ORIGINAL ARTICLE

Association of Health-Related Physical Fitness and Upper Limb Disability with Quality of Life in Breast Cancer Patients

Erum Ghaffar[1*], Fatima Latif[1], Syed Jamal[1], Fatima Mazhar[1], Rimsha Tariq[1] and Maria Samad[1]

[1]*Faculty of Allied Health Sciences, Hajvery University, Lahore, Pakistan*

ABSTRACT

Background: Breast cancer survivors commonly experience reduced physical fitness, impaired quality of life, and upper limb disability after treatment, negatively affecting functional independence and overall wellbeing. However, evidence on their combined association, particularly in local populations, remains limited.

Objective: To determine the association between health-related physical fitness, quality of life, and upper limb disability in breast cancer patients.

Methods: A cross-sectional study was conducted among breast cancer patients at the Institute of Nuclear Medicine and Oncology (INMOL), Atomic Energy Cancer Hospital, Lahore, from October 2025 to March 2026. Health-related physical fitness was assessed through objective measures including the six-minute walk test, handgrip strength, isometric leg press, back scratch, sit-and-reach, and anthropometric indices (waist–hip ratio, BMI). Quality of life was evaluated using the EORTC QLQ-C30 and BR23 modules, and upper-limb disability was assessed using the DASH questionnaire. Data were analyzed in SPSS version 25.

Results: The findings revealed that health-related physical fitness was significantly and inversely correlated with upper-limb disability ($r = -0.527$, $p < 0.001$). However, no statistically significant association was found between overall quality of life and either physical fitness ($r=0.153$, $p=0.054$) or upper limb disability ($r=-0.053$, $p=0.507$).

Conclusion: The study concludes that health-related physical fitness and upper limb disability are significantly associated with the quality of life in breast cancer patients. These findings highlight the potential importance of incorporating structured rehabilitation programs to support physical fitness and upper-limb function, which may serve as secondary strategies to optimize overall patient outcomes.

Keywords: *Breast cancer, physical fitness, upper limb disability, quality of life, rehabilitation, EORTC QLQ-C30.*

INTRODUCTION

When cells of the breast grow uncontrollably to form tumors, it is characterized as breast cancer, typically originating in the milk ducts or lobules and extending into adjacent tissues. In 2020, almost 2.3 million people were diagnosed with this disease, and almost 685,000 people were expected to die from it, especially in the transitional countries, and, according to the projections, the numbers will increase by more than 3 million new cases and 1 million deaths per year until the year 2040 [1]. Newer therapies such as surgery, radiotherapy, and endocrine therapy also have improved the outcome for patients, but they can sometimes involve long-term side effects such as lymphedema and neuropathy. In addition to these clinical complications, the disease has a significant effect on patients' quality of life (QoL), their body image, mental health, and family relationships [2]. The pressure pain threshold of survivors is often diminished, as is shoulder strength and range of motion, with increased pain with motion, indicating high pain sensitivity [3]. In the past 20 years, disability among survivors has more than quadrupled, and by 2018, nearly 70% of them reported a functional limitation (almost twice the rate of the general population) [4].

Health-related physical fitness comprises a set of physical characteristics important in everyday life, such as cardiorespiratory endurance, body composition, muscular strength, and flexibility [5]. The Six-Minute Walk Test (6MWT) is widely used as a valid and practical objective measure of functional capacity for assessing cardiorespiratory fitness in breast cancer survivors [6]. Likewise, handgrip strength measurements provide a valid, objective assessment of muscle strength, primarily of the upper limbs, and are good predictors of functional status in this population [7]. Quality of life (QoL) is a multi-faceted phenomenon, interpreted as a physical, psychological, and social state, and the degree of improvement achieved by the disease and the treatments it has undergone. Physical symptoms (*e.g.*, pain, fatigue, and functional limitations) have also been shown to have a meaningful impact on QoL after oncological interventions, consistently in breast cancer survivors [8]. In addition, psychological issues such as anxiety, hopelessness, and fear of recurrence have been shown to harm emotional functioning and wellbeing [9].

**Corresponding author: Erum Ghaffar, Faculty of Allied Health Sciences, Hajvery University, Lahore, Pakistan,*
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However, little is known from the literature about the full picture of the relationships among subdomains of health-related physical fitness, upper limb disability, and quality of life (QoL) within a single analytical model, especially in local populations [10]. Existing studies have mainly assessed the effects of physical activity on functional outcomes or quality of life separately, and the synergistic effects of these variables have not been examined.

This study sought to explore the association among health-related physical fitness, upper-limb disability, and quality of life within a single analytical framework to address this gap. This research does not assume a positive or negative outcome; rather, it explores the way that these variables interact and are relevant to the local population—women with breast cancer receiving active oncological therapy.

MATERIALS AND METHODS

A cross-sectional study was conducted at the INMOL Atomic Energy Cancer Hospital in Lahore. The study actually lasted from October 2025 to March 2026. The Institutional Review Board approved the conduct of this study, and compliance with ethical guidelines was obtained with the underlying approval of the HU ECRB-DPT-2025-73 (Ethics Committee and Research Board) on October 1 2025. The inclusion criteria were female patients with a diagnosis of breast cancer, including patients receiving active oncology therapy or attending for regular follow-up after breast cancer interventions. Age between 25 and 50+ years. Patients with surgical, chemical, and/or radiation therapy. Patients who can answer and comprehend questionnaires. The exclusion criteria were patients with metastatic cancer. Neurological diseases affecting upper limb function. Severe musculoskeletal conditions, not due to breast cancer. All cognitive impairments that will affect the ability to complete questionnaires. All participants provided informed consent before data collection, ensuring their voluntary participation and privacy.

A power analysis for linear multiple regression was a priori conducted using G*Power software (version 3.1.9.4). For estimation with 9 predictors (including primary independent variables and baseline clinical covariates), a sample size of 160 participants will provide 90% power at the 0.05 significance level and detect a small-to-medium effect size (f^2) of 0.10. Based on this calculation, participants were selected from the target population using non-probability convenience sampling to facilitate data collection in the clinical setting. Data collection has been done through structured face-to-face interviews with patients visiting the chemotherapy ward for their routine follow-up treatment. The interactive method was selected to ensure that respondents had a clear understanding of each questionnaire item and to minimize missing data. The tools were administered directly by the researcher in a hospital, with clarification as needed to ensure the accuracy and reliability of the data. Cardiorespiratory endurance, muscular strength, flexibility, and body composition were used as indicators of health-related physical fitness. Cardiorespiratory endurance was assessed using the 6-Minute Walk Test (6MWT), and the distance walked in 6 minutes was measured in meters. Handgrip strength (HGS) was assessed using a handheld dynamometer as a measure of muscular strength. Body composition was assessed using Body Mass Index (BMI), and flexibility was assessed using the back scratch and sit-and-reach tests. Breast cancer can affect a patient's physical fitness, as can breast cancer treatment, such as chemotherapy and surgery, which can cause muscle weakness, slowed endurance, and deconditioning. Loss of fitness can lead to decreased functional independence, increased fatigue, and decreased social participation. Higher physical fitness, however, is associated with better survival and overall health outcomes among cancer survivors [11]. To align with the empirical regression models, rather than using an unvalidated cumulative index, the individual fitness parameters (6MWT distance, handgrip strength, flexibility tests, and BMI) were used directly as distinct continuous independent variables in the statistical analyses to evaluate the unique contribution of each component.

Quality of Life (QoL) was evaluated using the EORTC QLQ-C30 (version 3.0) along with its breast cancer-specific module, QLQ-BR23. The EORTC QLQ-C30 is a validated, multidimensional tool used to assess the physical, psychological, and social wellbeing of cancer patients. All scale and individual item scores for the EORTC QLQ-C30 were linearly transformed to a range of 0 to 100 according to the EORTC scoring manual. For functional domains, higher scores indicate better functioning and health, whereas for symptom scales, higher scores represent greater distress and symptom severity [12]. To include disease-specific concerns, including body image, systemic therapy side effects, and arm/breast symptoms, the QLQ-BR23 module was added. In addition, the raw scores of this module were linearly transformed into the standard score range of 0-100 in the same official scoring procedure. In the latter, a higher score on functional scales corresponds to better body image and sexual functioning, and a higher score on symptom scales to a greater number of breast cancer-specific symptoms [13]. Collectively, these instruments capture a cross-section of overall and breast cancer-specific wellbeing, which are influenced by treatment and clinical outcomes on participants' quality of life. The Global Health Status (Global QoL) dimension of the EORTC QLQ-C30, which has been officially validated, was used as the primary continuous dependent

variable in the regression analysis. In contrast, all functional and symptom dimensions were included in the secondary bivariate correlation analysis.

Upper arm disability was evaluated with the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire, frequently used to measure disability after surgery (mastectomy or axillary lymph node dissection [ALD]). It is a validated instrument for assessing functional limitations, such as range of motion, lymphedema, or pain, in activities of daily living, including dressing, lifting, and personal hygiene [14]. The DASH score is one of the most widely used and standardized outcome measures in rehabilitation research, and it is reliable for quantifying musculoskeletal impairment and its subsequent effects on participants' independence. The DASH total score was computed using the official DASH scoring algorithm, which ranges from 0 (no disability) to 100 (severe disability). If fewer than 27/30 items were completed, the scale score would be calculated only if the official guidelines were followed, with missing items replaced by the mean score of the completed items. This total score value was used as one of the primary independent variables.

Data were analyzed using IBM SPSS Statistics (v. 27). Descriptive statistics were computed: mean ± standard deviation (SD) for continuous variables and frequencies (and percentages) for categorical variables. To achieve the main goal, Pearson's correlation coefficient was used to assess the relationships among the health-related physical fitness components, quality-of-life domains, and upper-limb disability. The Kolmogorov-Smirnov test was used to assess the normality of the data before analysis. Linear regression analysis was run as both a univariate and a multivariate analysis, with each score on a physical fitness component as an independent predictor, along with the DASH total score and baseline clinical factors (age, cancer stage), the latter as independent predictors. A p-value of 0.05 or lower (two-tailed p-value) was regarded as statistically significant.

RESULTS

A total of 160 participants were enrolled in the study, with a mean age of 48.58 ± 11.11 years. Every participant in this study sample (100%, *n*=160) was undergoing active chemotherapy cycles at the time of data collection. The average body mass index (BMI) was 25.96 ± 5.87 kg/m^2. Physical fitness variables examined descriptively showed that the mean distance in the 6-minute walk test (6MWT) was 381.71 ± 86.80 meters, handgrip strength was 17.36 ± 3.197 kg, and leg press was 51.01 ± 9.33 kg. Flexibility measures showed a mean back scratch of the right arm was -3.71 ± 5.57 cm, back scratch of the left arm was -3.35 ± 5.579 cm, and a sit-and-reach test score of -9.80 ± 3.67 cm (**Table 1**). The Pearson Correlation analysis showed a statistically significant, moderate negative correlation between health-related physical fitness and DASH scores (r=-0.527, p<0.001, *n*=160), indicating that as physical fitness increases, upper limb disability decreases (**Table 2, Fig. (1)**). There was no significant correlation between DASH score and QOL (**Table 2, Fig. (2)**).

Table 1: Demographics and health-related physical fitness components.

Variables	Frequency	Percentage
Marital Status		
Single	14	8.8
Married	106	66.3
Widowed	40	25.0
Cancer Stage		
I	25	15.6
II	68	42.5
III	46	28.7
IV	21	13.1
Treatment Status (Chemotherapy)	160	100.0
Variables	**Frequency**	**Mean (SD)**
Age (years)	160	48.58 (11.11)
Cardiorespiratory fitness		
(6MWT__meter)	160	381.71 (86.80)
Upper strength (handgrip strength test__kg)	160	17.36 (3.19)
Lower strength (Leg press__kg)	160	51.01 (9.33)
Anthropometric measurements		
Body mass index (kg/m^2)	160	25.96 (5.87)
Waist-hip ratio (cm)	160	0.79 (0.05)
Flexibility		
Sit and reach (cm)	160	-9.80 (3.67)
Back scratch right arm (cm)	160	-3.71 (5.577)
Back scratch left arm (cm)	160	-3.35 (5.579)

Table 2: Pearson correlation coefficients between physical fitness, quality of life, and disability of the upper limb.

Variables	DASH		Quality of Life	
	Correlation (r)	p-value	Correlation (r)	p-value
Health-Related Physical Fitness	-0.527**	<0.001	0.153	0.054
Quality of Life	-0.053	0.507	–	–

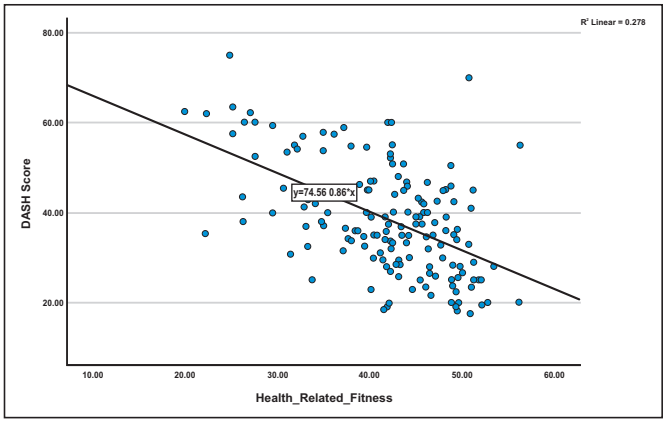

Fig. (1): Scatter plot between health-related physical fitness and DASH.

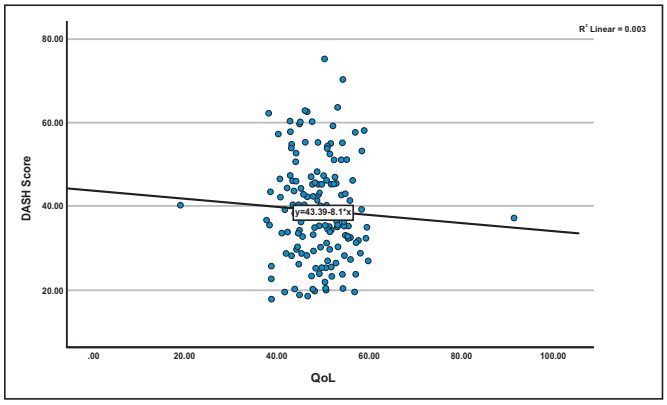

Fig. (2): Scatter plot between quality of life and DASH score.

Univariate and multivariable linear regression analyses were performed to identify factors associated with upper-limb disability. In the univariate models, age (p<0.001), BMI (p=0.002), cancer stage (p<0.001), and health-related physical fitness (p<0.001) were statistically significant predictors. However, when these variables were entered simultaneously into the multivariable regression model, only health-related physical fitness remained a significant independent predictor (β = -0.415, p < 0.001). The negative beta value indicates an inverse relationship: higher fitness levels are independently associated with lower upper limb disability scores. Baseline clinical characteristics such as age, BMI, and cancer stages lost their statistical significance in the final adjusted model (p>0.05) (**Table 3**).

Table 3: Linear regression analysis.

Variables	Univariate Analysis (Unadjusted)		Multivariate Analysis (Adjusted)	
	B (95% CI)	p-value	aB (95% CI)	p-value
Age (years)	0.390 (0.231, 0.549)	*<0.001	0.119 (-0.045, 0.302)	0.146
BMI (Kg/m^2)	0.502 (0.191, 0.814)	*0.002	0.117 (-0.042, 0.521)	0.095
Cancer Stages	3.944 (1.95, 5.93)	*<0.001	0.073 (-1.01, 2.94)	0.336
Health-Related Physical Fitness	-0.860 (-1.07, -0.642)	*<0.001	-0.415 (-0.945, -0.409)	*<0.001
Quality of life	-0.096 (-0.383, 0.190)	0.507	0.047 (-0.166, 0.339)	0.501

CI: Confidence interval, *Significant at p<0.05

DISCUSSION

This research evaluated the correlation of upper limb impairment, quality of life, and health-related physical fitness in breast cancer patients. The results showed a certain level of upper limb disability and moderate physical fitness and quality of life. Physical fitness and upper limb impairment were found to have a significant negative correlation, indicating that higher functional capacity is associated with greater fitness. However, no statistically significant correlation was observed between quality of life and upper limb impairment, or between physical fitness and quality of life. These findings imply that quality of life is affected by a broader range of factors than just physical health. However, physical fitness may be essential for reducing functional limitations.

Courneya *et al.* (who) examined the relationship between health-related fitness and quality of life in newly diagnosed breast cancer patients, providing some support for the current study's findings. Their study correlated higher levels of muscular and cardiorespiratory fitness with better quality-of-life outcomes, particularly in the physical domain. Nevertheless, the degree of correlation across domains varied, indicating that not all aspects of quality of life are equally influenced by physical fitness [15].

Similarly, a large study by Agussalim *et al.* (2024) found that exercise improves the quality of life for breast cancer survivors. The review indicates that regular exercise improves physical functioning, reduces therapy-related symptoms, and enhances general wellbeing [16]. This lack of correlation in our study contrasts with their findings, which the treatment status of our sample can clinically justify; all 160 participants were actively undergoing chemotherapy, where acute systemic side effects like severe fatigue overwhelmingly dictate the overall quality of life.

Furthermore, a meta-analysis using the EORTC QLQ-C30 scale was conducted by Chen *et al.* in 2023, who found that exercise therapies significantly improved quality of life in patients with breast cancer. The study also indicates that exercise programs are positively associated with functional scores and good health conditions [17]. Unlike the cohorts in Chen *et al.*, who were mostly evaluated post-treatment, our sample consisted entirely of patients undergoing active chemotherapy, meaning that localized physical or upper-limb improvements do not translate linearly into overall wellbeing during this intense treatment phase.

A more recent cross-sectional study by Abbad-Gomez *et al.* (p < 0.05) found that physically active breast cancer survivors had a much better health-related quality of life and lower levels of fatigue, pain, and mental distress compared with sedentary individuals [18]. These findings support the importance of physical activity and indicate that a range of interconnected factors impact quality of life, consistent with this study.

A combination of aerobic and resistance exercise significantly improves physical functioning and total quality of life in breast cancer survivors, a 2023 meta-analysis by Wang *et al.* finds, likely due to improved muscular strength and functional capacity, thereby decreasing impairment [19]. The present study revealed

that reductions in disability and improvements in physical fitness are correlated with upper limb impairment. This conclusion is supported by recent studies illustrating the influence of exercise in improving the functional outcomes.

The importance of physical fitness in rehabilitation is further emphasized by a 2022 systematic review conducted by Ficarra *et al.*, which evaluated the impact of exercise interventions on breast cancer patients and survivors. Their analysis of multiple studies revealed that exercise significantly improves overall functional performance, muscular strength, and cardiorespiratory fitness. Specifically, more than 83% of the studies included in their review reported a positive influence of physical activity on physical outcomes and general wellbeing [20]. These findings strongly support the present study's conclusion that enhanced physical fitness is a key factor in reducing impairment and improving patients' functional capacity during recovery.

A 2025 study argues that the quality of life of patients with breast cancer is greatly influenced by mental, emotional, and demographic factors and not just by physical factors. It means that as long as they are psychologically adjusted and have social support, patients can report a decent quality of life despite a physical impairment [21]. The current study, however, showed no noticeable relationship between upper limb impairment and quality of life. The multi-faceted nature of quality of life can account for this conclusion.

Overall, these results are consistent with recent research showing that physical fitness significantly enhances functional capacity and reduces impairment in patients with breast cancer. However, in this particular population, there was no statistically significant correlation between the level of upper-limb disability and quality of life. This lack of a robust association could also be explained by differences in the cancer stage, type of oncological treatments (mastectomy *versus* lumpectomy), and coping mechanisms. In addition, solid psychosocial factors, including supportive family systems, baseline resilience, and psychological counseling, can buffer patients' perceptions of overall wellbeing and quality of life despite deficits in physical and upper-limb function. Longitudinal designs and the incorporation of these various psychosocial factors in future research are required to gain greater insight into these complex, multidimensional relationships. There are several restrictions on this study. Generalizability may be limited because it was sampled from a specific population of breast cancer patients. The results might have been affected by differences in treatment features and by the use of self-reported metrics. However, the study offers valuable clinical data on the relationship between upper-limb impairment, quality of life, and physical fitness. Future studies should employ objective evaluation techniques, consider treatment-related aspects, and involve a wider range of groups. Additionally, integrating psychological support with planned exercise therapies may enhance breast cancer patients' overall quality of life and functional recovery.

CLINICAL IMPLICATIONS FOR REHABILITATION

This study indicates some non-causal implications for clinical practice based upon the cross-sectional trends noted. These results may provide evidence of the importance of the early introduction of structured, multidisciplinary rehabilitation pathways with concurrent targeted upper-limb PT and progressive physical fitness training during oncological treatment. As the physical fitness components correlate strongly with the functional capacity of the upper limbs, optimizing muscle strength and cardiorespiratory baseline could be a supportive approach to reducing functional decline. Furthermore, because a better quality of life is not necessarily just about physical performance, it is important that rehabilitation programs not only include physical exercise but also incorporate comprehensive psychosocial screening and emotional support to take a holistic approach to the patient's outcome during rehabilitation.

CONCLUSION

This study suggests that health-related PF is also significantly associated with the reduction of upper limb disability among breast cancer patients, and it plays an important role in the functional recovery. But the link with quality of life remained limited, as it is a multi-faceted construct. The results highlight the importance of holistic rehabilitation strategies that combine physical, psychological, and social aspects to maximize patient recovery and outcomes. A clinical implication of this cross-sectional data is that structured exercise and targeted upper-limb physical therapy may be useful as a supportive pathway to increase functional capacity. Still, only longitudinal studies can show that this is directly causally linked to improved outcomes.

ETHICS APPROVAL

The study was approved by the Institutional Review Board of the Institutional Ethics Committee (Ref. No: HU-ECRB-DPT-2025-73) on October 1, 2025. All procedures performed in studies involving human participants followed the ethical standards of the institutional and/or national research committee and the Declaration of Helsinki.

CONSENT FOR PUBLICATION

All participants provided informed consent before their inclusion in the study.

AVAILABILITY OF DATA

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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None.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Declared none.

AUTHORS' CONTRIBUTION

EG: Study concept, design, and manuscript drafting

FL: Manuscript drafting and analysis

SJ: Data collection, analysis, manuscript drafting

FM: Data analysis, manuscript drafting

RT: Critical review and revision

MS: Study design and manuscript drafting

All authors read and approved the final manuscript.

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