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Beyond symptom control: biopsychosocial benefits of inpatient rehabilitation on psychological distress and functional independence in advanced cancer patients

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Abstract: Patients with advanced cancer frequently experience psychological distress, cognitive impairment, and functional decline during hospitalisation, yet the broader biopsychosocial effects of inpatient rehabilitation remain insufficiently characterised. This single-centre retrospective observational study examined pre–post changes in anxiety, cognitive function, and activities of daily living among 25 patients with advanced malignancies admitted for inpatient rehabilitation at a tertiary rehabilitation unit. Psychological distress was assessed using the Hospital Anxiety and Depression Scale–Anxiety subscale, and cognitive function using the Patient-Reported Outcomes Measurement Information System (PROMIS) Cognitive Function scale, and functional independence using Activities of Daily Living scores. Nonparametric analyses were applied to evaluate rehabilitation-related changes, associations with length of hospital stay, and interrelationships among outcome domains. Significant improvements were observed following inpatient rehabilitation across anxiety, cognitive function, and functional independence (all $p < 0.001$). Rehabilitation-related gains were not associated with length of hospital stay, indicating that benefits were achieved independently of inpatient duration. Exploratory correlation analyses demonstrated a moderate positive association between improvements in cognitive function and functional independence, while reductions in anxiety were not directly correlated with cognitive or functional gains. These findings suggest that inpatient rehabilitation confers meaningful psychological, cognitive, and functional benefits in patients with advanced cancer, supporting its role as a biopsychosocial intervention that extends beyond symptom control within supportive oncology care.

Keywords: activities of daily living; advanced cancer; cognitive function; inpatient rehabilitation; psychological distress; supportive oncology

1. Introduction

Advances in oncological treatment have led to prolonged survival for many patients with cancer, including those with advanced and metastatic disease. As survival has improved, increasing attention has been directed toward the multidimensional consequences of cancer and its treatment, particularly in relation to psychological distress, cognitive impairment, and functional decline. These domains often coexist and interact, contributing substantially to reduced quality of life, loss of independence, and increased healthcare utilization. Consequently, contemporary oncology care has progressively shifted from a sole emphasis on disease control toward a more holistic model that recognizes the importance of addressing

biopsychosocial needs alongside tumor-directed treatment [1–3].

Psychological distress is highly prevalent among patients with advanced cancer, with anxiety representing one of the most commonly reported symptoms. Anxiety may arise from symptom burden, uncertainty regarding prognosis, treatment-related adverse effects, and disruption of social and occupational roles. Persistent anxiety has been associated with poorer treatment adherence, impaired decision-making, reduced functional engagement, and diminished overall well-being [4,5]. Despite its clinical importance, psychological distress remains under-recognized and undertreated in many inpatient oncology settings, where the primary focus often remains on acute medical management [6,7].

In parallel, cognitive impairment has emerged as an increasingly recognized concern in oncology populations. Cancer-related cognitive dysfunction may be attributable to a range of factors, including systemic inflammation, neurotoxic effects of anticancer therapies, fatigue, sleep disturbance, emotional distress, and reduced physical activity [8]. Cognitive difficulties, even when subtle, can interfere with daily functioning, rehabilitation participation, and the ability to engage meaningfully in care planning. Importantly, cognitive impairment is not limited to patients receiving intensive chemotherapy but has also been reported in individuals with advanced disease receiving supportive or palliative care [8,9].

Functional decline represents another major challenge for patients with advanced cancer, particularly during periods of hospitalization. Loss of functional independence in activities of daily living is associated with prolonged hospital stays, increased caregiver burden, higher risk of institutionalization, and poorer survival outcomes [10]. Hospitalization itself may exacerbate functional deterioration through immobility, deconditioning, and disruption of normal routines. For patients with advanced malignancies, functional loss is often viewed as an inevitable consequence of disease progression, leading to therapeutic nihilism regarding rehabilitation potential [11].

In recent years, inpatient rehabilitation has gained recognition as a valuable component of comprehensive cancer care. Rehabilitation interventions aim to optimize physical function, promote independence, and enhance participation in daily activities, while also addressing symptom burden and psychosocial needs [12]. Emerging evidence suggests that rehabilitation may confer benefits beyond physical outcomes, potentially influencing psychological well-being and cognitive function through increased activity, structured routines, and supportive patient–provider interactions [13]. However, much of the existing literature has focused on outpatient or early-stage cancer populations, with relatively limited data addressing the impact of inpatient rehabilitation among patients with advanced disease [8].

Moreover, studies examining rehabilitation outcomes in oncology have often evaluated psychological, cognitive, and functional domains in isolation, rather than considering their interrelationships [14,15]. A biopsychosocial perspective suggests that these domains are closely interconnected, with changes in one area potentially influencing outcomes in others [16]. Understanding whether improvements in psychological distress, cognitive function, and functional independence occur concurrently, and whether they are interrelated, may provide important insights into the mechanisms through which rehabilitation exerts its effects [17].

Another important consideration in inpatient rehabilitation research is the role of length of hospital stay. In resource-constrained healthcare systems, prolonged hospitalisation is often viewed as undesirable, and there is concern that meaningful rehabilitation benefits may require extended inpatient exposure. Clarifying whether

rehabilitation-related improvements are dependent on length of stay is therefore critical for informing service planning and optimising resource allocation, particularly in populations with complex medical needs [18,19].

The present study aimed to examine the biopsychosocial effects of inpatient rehabilitation among patients with advanced malignancies admitted to a tertiary rehabilitation unit. Specifically, we evaluated changes in psychological distress, cognitive function, and functional independence before and after inpatient rehabilitation, explored whether these changes were associated with length of hospital stay, and examined the interrelationships among improvements across outcome domains. By focusing on a real-world inpatient population with advanced disease, this study seeks to contribute to the growing evidence base supporting rehabilitation as an integral component of supportive oncology care, extending its role beyond symptom control to encompass broader psychological, cognitive, and functional benefits.

2. Methods

2.1. Study design and setting

This study employed a single-centre, retrospective observational pre–post design to examine changes in psychological distress, cognitive function, and functional independence among patients with advanced malignancies undergoing inpatient rehabilitation. The study was conducted in the Department of Rehabilitation Medicine, Yangming Hospital Affiliated to Ningbo University, a tertiary care hospital providing multidisciplinary inpatient rehabilitation services for patients with complex medical conditions, including advanced cancer. This study was reviewed and approved by the Ethics Committee of the Yangming Hospital Affiliated to Ningbo University (Yuyao People's Hospital) (No. 2026-06-024).

Inpatient rehabilitation at this institution is delivered through an interdisciplinary model that integrates medical management, physical and occupational therapy, nursing care, and psychosocial support. Rehabilitation programmes are individualised based on patients' clinical status, functional capacity, and rehabilitation goals, and are delivered within the context of routine clinical care rather than as part of an experimental intervention.

2.2. Study population and eligibility criteria

Patients were eligible for inclusion if they met the following criteria: (1) a documented diagnosis of malignant tumour based on clinical records; (2) admission to the inpatient rehabilitation service during the study period; (3) availability of complete pre-rehabilitation and post-rehabilitation assessments for psychological distress, cognitive function, and activities of daily living; and (4) sufficient medical stability to participate in inpatient rehabilitation activities as determined by the treating clinical team.

Patients were excluded if they had incomplete outcome data, were discharged prematurely before completion of rehabilitation assessments, or had severe cognitive impairment or altered consciousness that precluded valid questionnaire-based evaluation. Patients receiving rehabilitation solely for postoperative orthopaedic indications without active oncological disease were also excluded.

A total of 25 patients met the eligibility criteria and were included in the final analysis.

2.3. Clinical characteristics and data collection

Demographic and clinical information was extracted retrospectively from

electronic medical records. Collected variables included age, sex, primary cancer type, presence of metastatic disease, admission and discharge dates, and length of hospital stay. Primary cancer diagnoses were categorised into clinically relevant groups (gastrointestinal, lung, hepatobiliary, breast, genitourinary, gynecologic, and other or multiple) based on documented oncological diagnoses. Metastatic status was determined according to imaging reports and clinical documentation available at the time of admission. Length of hospital stay was calculated as the number of days between admission to and discharge from the inpatient rehabilitation unit.

2.4. Rehabilitation exposure

All patients received standard inpatient rehabilitation as part of routine clinical care. Rehabilitation programmes were delivered by an interdisciplinary team and typically included a combination of physical therapy, occupational therapy, functional training, and supportive care, with frequency and intensity tailored to individual tolerance and clinical condition. Rehabilitation goals focused on improving mobility, self-care ability, and overall functional independence, while also addressing symptom burden and promoting engagement in daily activities. Because this study was observational in nature, the specific content, duration, and intensity of rehabilitation interventions were not standardised across patients but reflected real-world clinical practice within the rehabilitation unit.

2.5. Outcome measures

Three outcome domains were evaluated before and after inpatient rehabilitation:

- Psychological distress was assessed using the anxiety subscale of the Hospital Anxiety and Depression Scale (HADS-A). The HADS-A is a widely used self-report instrument designed to screen for anxiety symptoms in medically ill populations, with higher scores indicating greater anxiety severity. The scale has been validated in oncology settings and is suitable for use in inpatient populations.
- Cognitive function was measured using the Patient-Reported Outcomes Measurement Information System (PROMIS) Cognitive Function scale, which assesses perceived cognitive abilities, including attention, memory, and mental clarity. Higher scores indicate better cognitive function. The PROMIS framework is increasingly used in clinical research due to its psychometric robustness and applicability across disease populations.
- Functional independence was evaluated using Activities of Daily Living (ADL) scores, which reflect patients' ability to perform basic self-care tasks. Higher ADL scores indicate greater functional independence. ADL assessment was conducted as part of routine rehabilitation evaluation by trained clinical staff.

For each outcome, pre-rehabilitation assessments were conducted at or near the time of admission to the rehabilitation unit, and post-rehabilitation assessments were conducted at discharge.

2.6. Statistical analysis

Descriptive statistics were used to summarise demographic and clinical characteristics of the study population. Continuous variables were reported as means and standard deviations, while categorical variables were presented as frequencies and percentages. Normality of outcome variables was assessed using the Shapiro–Wilk test. Given the small sample size and the ordinal or non-normally distributed nature of several outcome measures, nonparametric statistical methods were employed for inferential analyses.

Pre- and post-rehabilitation differences in psychological distress, cognitive

function, and functional independence were examined using the Wilcoxon signed-rank test. Effect sizes were calculated using the r statistic derived from the Z value of the Wilcoxon test to estimate the magnitude of change. To explore whether rehabilitation-related improvements were associated with length of hospital stay, change scores for each outcome were calculated as post-rehabilitation minus pre-rehabilitation values.

Associations between length of stay and outcome change scores were assessed using Spearman's rank correlation coefficients. Additional exploratory analyses examined interrelationships among changes in psychological distress, cognitive function, and functional independence using Spearman correlation analysis. All statistical tests were two-tailed, and a $p < 0.05$ was considered statistically significant. Statistical analyses were performed using SPSS software.

2.7. Ethical considerations

This study was conducted in accordance with the principles of the Declaration of Helsinki. As a retrospective observational study based on routinely collected clinical data, formal informed consent was waived in accordance with institutional policy. Patient confidentiality was maintained through anonymisation of data prior to analysis.

3. Results

3.1. Baseline characteristics of the study population

A total of 25 patients with advanced malignancies who underwent inpatient rehabilitation were included in the final analysis (**Table 1**). The mean age of the cohort was 65.7 years (Standard Deviation [SD] = 10.2), with an age range spanning from 42 to 85 years, reflecting a predominantly older inpatient population typical of advanced cancer rehabilitation settings. The mean length of hospital stay was 19.0 days (SD = 5.1), indicating a moderate duration of inpatient rehabilitation exposure.

Table 1. Baseline characteristics of the study population ($n = 25$)

Characteristic	Value
Age (years), mean $\pm$ SD	65.7 $\pm$ 10.2
Length of hospital stay (days), mean $\pm$ SD	19.0 $\pm$ 5.1
Sex, n (%)	
Female	14 (56.0)
Male	11 (44.0)
Primary cancer type, n (%)	
Gastrointestinal	10 (40.0)
Lung	7 (28.0)
Hepatobiliary	2 (8.0)
Breast	2 (8.0)
Genitourinary	2 (8.0)
Gynecologic	1 (4.0)
Other / multiple	1 (4.0)
Metastatic disease, n (%)	

Continuation Table:

Characteristic	Value
Yes	18 (72.0)
No	7 (28.0)

Female patients constituted a slight majority of the sample, accounting for 56.0% ($n = 14$) of the cohort, while male patients represented 44.0% ($n = 11$). With regard to primary cancer diagnoses, gastrointestinal malignancies were the most prevalent, comprising 40.0% of cases, followed by lung cancer at 28.0%. Hepatobiliary, breast, and genitourinary malignancies each accounted for 8.0% of the cohort, whereas gynecologic malignancies and other or multiple primary tumor types were less frequently observed, each representing 4.0% of patients.

Notably, the majority of patients (72.0%, $n = 18$) had documented metastatic disease at the time of admission, underscoring the advanced disease burden within this inpatient population, while the remaining 28.0% ($n = 7$) had no evidence of metastasis based on available clinical records. Collectively, these baseline characteristics highlight a clinically heterogeneous yet predominantly advanced cancer cohort with substantial functional and psychosocial vulnerability, providing an appropriate context for evaluating the biopsychosocial impact of inpatient rehabilitation.

3.2. Changes in psychological distress, cognitive function, and functional independence following inpatient rehabilitation

Pre–post analyses were conducted to examine changes in psychological distress, cognitive function, and functional independence following inpatient rehabilitation. Normality was assessed using the Shapiro–Wilk test, which did not indicate marked deviations from normality for most outcome variables; however, given the relatively small sample size and the ordinal characteristics of the clinical scales employed, nonparametric Wilcoxon signed-rank tests were used to compare pre- and post-rehabilitation scores.

Psychological distress, assessed using the HADS-A, showed a pronounced and consistent reduction following inpatient rehabilitation. Mean anxiety scores decreased from 16.52 ± 2.24 at baseline to 8.64 ± 1.98 at discharge (**Table 2**). Wilcoxon signed-rank testing confirmed that this reduction was statistically significant ($Z = -4.46$, $p < 0.001$), with all patients demonstrating lower post-rehabilitation anxiety scores compared with their baseline assessments. The magnitude of this change was large ($r = 0.89$), indicating a robust and clinically meaningful improvement in anxiety symptoms across the cohort.

Table 2. Changes in psychological distress, cognitive function, and functional independence following inpatient rehabilitation ($n = 25$)

Outcome measure	Pre-rehabilitation(Mean $\pm$ SD)	Post-rehabilitation (Mean $\pm$ SD)	Z value	p-value
HADS-A (anxiety)	16.52 $\pm$ 2.24	8.64 $\pm$ 1.98	−4.46	<0.001
PROMIS Cognitive Function	11.56 $\pm$ 2.22	14.68 $\pm$ 2.17	−4.58	<0.001
Activities of Daily Living (ADL)	62.60 $\pm$ 11.91	75.00 $\pm$ 10.41	−4.35	<0.001

Notes: Values are presented as mean $\pm$ standard deviation. Pre–post comparisons were performed using the Wilcoxon signed-rank test. All p values are two-tailed.

Cognitive function (CF), measured using the PROMIS Cognitive Function scale, also improved significantly following rehabilitation. Mean PROMIS-CF scores increased from 11.56 ± 2.22 prior to rehabilitation to 14.68 ± 2.17 at discharge (**Table 2**). This improvement was supported by Wilcoxon signed-rank analysis ($Z = -4.58$, $p < 0.001$), with all patients exhibiting higher post-rehabilitation cognitive function scores relative to baseline. The associated effect size was large ($r = 0.92$), suggesting a substantial and uniform enhancement in cognitive functioning during the inpatient rehabilitation period.

Functional independence, evaluated using ADL scores, demonstrated a significant increase following rehabilitation exposure. Mean ADL scores rose from 62.60 ± 11.91 at baseline to 75.00 ± 10.41 at discharge (**Table 2**). Wilcoxon signed-rank testing confirmed that this improvement was statistically significant ($Z = -4.35$, $p < 0.001$). Improvements in ADL scores were observed in 24 of 25 patients, with one patient showing no change and no instances of functional decline. The magnitude of this effect was large ($r = 0.87$), indicating a pronounced functional benefit associated with inpatient rehabilitation. The variability of pre-post changes across outcomes are illustrated in **Figure 1**.

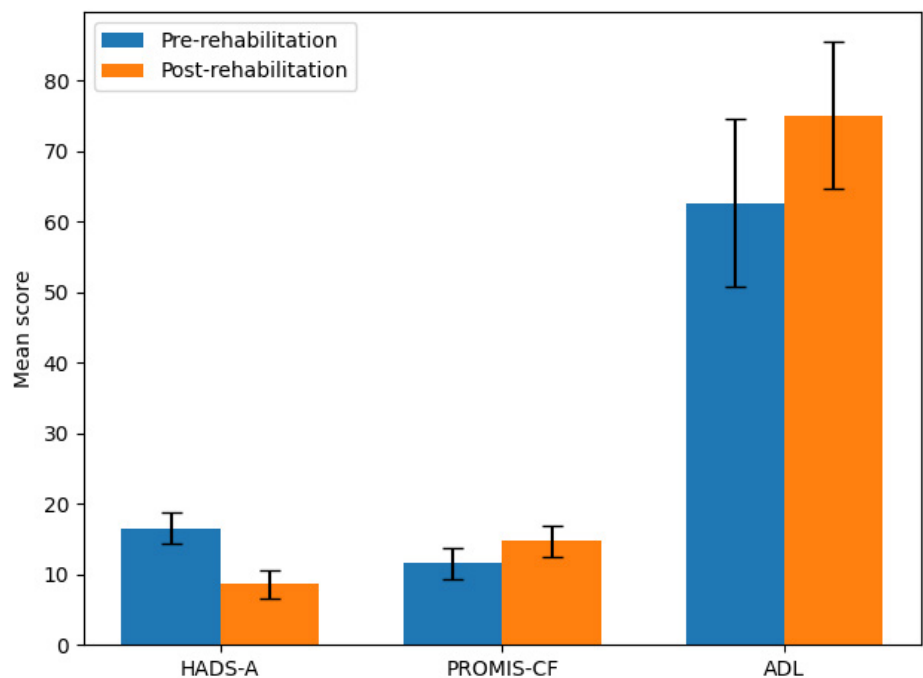


Figure 1. Mean pre- and post-rehabilitation scores for anxiety (HADS-A), cognitive function (PROMIS-CF), and activities of daily living (ADL). Error bars represent standard deviations.

These findings demonstrate that inpatient rehabilitation was associated with significant and clinically meaningful improvements across psychological, cognitive, and functional domains in this cohort of patients with advanced cancer, supporting the biopsychosocial value of rehabilitation beyond symptom control alone.

3.3. Association between length of hospital stay and rehabilitation-related changes

Additional analyses were conducted to examine whether the magnitude of rehabilitation-related improvements in psychological distress, cognitive function, and functional independence was associated with the length of hospital stay.

Change scores for each outcome were calculated as post-rehabilitation minus pre-rehabilitation values, and associations with length of stay were assessed using Spearman's rank correlation coefficients to account for the small sample size and the nonparametric characteristics of the clinical outcome measures.

As summarised in **Table 3**, no significant association was observed between length of hospital stay and the magnitude of anxiety reduction, as measured by changes in HADS-A scores (Spearman's $\rho = -0.046$, $p = 0.825$), indicating that improvements in psychological distress were not dependent on prolonged inpatient rehabilitation duration. Similarly, changes in cognitive function, assessed using the PROMIS Cognitive Function scale, were not significantly correlated with length of stay (Spearman's $\rho = 0.048$, $p = 0.818$), suggesting that gains in cognitive performance occurred independently of inpatient rehabilitation length. Functional independence demonstrated a comparable pattern, with no significant association identified between length of hospital stay and changes in ADL scores (Spearman's $\rho = 0.033$, $p = 0.876$).

Table 3. Association between length of hospital stay and rehabilitation-related changes in psychological distress, cognitive function, and functional independence

Outcome (Δ Post–Pre)	Spearman's ρ	p value
Δ HADS-A	–0.046	0.825
Δ PROMIS Cognitive Function	0.048	0.818
Δ Activities of Daily Living	0.033	0.876

These findings indicate that rehabilitation-related improvements across psychological, cognitive, and functional domains were achieved irrespective of the duration of inpatient hospitalisation, supporting the notion that the benefits of inpatient rehabilitation in this advanced cancer cohort were not contingent upon extended length of stay.

3.4. Associations among rehabilitation-related changes across outcome domains

Exploratory analyses were performed to examine the interrelationships among rehabilitation-related changes in functional independence, cognitive function, and psychological distress. Spearman's rank correlation coefficients were calculated using change scores derived as post-rehabilitation minus pre-rehabilitation values for each outcome (**Table 4**).

Table 4. Spearman correlations among rehabilitation-related change scores ($n = 25$)

Variable	Δ ADL	Δ PROMIS-CF	Δ HADS-A
Δ ADL	1.000	0.415*	–0.370
Δ PROMIS-CF	0.415*	1.000	–0.328
Δ HADS-A	–0.370	–0.328	1.000

Note: Values are Spearman's rank correlation coefficients. * $p < 0.05$ (two-tailed).

A statistically significant positive association was observed between improvements in functional independence and cognitive function (Δ ADL and

Δ PROMIS Cognitive Function; Spearman's $\rho = 0.415$, $p = 0.039$), indicating that patients who experienced greater gains in cognitive performance also tended to demonstrate greater improvements in activities of daily living. In contrast, changes in anxiety severity, as measured by Δ HADS-A, were not significantly correlated with changes in functional independence (Spearman's $\rho = -0.370$, $p = 0.069$) or cognitive function (Spearman's $\rho = -0.328$, $p = 0.110$), although the direction of these associations suggested a trend toward concurrent improvement.

Collectively, these findings suggest that improvements in cognitive and functional domains during inpatient rehabilitation may be interrelated, while reductions in psychological distress appear to occur in parallel but are not directly coupled to functional or cognitive gains within this cohort.

4. Discussion

The present study examined the biopsychosocial effects of inpatient rehabilitation among patients with advanced malignancies, with a particular focus on changes in psychological distress, cognitive function, and functional independence. Using a pre–post design and validated clinical instruments, we observed significant and clinically meaningful improvements across all three domains following inpatient rehabilitation, with large effect sizes for anxiety reduction, cognitive enhancement, and gains in activities of daily living. Importantly, these improvements were observed in a cohort characterised by advanced disease burden, high rates of metastasis, and substantial baseline vulnerability, underscoring the potential value of inpatient rehabilitation beyond symptom control alone.

4.1. Interpretation of psychological outcomes: beyond symptom alleviation

One of the most important findings of this study was the magnitude and consistency of anxiety reduction following inpatient rehabilitation. Anxiety scores, as measured by the HADS-A, decreased significantly from baseline to discharge, with all patients demonstrating improvement and none exhibiting deterioration. The uniformity of this effect, reflected in the Wilcoxon rank distribution and the large effect size observed, suggests that the reduction in psychological distress was not confined to a subset of highly responsive individuals but rather represented a cohort-wide response to rehabilitation exposure [20–22].

In the context of advanced cancer, psychological distress is often driven by multiple interacting factors, including symptom burden, functional loss, uncertainty regarding prognosis, and disruptions to personal identity and autonomy [23,24]. While pharmacological and psychological interventions targeting anxiety are well established, the present findings highlight the potential for structured inpatient rehabilitation to exert a meaningful anxiolytic effect through mechanisms that extend beyond direct symptom management [25]. Engagement in rehabilitation activities may restore a sense of agency, predictability, and mastery, thereby mitigating anxiety even in the presence of ongoing disease-related stressors [26].

Importantly, the reduction in anxiety observed in this cohort occurred over a relatively short inpatient stay and was not associated with length of hospitalisation, suggesting that psychological benefits may emerge early in the rehabilitation process [27]. This finding challenges the assumption that prolonged inpatient exposure is necessary to achieve meaningful psychological gains and instead supports the notion that targeted, interdisciplinary rehabilitation interventions can rapidly influence emotional well-being in advanced cancer populations [28].

4.2. Cognitive function improvement in the inpatient rehabilitation context

In parallel with reductions in psychological distress, significant improvements were observed in cognitive function, as assessed using the PROMIS Cognitive Function scale. Cognitive scores increased consistently across the cohort, with all patients demonstrating post-rehabilitation improvement relative to baseline. The magnitude of this effect was large, indicating that cognitive gains were not only statistically significant but also clinically relevant.

Cognitive impairment in patients with advanced cancer is multifactorial in origin and may arise from cancer-related inflammation, treatment effects, fatigue, sleep disturbance, emotional distress, and reduced physical activity [29]. Inpatient rehabilitation may influence cognitive function through several indirect pathways, including improved sleep–wake regulation, increased physical activity, structured daily routines, and enhanced psychosocial engagement [30,31]. Although cognitive rehabilitation was not the explicit primary target of the intervention in this study, the observed improvements suggest that cognitive function may be responsive to broader rehabilitation environments that address physical, emotional, and social dimensions simultaneously [32].

The absence of a significant association between length of hospital stays and cognitive improvement further supports the idea that cognitive benefits are not simply a function of prolonged exposure but may reflect qualitative aspects of rehabilitation, such as the intensity of engagement, interdisciplinary coordination, and patient–provider interaction [33,34]. These findings align with emerging perspectives in psycho-oncology that view cognitive functioning as a dynamic and modifiable outcome rather than an inevitable consequence of advanced disease [35].

4.3. Functional independence as a core rehabilitation outcome

Functional independence, measured using ADL scores, improved significantly following inpatient rehabilitation, with nearly all patients demonstrating gains and none experiencing functional decline. These findings are consistent with the established role of rehabilitation in preserving and enhancing functional capacity in oncology settings but are particularly noteworthy given the advanced disease stage and high prevalence of metastatic involvement within the cohort [36,37].

Functional decline in advanced cancer is often considered a progressive and irreversible process, particularly in inpatient populations with complex medical needs. The present results challenge this deterministic view by demonstrating that functional gains are achievable even in the context of advanced malignancy [38,39]. Moreover, the lack of association between functional improvement and length of hospital stay suggests that meaningful functional recovery may be attainable within relatively constrained timeframes when rehabilitation is appropriately structured and targeted [40,41].

From a clinical perspective, improvements in functional independence have implications that extend beyond physical performance. Enhanced ADL capacity may facilitate greater participation in self-care, improve perceived autonomy, reduce caregiver burden, and contribute to overall quality of life [42,43]. Thus, functional gains may serve as a central conduit through which rehabilitation exerts broader psychosocial benefits.

4.4. Length of hospital stay and the efficiency of rehabilitation

An important aspect of the present study was the examination of whether

rehabilitation-related improvements were dependent on the duration of inpatient hospitalisation. Across psychological, cognitive, and functional outcomes, no significant associations were identified between length of stay and the magnitude of improvement. This finding suggests that the benefits of inpatient rehabilitation are not contingent upon extended hospitalisation and may instead reflect the effectiveness of rehabilitation processes rather than their duration [41,44].

In healthcare systems increasingly constrained by resource limitations, the efficiency of interventions is a critical consideration. The observation that rehabilitation-related gains were achieved independently of length of stay supports the feasibility of delivering effective inpatient rehabilitation within limited timeframes, even among patients with advanced cancer [33,45]. This has important implications for service planning, particularly in settings where prolonged inpatient admissions may not be practical or desirable [46,47].

Furthermore, the absence of a dose–response relationship between length of stay and outcome improvement may reflect ceiling effects in rehabilitation responsiveness or indicate that key therapeutic mechanisms are activated early in the rehabilitation process [48,49]. Future studies employing more granular measures of rehabilitation intensity and content may help elucidate which components are most strongly associated with clinical benefit.

4.5. Interrelationships among psychological, cognitive, and functional domains

Exploratory correlation analyses provided additional insight into the relationships among rehabilitation-related changes across outcome domains. A moderate positive association was observed between improvements in cognitive function and functional independence, suggesting that gains in these domains may be interrelated. This finding supports a biopsychosocial framework in which cognitive and functional processes are mutually reinforcing, particularly within the structured and supportive environment of inpatient rehabilitation [49–51].

In contrast, reductions in anxiety were not significantly correlated with improvements in cognitive or functional outcomes, although the direction of these associations suggested concurrent improvement. This pattern may indicate that psychological distress, cognitive function, and physical performance represent partially independent response pathways within rehabilitation, each influenced by overlapping but distinct mechanisms [52,53]. Anxiety reduction may be more closely tied to emotional support, reassurance, and environmental stability, whereas cognitive and functional gains may reflect physical reconditioning and task engagement [54,55].

The presence of a significant cognitive–functional association, in the absence of strong anxiety–function coupling, highlights the complexity of rehabilitation responses and underscores the importance of multidimensional outcome assessment [56,57]. Rather than assuming a linear cascade from psychological improvement to functional recovery, these findings suggest that rehabilitation exerts parallel effects across domains, with selective interconnections.

4.6. Clinical implications for inpatient oncology rehabilitation

Collectively, the findings of this study have several important clinical implications. First, they support the integration of inpatient rehabilitation as a core component of comprehensive cancer care, even for patients with advanced and metastatic disease. The observed improvements across psychological, cognitive, and functional domains indicate that rehabilitation can address a broad spectrum of patient needs beyond symptom palliation.

Second, the independence of rehabilitation benefits from length of hospital stay suggests that rehabilitation services can be delivered efficiently, potentially reducing concerns regarding resource utilisation. This is particularly relevant in acute care settings, where competing demands often limit the availability of prolonged rehabilitation interventions.

Third, the observed coupling between cognitive and functional improvement highlights the potential value of interventions that simultaneously target physical activity and cognitive engagement. Rehabilitation programmes that incorporate cognitively stimulating tasks alongside physical training may maximise functional recovery and enhance overall patient outcomes.

4.7. Limitations and future directions

Several limitations of this study should be acknowledged. The sample size was modest, and the study employed a single-centre, pre–post design without a control group, limiting causal inference. The absence of long-term follow-up precludes conclusions regarding the durability of observed improvements beyond discharge. Additionally, while validated instruments were used, the study did not include detailed assessments of rehabilitation content, intensity, or adherence, which may influence outcomes.

Future research should aim to replicate these findings in larger, multi-centre cohorts and explore the specific rehabilitation components most strongly associated with psychological, cognitive, and functional gains. Longitudinal designs incorporating post-discharge follow-up would be particularly valuable in determining whether inpatient rehabilitation confers sustained benefits over time.

5. Conclusion

In this single-centre observational study, inpatient rehabilitation was associated with significant and clinically meaningful improvements in psychological distress, cognitive function, and functional independence among patients with advanced malignancies. These benefits were observed consistently across the cohort, despite substantial disease burden and a high prevalence of metastatic involvement, underscoring the capacity of rehabilitation to address multidimensional patient needs in advanced cancer settings.

Importantly, improvements across psychological, cognitive, and functional domains were achieved independently of length of hospital stay, suggesting that the benefits of inpatient rehabilitation are not contingent upon prolonged hospitalisation. This finding highlights the potential efficiency of rehabilitation interventions and supports their feasibility within resource-constrained inpatient environments. In addition, the observed association between gains in cognitive function and functional independence points to an interrelated recovery process across domains, reinforcing the relevance of a biopsychosocial framework for understanding rehabilitation outcomes in oncology care.

Collectively, these findings support the integration of inpatient rehabilitation as an essential component of comprehensive supportive cancer care, extending its role beyond symptom control to encompass broader psychological, cognitive, and functional benefits. While further research is warranted to confirm these findings in larger and multi-centre cohorts, the present study provides real-world evidence that meaningful rehabilitation-related gains are achievable even in patients with advanced disease, and that such gains may be realised within relatively limited inpatient stays.

Author contributions: Conceptualization, QQ and ZW; methodology, QQ; software, QQ; validation, QQ and ZW; formal analysis, QQ; investigation, QQ; resources, QQ; data curation, QQ; writing—original draft preparation, QQ and ZW; writing—review and editing, QQ; visualization, QQ; supervision, QQ and ZW; project administration, QQ; funding acquisition, QQ and ZW. All authors have read and agreed to the published version of the manuscript.

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Informed consent statement: This retrospective study was approved by the institutional review board, and the need for written informed consent was waived in accordance with institutional policy governing research involving routinely collected clinical data.

Conflict of interest: The authors declare no conflict of interest.

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