

Exploring Relationship Between Health-Related Physical Fitness, Fatigue, and Quality of Life Among Patients Undergoing Chemotherapy: A Cross-Sectional Study

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ABSTRACT

Background: Chemotherapy is associated with functional decline, cancer-related fatigue, and impaired quality of life, yet these interrelated outcomes are insufficiently characterized in local oncology rehabilitation settings. **Objective:** To examine the relationship between health-related physical fitness, cancer-related fatigue, and quality of life among adult patients receiving chemotherapy. **Methods:** This cross-sectional analytical study included 194 adult chemotherapy patients at a tertiary care setting in Lahore, Pakistan. Health-related physical fitness was assessed using the 30-second Sit-to-Stand test, fatigue using the Brief Fatigue Inventory, and quality of life using the EORTC QLQ-C30. Descriptive statistics, Shapiro-Wilk testing, Spearman correlation, and regression analysis were performed using SPSS version 26.0. **Results:** Participants had a mean age of 45.26 ± 16.12 years and mean BMI of 26.50 ± 3.89 kg/m². Mean Sit-to-Stand score was 16.34 ± 4.00 repetitions, mean Brief Fatigue Inventory score was 4.88 ± 1.32 , and mean global quality-of-life score was 52.66 ± 13.34 . Sit-to-Stand score was strongly positively associated with global quality of life ($r = 0.875$, $p < 0.001$), while fatigue was strongly negatively associated with global quality of life ($r = -0.832$, $p < 0.001$). Sit-to-Stand score was inversely associated with fatigue ($r = -0.772$, $p < 0.001$). The regression model explained 85.1% of variance in global quality of life. **Conclusion:** Functional physical fitness and fatigue were strongly associated with quality of life among chemotherapy patients, supporting routine assessment of these modifiable clinical indicators during oncology care. **Keywords:** Physical fitness; Cancer-related fatigue; Quality of life; Chemotherapy; EORTC QLQ-C30; Sit-to-Stand test.

INTRODUCTION

Cancer remains one of the most substantial public health challenges of the twenty-first century, with a rising global burden that increasingly affects health systems, patients, families, and rehabilitation services. Recent global estimates indicate that cancer incidence and mortality continue to increase, with a disproportionate burden in low- and middle-income settings where delayed diagnosis, limited supportive care, and constrained rehabilitation access may further compromise patient outcomes (1). As advances in oncology have improved survival for many cancer types, clinical attention has expanded beyond disease control alone toward functional status, symptom burden, and quality of life during and after treatment. Chemotherapy remains a central therapeutic modality across neoadjuvant, adjuvant, curative, and palliative treatment pathways; however, its systemic toxicities may substantially affect physical performance, daily independence, psychological wellbeing, and overall quality of life (2).

Cancer-related fatigue is among the most common and disabling symptoms experienced by patients receiving chemotherapy. Unlike ordinary tiredness, cancer-related fatigue is often persistent, disproportionate to recent activity, only partially relieved by rest, and influenced by interacting physiological, psychological, inflammatory, nutritional, and treatment-related mechanisms (3). In patients undergoing chemotherapy, fatigue may restrict mobility, reduce participation in daily activities, impair social engagement, and contribute to emotional distress. Because fatigue is frequently under-recognized in routine oncology care, its relationship with functional performance and quality of life requires clearer clinical characterization, particularly in settings where structured oncology rehabilitation is not consistently integrated into cancer services (3-6).

Health-related physical fitness represents a clinically meaningful and potentially modifiable dimension of patient functioning. It includes components such as muscular strength and endurance, cardiorespiratory capacity, flexibility, mobility, and body composition, all of which contribute to a patient's ability to perform daily activities and maintain independence during treatment. Chemotherapy may accelerate deconditioning through reduced physical activity, muscle weakness, pain, anorexia, anemia, neuropathy, and treatment-related symptom clustering. Functional performance measures such as the 30-second Sit-to-Stand test provide a practical way to estimate lower-limb functional capacity and physical performance in clinical settings, especially where advanced exercise testing is not feasible. Preserved or better physical fitness may be associated with lower symptom burden and better perceived wellbeing, whereas poor functional capacity may intensify fatigue and reduce quality of life (4).

Quality of life in cancer patients is multidimensional and includes physical, emotional, cognitive, social, and role-related functioning, as well as symptom domains such as fatigue, pain, nausea, appetite disturbance, and sleep disruption. During chemotherapy, impairments in these domains may occur simultaneously, making patient-reported outcomes essential for understanding the full treatment experience. Fatigue has been repeatedly identified as one of the most important contributors to reduced quality of life, but its interaction with objective functional performance remains insufficiently described in many local oncology populations (5). In Pakistan and similar healthcare contexts, evidence remains limited regarding how functional fitness and cancer-related fatigue jointly relate to quality of life among adult chemotherapy patients using validated tools such as the Brief Fatigue Inventory and the EORTC QLQ-C30 (7-9).

Although previous research has examined fatigue, physical activity, and quality of life in cancer populations, fewer studies have assessed the combined relationship between functional physical fitness, fatigue severity, and global quality of life among patients actively receiving chemotherapy in tertiary care settings in Pakistan. This gap is clinically relevant because physical fitness and fatigue are potentially modifiable factors that may be assessed through low-cost, feasible instruments and used to guide supportive oncology rehabilitation. Therefore, this study aimed to investigate the relationship between health-related physical fitness, cancer-related fatigue, and quality of life among adult patients undergoing chemotherapy at a tertiary care center in Lahore, Pakistan. The study hypothesized that higher functional physical fitness would be positively associated with better quality of life and negatively associated with fatigue, whereas greater fatigue would be associated with poorer quality of life.

MATERIALS AND METHODS

This cross-sectional analytical study was conducted among adult cancer patients receiving chemotherapy at the University of Lahore Teaching Hospital, Lahore, Pakistan. The study was designed to examine the relationship between health-related physical fitness, cancer-related fatigue, and quality of life using a single-time-point observational approach. A cross-sectional design was considered appropriate because the primary objective was to assess associations among functional performance, fatigue severity, and patient-reported quality of life rather than to determine causal effects or treatment

efficacy. The study population comprised patients with a confirmed diagnosis of cancer who were actively receiving chemotherapy during the study period.

Participants were selected using a non-probability convenience sampling technique from eligible patients available in the chemotherapy care setting. Patients were considered eligible if they were aged 18 years or above, of either sex, had a confirmed cancer diagnosis, had completed at least one cycle of chemotherapy, were able to understand and respond to the study questionnaires, and provided written informed consent. Patients were excluded if they had not yet started chemotherapy, were physically unable to safely perform the functional fitness assessment, had cognitive impairment, altered mental status, acute severe medical complications, severe psychiatric illness, or communication barriers that prevented valid questionnaire completion. These criteria were applied to ensure participant safety during the Sit-to-Stand assessment and to improve the validity of self-reported fatigue and quality-of-life data.

After ethical approval and written informed consent, data were collected using a structured proforma, standardized questionnaires, and a functional performance assessment. Sociodemographic variables included age, sex, marital status, educational status, occupation, and income. Clinical variables included cancer diagnosis, cancer stage, duration of illness, number of chemotherapy sessions, comorbidity status, and body mass index. Health-related physical fitness and fatigue were treated as the main independent variables, while global quality of life was treated as the dependent variable. Age, sex, body mass index, comorbidity, cancer-related characteristics, and chemotherapy-related characteristics were considered clinically relevant covariates because of their potential influence on physical function, fatigue, and quality-of-life outcomes.

Health-related physical fitness was assessed using the 30-second Sit-to-Stand test, which measures the number of complete sit-to-stand repetitions performed within 30 seconds and provides a practical indicator of lower-limb functional strength and endurance. Before testing, participants were instructed regarding the procedure, and the test was performed only when the participant was considered physically able to complete it safely. Fatigue was assessed using the Brief Fatigue Inventory, which evaluates fatigue severity and the extent to which fatigue interferes with daily functioning. Quality of life was assessed using the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30, which measures global health status, functional domains, and symptom burden in cancer populations. Data collection was performed in a standardized sequence to reduce measurement variability, with demographic and clinical information recorded first, followed by questionnaire-based assessment and functional testing.

To reduce information bias, the same structured data collection format was used for all participants, and responses were recorded according to predefined scoring procedures for each instrument. Participant records were reviewed where required to confirm clinical information, including cancer diagnosis, disease stage, chemotherapy exposure, and comorbidity status. Selection bias was minimized by applying the same eligibility criteria to all available patients during recruitment, although the use of convenience sampling was recognized as a limitation of the design. Potential confounding was addressed analytically by identifying demographic and clinical variables that could plausibly influence quality of life, including age and body mass index, and by using regression analysis to examine the contribution of physical fitness and fatigue to global quality of life.

The final sample included 194 adult chemotherapy patients who fulfilled the eligibility criteria and completed the required assessments. Data were entered and analyzed using SPSS version 26.0. Descriptive statistics were used to summarize participant characteristics and study variables. Continuous variables were presented as mean and standard deviation when appropriate, while categorical variables were summarized using frequencies and percentages. The Shapiro-Wilk test was used to assess the distribution of continuous variables. Correlation analysis was performed to evaluate the relationships among Sit-to-Stand score, Brief Fatigue Inventory total score, and global quality-of-life score. Spearman

correlation coefficients were used to describe monotonic associations among the principal variables. Regression analysis was conducted to examine the extent to which physical fitness and fatigue predicted global quality of life, with clinically relevant covariates considered where available. Statistical significance was assessed at a p-value threshold of less than 0.05, and very small p-values were reported as $p < 0.001$ rather than as zero.

Data integrity was maintained through careful review of completed forms before entry, verification of entered values, and consistency checks for implausible or incomplete responses. Participant confidentiality was maintained by anonymizing study records and restricting access to collected data. The study was approved by the Institutional Ethical Review Committee of the University of Lahore under approval number UOL/IREB/26/20/09/0030. Written informed consent was obtained from all participants before data collection, and participation was voluntary. The study was conducted in accordance with ethical principles for human participant research, with attention to privacy, confidentiality, and participant safety during functional assessment.

RESULTS

A total of 194 adult patients receiving chemotherapy were included in the analysis. The mean age of the participants was 45.26 ± 16.12 years, with an age range of 18.0 to 74.0 years. The mean body mass index was 26.50 ± 3.89 kg/m², ranging from 15.4 to 36.9 kg/m².

Table 1. Demographic Characteristics of Participants

Variable	Mean \pm SD	Range
Age, years	45.26 ± 16.12	18.0–74.0
BMI, kg/m ²	26.50 ± 3.89	15.4–36.9

Abbreviations: BMI, body mass index; SD, standard deviation.

The demographic profile showed that the study population primarily represented middle-aged adult chemotherapy patients, with a mean BMI within the overweight range. These characteristics provide the clinical context for interpreting functional fitness, fatigue severity, and quality-of-life outcomes in this sample.

Table 2. Health-Related Physical Fitness, Fatigue, and Global Quality of Life Scores

Variable	Mean \pm SD	Range
STS score, repetitions	16.34 ± 4.00	6.2–25.5
BFI total score	4.88 ± 1.32	1.4–8.7
Global QoL score	52.66 ± 13.34	20.0–79.7

Abbreviations: BFI, Brief Fatigue Inventory; QoL, quality of life; SD, standard deviation; STS, 30-second Sit-to-Stand test.

Participants demonstrated a mean STS score of 16.34 ± 4.00 repetitions, indicating moderate functional physical performance within the chemotherapy population. The mean BFI total score was 4.88 ± 1.32 , reflecting a moderate level of cancer-related fatigue. The mean global QoL score was 52.66 ± 13.34 , suggesting an overall moderate level of perceived quality of life among participants undergoing chemotherapy.

Table 3. EORTC QLQ-C30 Quality-of-Life Domain Scores

Domain	Mean \pm SD
Physical functioning	53.45 ± 14.09
Emotional functioning	52.86 ± 14.98
Social functioning	53.35 ± 14.56
Fatigue domain	51.53 ± 13.83
Pain domain	60.69 ± 11.79

Abbreviations: EORTC QLQ-C30, European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30; SD, standard deviation.

The functional domains showed comparable mean scores, with physical functioning at 53.45 ± 14.09 , emotional functioning at 52.86 ± 14.98 , and social functioning at 53.35 ± 14.56 . Among the symptom-related domains, the fatigue domain had a mean score of 51.53 ± 13.83 , while the pain domain had the highest mean score at 60.69 ± 11.79 , indicating that pain and fatigue were prominent symptom burdens within the study population.

Table 4. Shapiro-Wilk Test for Distribution of Main Continuous Variables

Variable	Statistic	p-value
STS score	0.990	0.181
BFI total score	0.996	0.840
Global QoL score	0.987	0.074

Abbreviations: BFI, Brief Fatigue Inventory; QoL, quality of life; STS, 30-second Sit-to-Stand test.

The Shapiro-Wilk test showed p-values greater than 0.05 for STS score, BFI total score, and global QoL score. These findings indicated no statistically significant departure from normality for the principal continuous variables based on the reported test results. Association testing was subsequently reported using Spearman correlation coefficients to examine the monotonic relationships among physical fitness, fatigue, and quality of life.

Table 5. Spearman Correlation Analysis Among Physical Fitness, Fatigue, and Global Quality of Life

Variable Pair	r	p-value
STS score and global QoL	0.875	<0.001
BFI total score and global QoL	-0.832	<0.001
STS score and BFI total score	-0.772	<0.001

Abbreviations: BFI, Brief Fatigue Inventory; QoL, quality of life; STS, 30-second Sit-to-Stand test.

Spearman correlation analysis demonstrated a strong positive association between STS score and global QoL score ($r = 0.875$, $p < 0.001$), indicating that higher functional physical performance was associated with better quality of life. BFI total score showed a strong negative association with global QoL score ($r = -0.832$, $p < 0.001$), indicating that higher fatigue severity was associated with poorer quality of life. STS score was also strongly and inversely associated with BFI total score ($r = -0.772$, $p < 0.001$), suggesting that participants with better functional fitness tended to report lower fatigue severity.

Table 6. Regression Model Summary for Prediction of Global Quality of Life

R	R ²	Adjusted R ²	Standard Error
0.923	0.851	0.848	27.055

The regression model explained 85.1% of the variance in global quality-of-life scores, with an adjusted R² of 0.848. This indicates that the predictors included in the model accounted for a substantial proportion of variability in global quality of life among chemotherapy patients. However, interpretation of individual predictor effects requires coefficient-level regression output, including standard errors, confidence intervals, and p-values.

Table 7. Regression Coefficients Reported for Predictors of Global Quality of Life

Predictor	B
STS score	0.402
BFI total score	-0.634
Age	-0.057
BMI	0.328

Abbreviations: B, unstandardized regression coefficient; BFI, Brief Fatigue Inventory; BMI, body mass index; STS, 30-second Sit-to-Stand test.

The reported coefficient estimates indicated a positive coefficient for STS score and a negative coefficient for BFI total score in relation to global quality of life. Age showed a small negative coefficient, while BMI showed a positive coefficient. Because standard errors, 95% confidence intervals, standardized

coefficients, and predictor-level p-values were not available in the supplied regression output, the statistical precision and independent significance of these predictors cannot be fully evaluated from the reported data alone.

Overall, the results showed strong associations among functional physical fitness, fatigue severity, and quality of life in patients receiving chemotherapy. Higher STS scores were associated with better global quality of life and lower fatigue severity, while higher BFI scores were associated with poorer global quality of life. These findings support the clinical relevance of assessing functional performance and fatigue burden in chemotherapy patients, while the cross-sectional design limits interpretation to association rather than causation.

Aggregated analysis from 194 adults undergoing chemotherapy

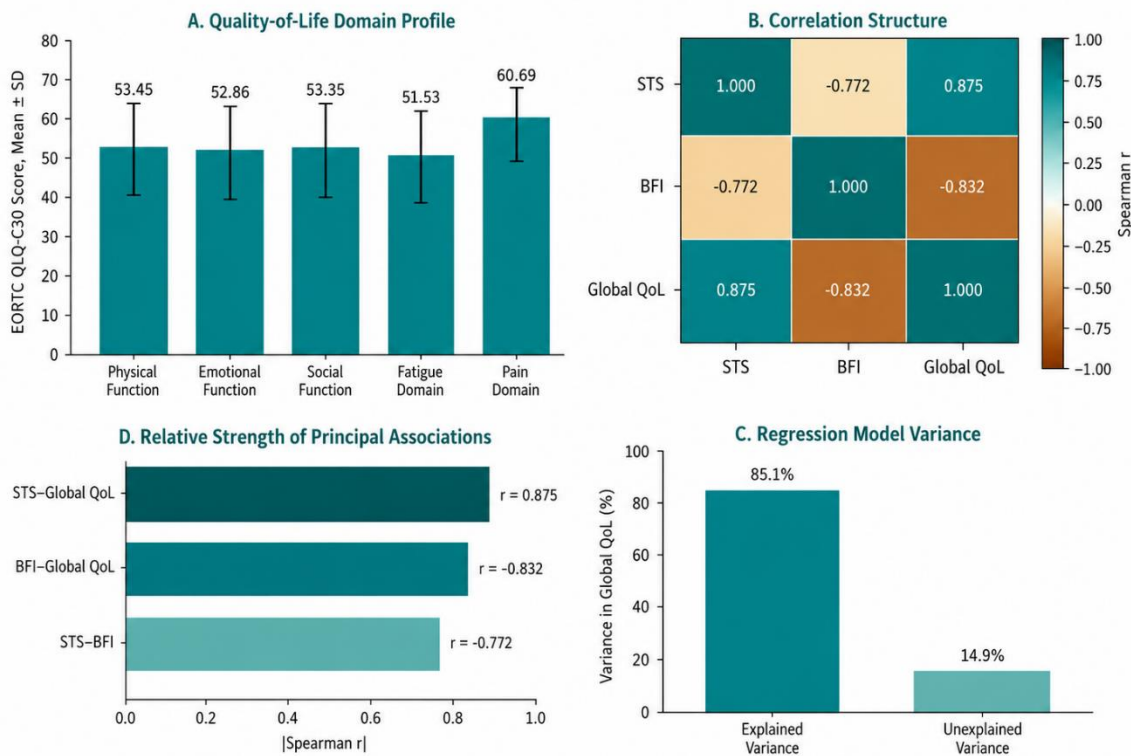


Figure 1. Integrated Functional Fitness, Fatigue, and Quality-of-Life Profile in Chemotherapy Patients

The panelled figure summarizes the functional, symptom, association, and model-level findings among 194 adults undergoing chemotherapy. Quality-of-life domain profiling showed comparable functional scores for physical functioning, emotional functioning, and social functioning, with mean values of 53.45 ± 14.09 , 52.86 ± 14.98 , and 53.35 ± 14.56 , respectively, while symptom burden was most pronounced for pain at 60.69 ± 11.79 and fatigue at 51.53 ± 13.83 . The correlation structure demonstrated strong interdependence among the principal clinical variables, with higher Sit-to-Stand performance positively associated with global quality of life ($r = 0.875$, $p < 0.001$), fatigue inversely associated with global quality of life ($r = -0.832$, $p < 0.001$), and functional fitness inversely associated with fatigue severity ($r = -0.772$, $p < 0.001$). The ranked association panel indicates that the strongest observed relationship was between functional physical performance and global quality of life, followed by the fatigue-quality-of-life relationship. The regression model accounted for 85.1% of the variance in global quality-of-life scores, supporting the clinical relevance of jointly assessing physical fitness and fatigue burden in chemotherapy patients while maintaining interpretation within the limits of the cross-sectional design.

DISCUSSION

The present study examined the relationship between health-related physical fitness, cancer-related fatigue, and quality of life among adult patients receiving chemotherapy. The findings demonstrated

strong and clinically relevant associations among these three variables. Participants had moderate functional physical performance, reflected by a mean 30-second Sit-to-Stand score of 16.34 ± 4.00 repetitions, moderate fatigue severity with a mean Brief Fatigue Inventory score of 4.88 ± 1.32 , and moderate global quality of life with a mean score of 52.66 ± 13.34 . The quality-of-life domain profile further indicated that physical, emotional, and social functioning were similarly affected, whereas symptom-related burden was prominent, particularly for pain and fatigue. These findings suggest that chemotherapy patients experience a combined burden of functional limitation and symptom distress, both of which may influence perceived wellbeing during active treatment.

The strong positive correlation between Sit-to-Stand performance and global quality of life indicates that patients with better functional physical fitness tended to report better overall quality of life. This association is clinically plausible because lower-limb functional capacity contributes directly to mobility, independence in daily activities, participation in household and social roles, and perceived control during treatment. Chemotherapy-related deconditioning, reduced physical activity, muscle weakness, neuropathy, pain, and systemic treatment effects may impair functional performance, thereby limiting patients' ability to maintain daily routines. The current findings are consistent with evidence showing that physical activity and exercise-based approaches are associated with improvements in physical fitness and health-related quality of life among cancer patients and survivors (5,6). However, because the present study used a cross-sectional design, the observed association should not be interpreted as evidence that higher physical fitness caused better quality of life; rather, it identifies functional performance as an important clinical marker that may help characterize wellbeing in chemotherapy patients (13).

Fatigue showed a strong negative correlation with global quality of life, indicating that patients who experienced greater fatigue reported poorer overall wellbeing. This finding aligns with previous evidence that cancer-related fatigue is one of the most prevalent and disabling symptoms among patients undergoing chemotherapy and has a substantial impact on physical, emotional, cognitive, and social functioning (3). The persistence and multidimensional nature of cancer-related fatigue may explain its strong association with quality of life. Unlike ordinary tiredness, cancer-related fatigue may not resolve fully with rest and may interact with anemia, inflammation, sleep disturbance, pain, nutritional status, psychological distress, and reduced activity tolerance. These mechanisms can create a cycle in which fatigue restricts activity, reduced activity worsens deconditioning, and deconditioning further intensifies fatigue and functional limitation.

The inverse relationship between Sit-to-Stand performance and fatigue further supports the clinical relevance of assessing physical fitness and fatigue together rather than as isolated outcomes. Patients with better functional fitness tended to report lower fatigue severity, which is consistent with systematic review evidence indicating that therapeutic exercise, including aerobic and resistance-based interventions, can reduce cancer-related fatigue in patients undergoing chemotherapy (7,8). These findings provide a rationale for incorporating simple functional assessments into oncology and rehabilitation settings. The 30-second Sit-to-Stand test is practical, low-cost, and feasible in routine clinical environments, making it suitable for identifying patients who may benefit from rehabilitation referral, supervised exercise counseling, or supportive symptom management. Nevertheless, the present findings should be interpreted as association-based evidence; intervention trials would be required to determine whether improving functional fitness leads to measurable reductions in fatigue and improvements in quality of life (8, 11).

The regression model indicated that the included predictors explained a substantial proportion of variance in global quality of life, with an R^2 of 0.851 and adjusted R^2 of 0.848. This suggests that physical fitness and fatigue, together with the included covariates, were strongly related to quality-of-life variation in this sample. The reported coefficient pattern showed a positive coefficient for Sit-to-Stand score and a negative coefficient for fatigue, which is consistent with the direction of the correlation findings.

However, individual predictor-level interpretation remains limited because standard errors, standardized coefficients, confidence intervals, and predictor-specific p-values were not available in the supplied regression output. Therefore, although the model supports the importance of functional performance and fatigue burden, the independent statistical contribution and precision of each predictor should be confirmed through complete regression reporting before final publication.

The present findings are also consistent with contemporary supportive oncology recommendations emphasizing exercise, behavioral, and integrative approaches for the management of cancer-related fatigue (9). In resource-constrained oncology settings, routine screening for fatigue and functional limitation may be particularly important because patients may not spontaneously report fatigue or may consider it an unavoidable consequence of chemotherapy. Early identification of reduced functional performance and moderate-to-severe fatigue could support timely referral to rehabilitation, structured physical activity guidance, energy conservation education, and multidisciplinary symptom management. In the Pakistani tertiary care context, these findings highlight the need to integrate rehabilitation-oriented assessment into chemotherapy care pathways, especially for patients at risk of progressive deconditioning and reduced quality of life (10-12).

This study has several limitations. The cross-sectional design prevents causal inference and does not establish temporal relationships among physical fitness, fatigue, and quality of life. Convenience sampling from a single tertiary care setting may limit generalizability to other oncology populations, rural settings, private-sector facilities, or patients with more advanced functional impairment. Patients who were unable to safely perform the Sit-to-Stand test were excluded, which may have underestimated the burden of poor physical fitness and fatigue in more debilitated chemotherapy patients. Important clinical variables such as cancer type, cancer stage, chemotherapy regimen, treatment intent, number of cycles, comorbidity profile, anemia status, pain severity, nutritional status, and psychological distress may have influenced the observed associations and should be more fully reported or adjusted for in future analyses. Fatigue and quality of life were assessed using self-report tools, which may be affected by recall, mood, literacy, and response bias. Despite these limitations, the study has important strengths, including the use of validated patient-reported outcome measures, inclusion of an objective functional performance test, and simultaneous evaluation of physical fitness, fatigue, and quality of life in an active chemotherapy population.

Overall, the findings indicate that functional physical fitness and cancer-related fatigue are strongly associated with quality of life among patients undergoing chemotherapy. The direction and magnitude of the associations suggest that routine assessment of functional performance and fatigue may help identify patients with poorer wellbeing and greater supportive care needs. Future multicenter longitudinal studies should examine whether changes in functional fitness and fatigue over the chemotherapy course predict subsequent quality-of-life outcomes and whether structured rehabilitation interventions can improve patient-centered outcomes in this population.

CONCLUSION

This study found strong associations among health-related physical fitness, cancer-related fatigue, and quality of life in adult patients receiving chemotherapy. Higher 30-second Sit-to-Stand performance was associated with better global quality of life and lower fatigue severity, whereas higher fatigue was associated with poorer quality of life. These findings indicate that functional physical fitness and fatigue are clinically important, interrelated indicators of wellbeing during chemotherapy. Routine assessment of functional performance and fatigue may help identify patients requiring supportive oncology rehabilitation, symptom management, and closer monitoring; however, because the study was cross-sectional, the findings should be interpreted as associations rather than causal effects.

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