Research Square

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When Need Exceeds Care: The Rehabilitation Gap After Breast Cancer Surgery

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Abstract

Purpose

To quantify the extent to which physiotherapy (PT) utilization aligns with objectively defined postoperative upper-limb morbidity among women after breast-cancer surgery.

Methods

This pooled analysis included 1,602 women enrolled across three prospective observational cohorts (2023–2024) at two tertiary centers in Israel. Morbidity was defined using standardized criteria across four domains: pain (> 1/10), shoulder range-of-motion limitation, functional impairment (QuickDASH ≥ 20), and clinician-diagnosed lymphedema. PT utilization was defined as ≥ 1 postoperative PT session. Multivariable logistic regression was used to identify predictors of morbidity and PT use.

Results

Among the 1,589 women with complete PT data, morbidity was common (978/1,589; 61.5%). Women with morbidity had higher clinical burden, including greater comorbidity prevalence, more advanced tumor stage, and increased exposure to adjuvant treatments. Despite this burden, PT utilization remained inconsistent. Only 68.5% of women with morbidity (670/978) received PT, while 31.5% remained symptomatic without treatment, indicating substantial unmet rehabilitation need. Preventive PT in women without morbidity was infrequent (16.2%). Utilization was driven primarily by pain (OR 2.32), whereas chemotherapy (OR 0.66), insomnia (OR 0.75), and anxiety (OR 0.94 per point) were associated with lower likelihood of PT attendance. Objective impairment (ROM limitation, functional disability) was not independently associated with PT use.

Conclusion

Postoperative upper-limb morbidity is highly prevalent yet remains undertreated under current symptom-driven survivorship pathways. The mismatch between clinical need and care delivery highlights a critical opportunity for proactive, risk-stratified screening and earlier rehabilitation referral to support equitable recovery and prevent long-term disability.

Introduction

Upper-limb morbidity is a frequent and impactful consequence of breast-cancer surgery [1]. Pain, reduced shoulder range of motion, functional limitations, and lymphedema can interfere with daily activities, delay return to work, and impair long-term survivorship [2, 3]. Importantly, several prospective

studies have shown that arm morbidity often emerges, persists, or intensifies months after surgery rather than resolving early, underscoring the need for timely and ongoing monitoring [4].

Physiotherapy (PT) is a cornerstone of postoperative rehabilitation [5, 6]. Therapeutic exercise, manual therapy, and patient-centered education can prevent or attenuate arm morbidity, improve functional outcomes, and reduce the likelihood of chronic disability [7–12]. Despite these well-established clinical benefits, PT remains markedly underutilized within many breast-cancer care pathways [13, 14]. Prior research consistently demonstrates that substantial proportions of symptomatic women do not receive rehabilitation, even when morbidity is objectively measurable [15, 16].

Multiple factors may contribute to this underuse[17, 18]. Breast-cancer survivors frequently navigate complex recovery trajectories that include ongoing oncologic treatments, emotional distress, and practical barriers such as travel, cost, or uncertainty about when physiotherapy is needed[19, 20]. At the provider level, morbidity may be underestimated or assumed to be self-limiting[15]. Consequently, persistent and clinically meaningful impairments may go untreated, widening the gap between what survivors need and the care they ultimately receive [4, 16].

Although postoperative arm morbidity is increasingly recognized, less is known about whether women with objectively defined impairment actually receive physiotherapy in real-world settings. Clarifying this gap is essential, as untreated impairments may progress to long-term disability, reduced functional capacity, and greater healthcare burden.

The objective of this study was therefore to quantify the gap between rehabilitation need and PT utilization after breast-cancer surgery, using a large pooled cohort from three prospective studies.

Methods

Study Design and Setting

We conducted a pooled analysis of three prospective observational cohorts recruited between March 2023 and September 2024 at two tertiary medical centers in Israel. Each cohort used synchronized protocols for postoperative assessment of upper-limb morbidity, psychosocial factors, and physiotherapy (PT) utilization across standardized follow-up windows (0–3, 6, 12, 24, and 36 months). The protocol was approved by the institutional review board of Assuta Medical Centers (ASMC-0018-23 and ASMC-0025-24), and all participants provided written informed consent in accordance with the Declaration of Helsinki. The study was prospectively registered at ClinicalTrials.gov (NCT05950685; registration date: March 19, 2023).

Participants

Eligible participants included women aged 18–80 years who underwent oncologic breast surgery (lumpectomy or mastectomy), with or without sentinel lymph-node biopsy (SLNB) or axillary lymph-node dissection (ALND). Exclusion criteria were benign pathology, metastatic disease at surgery, pre-existing lymphedema, or repeat ipsilateral breast procedures. Women were included in the analytic sample if they completed at least one postoperative morbidity and PT-utilization assessment.

Exposure Definition

The exposure of interest was the clinical context of breast-cancer surgery followed by routine postoperative care pathways. PT utilization was not assigned by protocol and instead reflected real-world clinical referral or patient-initiated use within survivorship care.

Outcome Measures

Postoperative upper-limb morbidity was defined across four validated domains:

1. Pain: Numerical Rating Scale (0–10), with > 1 considered clinically meaningful postoperative pain [21].
2. Range of motion (ROM): Self-reported inability to achieve full overhead elevation with a straight arm [22].
3. Functional impairment: QuickDASH score ≥ 20, indicating clinically meaningful disability [23].
4. Lymphedema: Clinician-diagnosed lymphedema documented by a physician or PT [24].

Objective morbidity was coded as present if ≥ 1 domain met the clinical threshold. Psychosocial variables included perceived need for PT, insomnia (yes/no), and self-reported physical activity. PT utilization was defined as ≥ 1 session attended with a licensed physical therapist during the observation window.

Data Collection

Sociodemographic and clinical variables (age, BMI, tumor stage, surgical approach, adjuvant treatment) were extracted from electronic medical records. Morbidity assessments and questionnaires were conducted in-person or by telephone by trained physiotherapists using uniform instruments. Data harmonization ensured variable consistency across the three cohorts prior to pooling.

Statistical Analysis

Continuous variables were summarized as median (interquartile range [IQR]) and compared using the Mann–Whitney U test. Categorical variables were summarized as n (%) and compared using χ^2 tests. Missingness was < 1% across analytic variables; therefore, complete-case analysis was applied.

Analyses were conducted in SPSS version 29 (IBM Corp). Statistical significance was defined as two-sided $p < 0.05$.

Results

Participant Characteristics and Morbidity Status

A total of 1,602 women were included in the pooled analysis (*Supplementary Figure 1*). The median age of the cohort was 58 years (IQR 50–67), and the median body mass index (BMI) was 25.8 kg/m² (IQR 22.7–29.3).

Women who developed upper-limb morbidity during follow-up (n = 978) differed from those without morbidity (n = 624) across several clinical and psychosocial characteristics. Specifically, women with morbidity were more likely to have one or more comorbid conditions, more advanced tumor stage, and greater exposure to adjuvant treatments, including chemotherapy, radiation therapy, and hormonal therapy. Insomnia was more prevalent and physical-activity levels were lower among women with morbidity. Although time since surgery was modestly longer in the morbidity group, age and BMI did not differ significantly between groups. Detailed participant characteristics are presented in *Table 1*.

Table 1. Participant characteristics by morbidity status.

Variable	No morbidity (n = 624)	Morbidity (n = 978)	p-value
Age, years, median (IQR)	59.0 (50.0–68.0)	58.0 (50.0–67.0)	0.640
BMI, kg/m², median (IQR)	25.6 (22.6–29.4)	25.9 (22.8–29.3)	0.780
Months since surgery, median (IQR)	18.2 (0.0–33.6)	21.9 (8.6–34.9)	0.003
Comorbidity (≥1 condition)	139 (22.3%)	475 (48.6%)	<0.001
Type of breast surgery			
Lumpectomy	460 (77.3%)	766 (78.4%)	0.003
Mastectomy	97 (16.3%)	184 (18.8%)	
Axillary surgery			
No axillary surgery	36 (6.9%)	66 (9.6%)	<0.001
SLNB	439 (84.1%)	492 (71.2%)	
ALND	47 (9.0%)	133 (19.2%)	
Breast reconstruction	61 (14.5%)	150 (15.6%)	0.670
Tumor stage			
In situ/precancerous	20 (6.5%)	22 (2.7%)	<0.001
Localized	276 (89.9%)	706 (88.0%)	
Advanced	11 (3.6%)	74 (9.2%)	
Postoperative complications	42 (14.0%)	185 (19.2%)	0.047
Chemotherapy	57 (11.6%)	245 (25.1%)	<0.001
Radiation therapy	128 (26.0%)	397 (40.6%)	<0.001
Hormonal therapy	132 (26.8%)	457 (46.8%)	<0.001
Insomnia	56 (24.6%)	493 (51.9%)	<0.001
Anxiety score, median (IQR)	2.0 (1.0–4.0)	1.0 (0.0–5.0)	0.047
Physical activity score, median (IQR)	1.0 (0.0–1.0)	0.0 (-1.0–1.0)	<0.001

Abbreviations: BMI, body mass index; IQR, interquartile range; SLNB, sentinel lymph node biopsy; ALND, axillary lymph node dissection.

Notes: Continuous variables are presented as median (IQR); categorical variables are presented as n (%). Group comparisons were performed using the Mann–Whitney U test for continuous variables and the χ^2 test for categorical variables.

Arm Morbidity Patterns Differed Substantially According to Physiotherapy Utilization.

Among the 1,589 women with complete PT data, pain was more prevalent among women who received PT compared with those who did not (84.2% vs 71.8%, p<0.001). Functional impairment, defined as a QuickDASH score ≥20, was also more frequent in the PT group (22.5% vs 15.0%, p<0.001), whereas range-of-motion limitation occurred at similar rates in both groups.

Lymphedema was relatively infrequent and did not differ significantly between groups. In contrast, objective arm morbidity—defined as the presence of at least one morbidity domain—was markedly more prevalent among women who received PT compared with those who did not (87.1% vs 37.6%, p<0.001). Detailed morbidity patterns by PT utilization are presented in *Table 2*.

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Table 2. Arm morbidity and physiotherapy utilization.

Variable	No PT (n = 820)	Received PT (n = 769)	p-value
Pain >1 (0–10 NRS)	277 (71.8%)	624 (84.2%)	<0.001
ROM limitation (unable to reach fully overhead)	141 (36.1%)	271 (36.4%)	0.940
QuickDASH ≥ 20	123 (15.0%)	173 (22.5%)	<0.001
Lymphedema (clinical diagnosis)	38 (9.7%)	53 (7.1%)	0.120
Arm morbidity (≥1 domain)	308 (37.6%)	670 (87.1%)	<0.001

Abbreviations: PT, physiotherapy; ROM, range of motion; NRS, numerical rating scale; QuickDASH, Disabilities of the Arm, Shoulder and Hand questionnaire (short form).

Notes: Morbidity indicators were coded as binary variables based on predefined clinical thresholds. Objective arm morbidity was defined as the presence of ≥1 morbidity domain. P-values were calculated using χ^2 tests.

Table 3. Predictors of Postoperative Arm Morbidity After Breast-Cancer Surgery

Variable	p-value	OR	95% CI
Insomnia	<0.001	2.44	1.61–3.65
Radiation therapy	<0.001	2.44	1.64–3.67
BMI (per unit increase)	0.017	1.05	1.01–1.09
Comorbidity (≥1)	<0.001	2.94	1.93–4.49
Extreme pain during hospitalization	0.013	2.62	1.22–5.60
Chemotherapy	0.112	1.42	0.92–2.19
Anxiety (per point)	0.156	1.06	0.98–1.14
Education (higher)	0.064	0.83	0.69–1.01

Abbreviations: OR, odds ratio; CI, confidence interval; BMI, body mass index; RT, radiation therapy; VAS, Visual Analog Scale.

Notes: table three presents the results of a multivariable logistic regression analysis evaluating clinical, psychosocial, and treatment-related predictors of postoperative arm morbidity. Odds ratios (ORs) were directionally aligned so that OR > 1 reflects a higher likelihood of morbidity.

Factors Associated with Physiotherapy Utilization

Physiotherapy utilization was primarily associated with symptom-related factors rather than objective functional impairment. In multivariable analysis, higher pain levels were associated with increased likelihood of PT utilization (OR 2.32), while higher physical-activity levels were modestly associated with PT attendance (OR 1.02).

In contrast, insomnia (OR 0.75), chemotherapy exposure (OR 0.66), and higher anxiety scores (OR 0.94 per point) were associated with lower likelihood of PT utilization (*Figure 1; Supplementary Table S1*). Objective indicators of impairment, including range-of-motion limitation and functional disability (QuickDASH ≥20), were not independently associated with PT attendance.

Relationship Between Arm Morbidity and Physiotherapy Utilization

Postoperative upper-limb morbidity was common, yet PT utilization did not consistently correspond to clinical recovery needs. Among the cohort (N = 1,589), 978 women (61.5%) developed morbidity. PT delivery was predominantly reactive: among women with morbidity, 670 (68.5%) received PT, whereas 308 (31.5%) remained symptomatic without treatment, representing a considerable degree of unmet rehabilitation need (*Figure 3; Supplementary Table S2*).

Preventive PT—initiated in the absence of morbidity—was infrequently utilized. Among women without morbidity (n = 611), 99 (16.2%) received PT, whereas 512 (83.8%) neither experienced morbidity nor

received therapy, representing clinically appropriate non-utilization (*Figure 2; Supplementary Table S2*). Collectively, these utilization patterns demonstrate that PT is largely initiated only after morbidity has already emerged rather than integrated proactively into the postoperative care pathway, highlighting an opportunity for earlier rehabilitation engagement within survivorship care models.

Discussion

This pooled analysis of 1,602 women provides one of the most comprehensive evaluations to date of postoperative upper-limb morbidity and PT utilization after breast-cancer surgery. To our knowledge, this is the first pooled prospective dataset to quantify the rehabilitation care gap using standardized morbidity thresholds rather than administrative utilization codes or patient-reported unmet need. Across three prospective cohorts spanning the first three postoperative years, morbidity was both common and persistent. More than 60% of women met criteria for at least one morbidity domain, indicating that impairments such as pain, range-of-motion restriction, functional limitation, and lymphedema represent ongoing survivorship challenges rather than transient postoperative phenomena. These findings align with prior work showing that morbidity frequently emerges or progresses months after surgery and may remain unrecognized in the absence of structured follow-up **[1,20,25,26].**

Despite this substantial clinical burden, PT utilization was markedly inconsistent. Among women with morbidity, only 68.5% received PT, leaving 31.5% symptomatic yet untreated. Conversely, preventive PT in women without morbidity was relatively uncommon (16.2%), suggesting that rehabilitation was primarily initiated reactively—after symptoms appeared—rather than being embedded proactively in the postoperative care continuum.

The multivariable analysis identified pain as the strongest predictor of PT utilization (OR 2.32), while insomnia and chemotherapy were associated with lower likelihood of attending PT. These findings demonstrate that access to rehabilitation was influenced more by distressing symptoms and treatment burden than by objective measures of need. Functional limitations and ROM restriction—despite being clinically meaningful—did not independently predict rehabilitation use, underscoring a gap between functional need and care delivery.

Collectively, the findings indicate that postoperative survivorship is currently managed within a reactive model that depends largely on patient-initiated help-seeking [15]. Many breast-cancer survivors may underestimate symptoms, normalize functional decline, or prioritize oncologic treatments, while treatment-related fatigue and emotional distress further reduce capacity to engage in rehabilitation [18,27,28]. This aligns with recent international work showing that women often navigate upper-limb dysfunction and rehabilitation independently and without consistent clinical guidance from their care teams [15,29].

Transitioning from this reactive approach to a proactive survivorship model is essential [30]. Routine functional screening and scheduled reassessment timepoints—core components of the Prospective Surveillance Model—could enable earlier identification of impairment and more timely rehabilitation

referral [26]. Expanding access through tele-rehabilitation or community-based services may help overcome logistical and geographic barriers to participation [31].

Survivorship is not defined by cancer removal alone. The true measure of recovery is whether women regain function, confidence, and participation in life—and this will not be achieved until rehabilitation is embedded as a standard part of care.

Strengths and Limitations

This study has several strengths. It draws on a large, real-world prospective dataset comprising three postoperative cohorts evaluated across different points in the survivorship trajectory. The use of standardized and validated measures to capture upper-limb morbidity—including pain, ROM, functional limitation, and lymphedema—enhances internal consistency and supports direct comparison with existing literature. By integrating clinical, demographic, treatment-related, and psychosocial variables, this work provides a multidimensional view of what drives morbidity and rehabilitation use, rather than reducing postoperative recovery to a single symptom domain. Importantly, the inclusion of women at varying phases after surgery—from early postoperative recovery to later survivorship—allows the findings to reflect heterogeneity that mirrors clinical reality and increases the applicability of results to routine practice.

Implications for Practice

Findings from this study highlight a necessary shift away from a reactive, patient-initiated model of postoperative survivorship toward a proactive pathway embedded within oncology care. Incorporating routine functional screening and scheduled reassessment timepoints could allow earlier detection of morbidity and timely intervention. Embedding physiotherapy through automatic referral triggers, structured communication between oncologists and rehabilitation teams, and digital follow-up reminders may reduce preventable disability and ensure women receive rehabilitation when it is most clinically impactful. Expanding access via tele-rehabilitation and community-based services is essential to address persistent logistical and geographic barriers and to support equitable recovery for all women following breast-cancer surgery.

Conclusion

Upper-limb morbidity after breast-cancer surgery is common, yet PT is not consistently accessed—even among women with objectively defined impairment. This reflects a reactive survivorship model, in which rehabilitation is initiated mainly when symptoms become distressing rather than through structured clinical pathways.

The clinical and psychosocial predictors identified in this study indicate that high-risk women can be recognized early, but risk identification must be followed by actionable systems. Routine postoperative screening, risk-stratified referral, and accessible rehabilitation models—including tele-rehabilitation—

offer practical strategies to close this gap. Embedding proactive rehabilitation into survivorship care is essential to reducing preventable long-term disability and ensuring equitable recovery for women following breast-cancer treatment.

Declarations

Authors' Contributions (CRediT Taxonomy)

Conceptualization, I.K., D.R.S., M.F., and M.A.B-D.; Methodology, I.K., D.R.S., and M.F.; Validation, I.K. and M.F.; Formal Analysis, I.K. and M.F.; Investigation, I.K., I.R., S.S., and D.B.; Resources, I.K., D.B., and M.A.B-D.; Data Curation, I.K. and D.B.; Writing—Original Draft Preparation, I.K.; Writing—Review and Editing, all authors; Visualization, I.K. and M.F.; Supervision, D.R.S., M.F., and M.A.B-D.; Project Administration, I.K.; Funding Acquisition, I.K., D.R.S., and M.A.B-D.
All authors have read and approved the final version of the manuscript and agree to be accountable for its integrity and accuracy.

Ethics Approval and Consent to Participate

The study was approved by the Assuta Medical Centers IRB (ASMC-0018-23, ASMC-0025-24), and written informed consent was obtained from all participants.

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Declaration of interests

The authors declare no competing interests.

Data Availability

Deidentified participant-level data, statistical analysis code, and the full study protocol are available in a public repository at Zenodo (DOI: 10.5281/zenodo.17583982). All data have been fully anonymized and contain no direct identifiers. No restrictions apply to data access.

Use of Generative AI

During the preparation of this manuscript, the authors used ChatGPT (OpenAI; version 5) to assist with English language editing and phrasing suggestions only. The tool was not used to generate scientific content, analyze data, or draw conclusions. All authors reviewed and edited the text to ensure accuracy and accept full responsibility for the final content.

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Figures

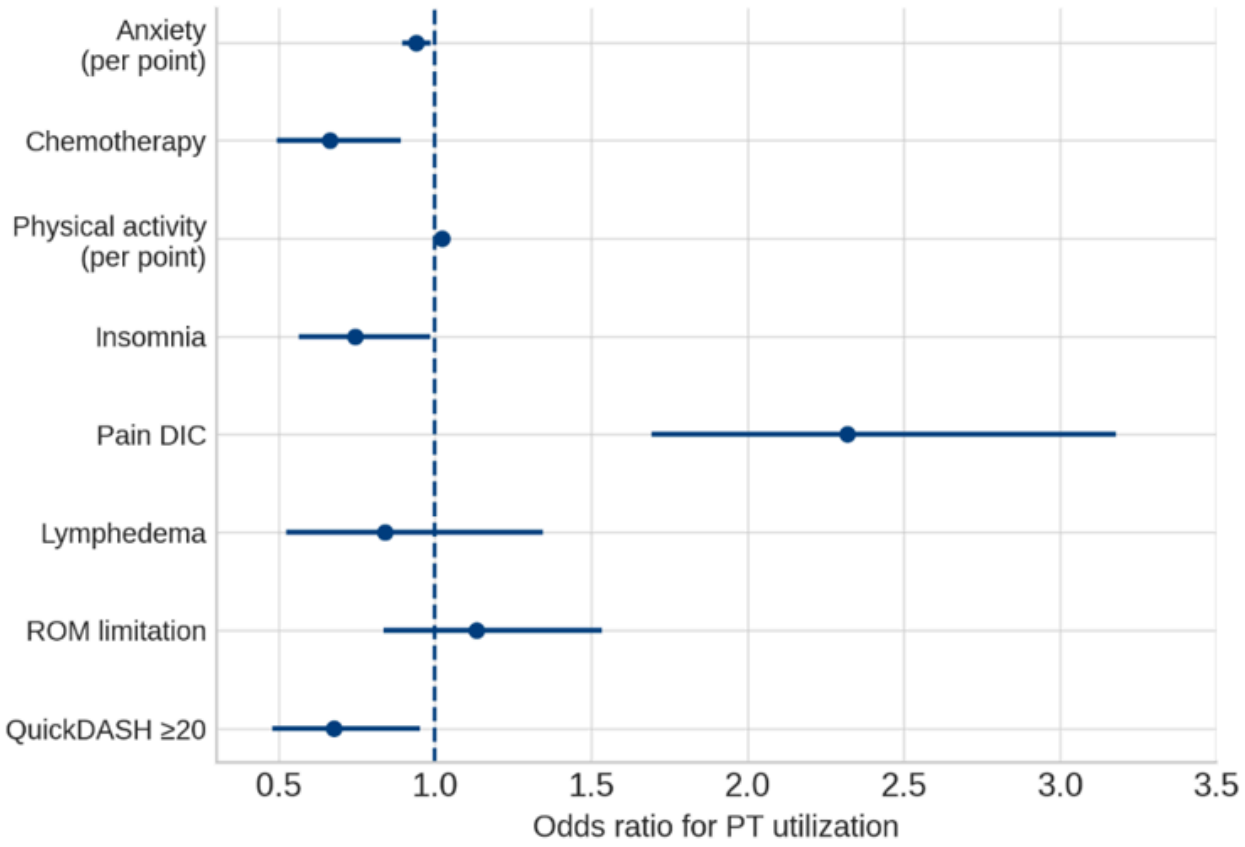


Figure 1

Factors associated with physiotherapy utilization after breast cancer surgery.

Abbreviations: PT, physiotherapy; OR, odds ratio; CI, confidence interval; ROM, range of motion; QuickDASH, Disabilities of the Arm, Shoulder and Hand questionnaire (short form); DIC pain, dichotomized postoperative pain ≥1.

Odds ratios (ORs) and 95% confidence intervals (CIs) were derived from a multivariable logistic regression model. The dashed vertical line indicates OR = 1. ORs >1 represent higher likelihood of physiotherapy utilization, whereas ORs <1 represent lower likelihood.

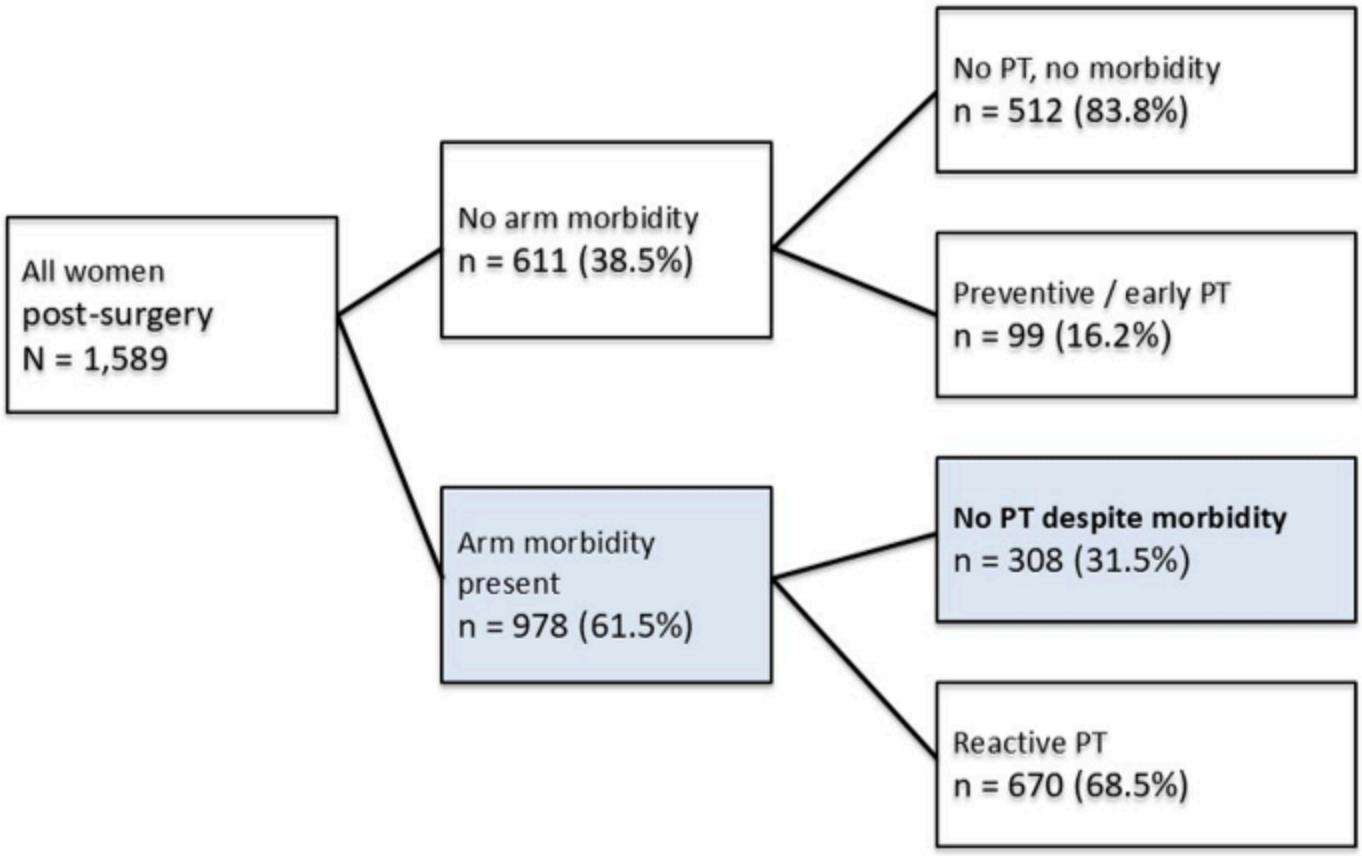


Figure 2

Clinical utilization pathways of physiotherapy after breast-cancer surgery

Legend: Boxes represent mutually exclusive postoperative care states based on morbidity status and physiotherapy use. The highlighted cell reflects untreated morbidity (31.5%). “No morbidity + No PT” denotes clinically appropriate non-utilization, often consistent with low ARM-BCT risk.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- FigureS1Flowchart300DPI.jpg
- Table1S.docx
- Table2S.docx