been recommended by professionals such as Dent et al. (2019) and Rodríguez-Mañas et al. (2021), who have promoted multidomain frailty models for directing clinical practice.[15,16]

However, there are some limitations in this study. The small number of participants and short follow-up time make it hard to apply these findings to everyone and don't allow us to understand long-term benefits. It is also unclear which of the individual elements of the rehabilitation program played the greatest role in causing these improvements. Larger, stratified cohorts, and longer-term observation will be needed in future research to determine the most effective elements of rehabilitation and how frailty trajectories change over time.

In total, this research adds to the expanding evidence base that frailty is not only a predictor but also a reversible target in the rehabilitation process. Multidimensional testing allows clinicians to individualize interventions and track outcomes more precisely. While the population ages and the prevalence of chronic disease increases, incorporating such testing into standard care may be a necessity for maximizing function, quality of life, and autonomy in older individuals with cardiorespiratory disease.

Conclusion

This study highlights that frailty, though prevalent among older patients with chronic heart failure and COPD, is not a fixed condition and can be improved through tailored, multidisciplinary rehabilitation programs. Both physical and non-physical domains of frailty responded positively to intervention, underscoring the importance of a multidimensional assessment approach. Personalized rehabilitation led to significant gains in physical function, cognitive status, mood, and overall frailty, demonstrating that even vulnerable older adults can meaningfully benefit. Integrating comprehensive frailty evaluations into routine clinical care may enhance patient outcomes and support healthier aging in those with cardiorespiratory disease.

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