Original Article

Short-Term QuickDASH Outcomes Following ERAS-Based Rehabilitation After Modified Radical Mastectomy: A Nonrandomized Controlled Study

Joudy Gessal,[*] Regina Grimonia Sompotan,[**] Kortensi Karianga,[**] Thomas Khosasih[**]

**Physical Medicine and Rehabilitation Department of the Faculty of Medicine of Sam Ratulangi University, Manado, Indonesia*
***Resident of Physical Medicine and Rehabilitation Department of the Faculty of Medicine of Sam Ratulangi University, Manado, Indonesia*

Abstract

Introduction: *Modified Radical Mastectomy (MRM) may cause postoperative upper-limb dysfunction in breast cancer patients. Enhanced Recovery After Surgery (ERAS) combined with upper-limb-specific exercise may improve shoulder functional recovery. This study aimed to evaluate the effect of ERAS combined with upper-limb-specific exercise on shoulder functional ability after MRM.*
Methods*: This experimental pretest–posttest controlled study included 24 breast cancer patients undergoing MRM, equally divided into ERAS and Non-ERAS groups. Shoulder functional ability was assessed using the Quick-DASH Score at one and four weeks postoperatively. Data were analyzed using paired and independent t-tests.*
Results*: The Quick-DASH Score decreased significantly in both groups. The Non-ERAS group improved from 67.08 ± 2.68 to 35.67 ± 4.98, while the ERAS group improved from 48.08 ± 6.80 to 12.50 ± 6.74, both $p < 0.001$. The reduction was significantly greater in the ERAS group than in the Non-ERAS group, 35.58 ± 3.26 vs. 31.42 ± 3.18, $p = 0.002$.*
Conclusion*: ERAS combined with upper-limb-specific exercise significantly improves shoulder functional ability after MRM and may be considered a perioperative rehabilitation approach for breast cancer patients.*

Keywords*: ERAS, Upper limb specific exercise, Breast cancer, Modified Radical Mastectomy, Quick-DASH, Rehabilitation*

Korespondensi: Joudy Gessal
E-mail: *jgessal@gmail.com*

Hasil QuickDASH Jangka Pendek setelah Rehabilitasi Berbasis ERAS pada Pasien Pasca Mastektomi Radikal Modifikasi: Studi Terkontrol Nonrandomisasi

Joudy Gessal,[*] Regina Grimonia Sompotan,[**] Kortensi Karianga,[**] Thomas Khosasih[**]

[*]Departemen Ilmu Kedokteran Fisik dan Rehabilitasi, Fakultas Kedokteran Universitas Sam Ratulanggi, Manado, Indonesia
[**]Residen Departemen Ilmu Kedokteran Fisik dan Rehabilitasi, Fakultas Kedokteran Universitas Sam Ratulanggi, Manado, Indonesia

Abstrak

Pendahuluan: *Modified Radical Mastectomy (MRM) dapat menyebabkan gangguan fungsi ekstremitas atas pada pasien kanker payudara. Enhanced Recovery After Surgery (ERAS) yang dikombinasikan dengan upper limb specific exercise berpotensi meningkatkan pemulihan fungsi bahu. Penelitian ini bertujuan mengevaluasi pengaruh ERAS yang dikombinasikan dengan upper limb specific exercise terhadap kemampuan fungsional bahu pasca MRM.*
Metode*: Penelitian eksperimental dengan desain pretest–posttest dan kelompok kontrol ini melibatkan 24 pasien kanker payudara yang menjalani MRM, terbagi sama rata kedalam kelompok ERAS dan Non-ERAS. Kemampuan fungsional bahu dinilai menggunakan Quick-DASH Score pada minggu pertama dan keempat pasca operasi. Analisis data menggunakan uji t berpasangan dan uji t tidak berpasangan.*
Hasil*: Quick-DASH Score menurun bermakna pada kedua kelompok. Kelompok Non-ERAS membaik dari 67,08 ± 2,68 menjadi 35,67 ± 4,98, sedangkan kelompok ERAS membaik dari 48,08 ± 6,80 menjadi 12,50 ± 6,74, keduanya p < 0,001. Penurunan skor lebih besar pada kelompok ERAS dibandingkan Non-ERAS, yaitu 35,58 ± 3,26 vs. 31,42 ± 3,18, p = 0,002.*
Kesimpulan*: ERAS yang dikombinasikan dengan upper limb specific exercise secara signifikan meningkatkan kemampuan fungsional bahu pasca-MRM dan dapat dipertimbangkan sebagai pendekatan rehabilitasi perioperatif pada pasien kanker payudara.*

Kata kunci*: ERAS, Upper limb specific exercise, Kanker payudara, Modified Radical Mastectomy, Quick-DASH, Rehabilitasi*

Introduction

Breast cancer remains a major global health problem and is among the most common malignancies among women. In Indonesia, breast cancer accounted for 65,858 new cases in 2020, representing 16.6% of all newly diagnosed cancer cases.[1-3] Although breast cancer primarily affects the breast, the disease and its treatment can cause systemic and functional consequences, including muscle weakness, fatigue, pain, fibromyalgia, and other dysfunctions that can increase morbidity and reduce quality of life.[4,5]

Surgery remains an important component of breast cancer management, particularly for early-stage and locally advanced disease. Modified Radical Mastectomy (MRM) is still widely used as a standard surgical procedure for stage II and III breast cancer, especially in low- and middle-income settings.[2,6] In selected cases, neoadjuvant chemotherapy may be administered before surgery to reduce tumor size and improve surgical feasibility. However, despite its therapeutic role, MRM may lead to postoperative pain, bleeding, reduced mobility, and functional limitations of the shoulder, arm, and hand. These postoperative impairments may interfere with activities of daily living and contribute to long-term disability if not properly managed.[7]

Functional impairment of the upper extremity after MRM is a major concern in rehabilitation medicine. Surgical trauma, pain, soft-tissue tightness, limited shoulder range of motion, and postoperative immobilization may reduce shoulder function and limit the patient's ability to perform daily activities,

including dressing, combing hair, lifting objects, and household tasks. Therefore, postoperative rehabilitation should not only promote wound healing but also restore upper-extremity function and prevent disability.[7-9]

Enhanced Recovery After Surgery (ERAS) is a multidisciplinary, multimodal perioperative approach that reduces surgical stress, minimizes complications, and accelerates postoperative recovery. ERAS principles in breast surgery include multimodal analgesia, reduced opioid use, anesthetic strategies to reduce postoperative nausea and vomiting, and early mobilization. Implementing ERAS in breast cancer surgery is expected to reduce systemic complications and improve functional recovery after MRM.[8,9]

Prehabilitation is an important component of ERAS. It introduces rehabilitation strategies before surgery to optimize physical function and improve patient tolerance to surgical stress.[8,9] For patients undergoing breast cancer surgery, preoperative preparation may improve readiness for postoperative recovery and facilitate an earlier return to function. Upper limb-specific exercise, consisting of shoulder range of motion exercise, stretching, and strengthening, may help restore shoulder mobility, reduce chest tightness, improve shoulder functional ability, and enhance quality of life after breast cancer surgery.[10–12]

Previous studies have reported favorable outcomes with ERAS protocols in breast surgery. ERAS has been associated with improved pain control, reduced opioid use, shorter length of hospital stay, and lower perioperative morbidity.[9,13] Other studies have also shown that preoperative exercise and early upper-limb exercise after breast cancer surgery are safe and beneficial for improving upper-extremity recovery and postoperative functional outcomes.[10–12] However, evidence on the combined effect of ERAS and upper-limb-specific exercise on shoulder functional ability after MRM remains limited, particularly in the local clinical setting.

Therefore, this study aimed to analyze the effect of Enhanced Recovery After Surgery (ERAS) combined with upper-limb-specific exercise on shoulder function in breast cancer patients after Modified Radical Mastectomy (MRM). Shoulder function was evaluated using the Quick-DASH Score, which assesses disability of the shoulder, arm, and hand. The findings of this study are expected to support integrating ERAS and structured upper-limb rehabilitation into perioperative care for breast cancer patients undergoing MRM.

Method

This study was conducted as an experimental pre- and post-test controlled study involving two parallel groups: an ERAS-combined upper-limb-specific exercise group and a non-ERAS control group. The study was performed at Prof. Dr. R. D. Kandou Hospital, Manado, Indonesia, involving patients with breast cancer who were scheduled to undergo MRM. The study protocol was reviewed and approved by the Health Research Ethics Committee of RS R.D. Kandou, Manado, Indonesia (Ethical Approval No. 199/EC/KEPK-KANDOU/X/2024).

Women aged 30–65 years with histopathologically confirmed breast cancer who were scheduled to undergo their first MRM procedure were considered eligible. Participants were required to have stable hemodynamic status, controlled comorbidities, corrected nutritional status, normal or corrected visual function, normal hearing as determined by whisper test, and no balance or coordination impairment. Cognitive eligibility was determined using the Mini Mental State Examination (MMSE), with a score greater than 25 required for inclusion. All participants provided written informed consent before enrollment.

Patients were excluded if they had distant metastasis, lymphedema, pre-existing limitation of shoulder joint range of motion, or cardiovascular conditions that contraindicated physical exercise according to adapted American College of Sports Medicine criteria. Participants were considered withdrawn if they missed two consecutive exercise sessions, voluntarily discontinued participation, did not follow the ERAS protocol, developed unstable hemodynamic status, or required postoperative intensive care.

Eligible participants were allocated into either the ERAS group or the Non-ERAS group. Functional assessment was performed before intervention and after surgery, with the primary postoperative functional outcome measured at one week and four weeks after MRM using the Quick-DASH Score. A total of 24 patients were included in the final study sample: 12 in the ERAS group and 12 in the non-ERAS group.

Participants in the ERAS group received preoperative education, psychological support, and structured prehabilitation before surgery. Prehabilitation consisted of aerobic exercise and upper limb-specific exercise. Aerobic exercise included static cycling for 30 minutes at moderate intensity (Borg scale

Figure 1. Prehabilitation for ERAS group

12–14), three times per week, and walking for 30 minutes twice per week, monitored using the STRAVA application and the talk test.

Upper-limb-specific exercise consisted of shoulder range-of-motion exercises combined with dynamic shoulder stretching, held for 10–15 seconds, performed three times per week. Upper-limb strengthening exercises included bench press and cable front raise, based on each patient's one-repetition maximum. Strengthening exercises were performed two to three times per week, with three sets of 8–10 repetitions. The prehabilitation program was performed for four consecutive weeks before neoadjuvant therapy.

Exercise sessions used a combination of center-based and home-based approaches. Home-based exercise was monitored according to schedule, with daily telephone evaluation on working days. After surgery, early mobilization was initiated as soon as consciousness recovered, with a target of ambulation within the first 24 postoperative hours in the ERAS group. Postoperative aerobic exercise and upper limb-specific exercise, excluding strengthening exercise, were continued in the ERAS group until outpatient follow-up.

Participants in the Non-ERAS group received standard postoperative rehabilitation both after surgery and during outpatient follow-up. Unlike the ERAS group, the Non-ERAS group did not receive structured preoperative education, psychological support, or prehabilitation.

The primary outcome was postoperative shoulder functional ability, assessed using the Quick-DASH Score. Quick-DASH is a validated instrument for evaluating upper-extremity disability and has been used to assess shoulder, arm, and hand function in breast cancer survivors. A lower Quick-DASH Score indicates better upper-extremity functional ability, whereas a higher score indicates greater disability.

Data were analyzed using SPSS version 29. Descriptive analysis summarized participant characteristics and study variables using frequency distribution, mean, and standard deviation. Data normality was tested using the Shapiro–Wilk test. Within group differences in Quick-DASH Score between the first and fourth postoperative weeks were analyzed using the paired t-test when data were normally distributed. If the data were not normally distributed, we planned to use the Wilcoxon signed-rank test. Between-group differences in Quick-DASH Score changes between the ERAS and Non-ERAS groups were analyzed using the independent t-test when data were normally distributed. If the data were not normally distributed, the Mann–Whitney test was planned. A p-value of <0.05 was considered statistically significant.

Result

Initially, 25 patients were included in the study. During the observation period, one participant discontinued postoperative intervention due to a wound-related complication and was therefore excluded from further evaluation. A total of 24 female patients with breast cancer who underwent MRM completed the study and were included in the final analysis. The participants were divided equally into two groups: 12 patients in the Enhanced Recovery After Surgery combined with upper limb-specific exercise group and 12 patients in the Non-ERAS group. The functional ability of the shoulder, arm, and hand was assessed using the Quick-DASH Score at one week and four weeks after surgery. The distribution of research subjects is shown in Table 1.

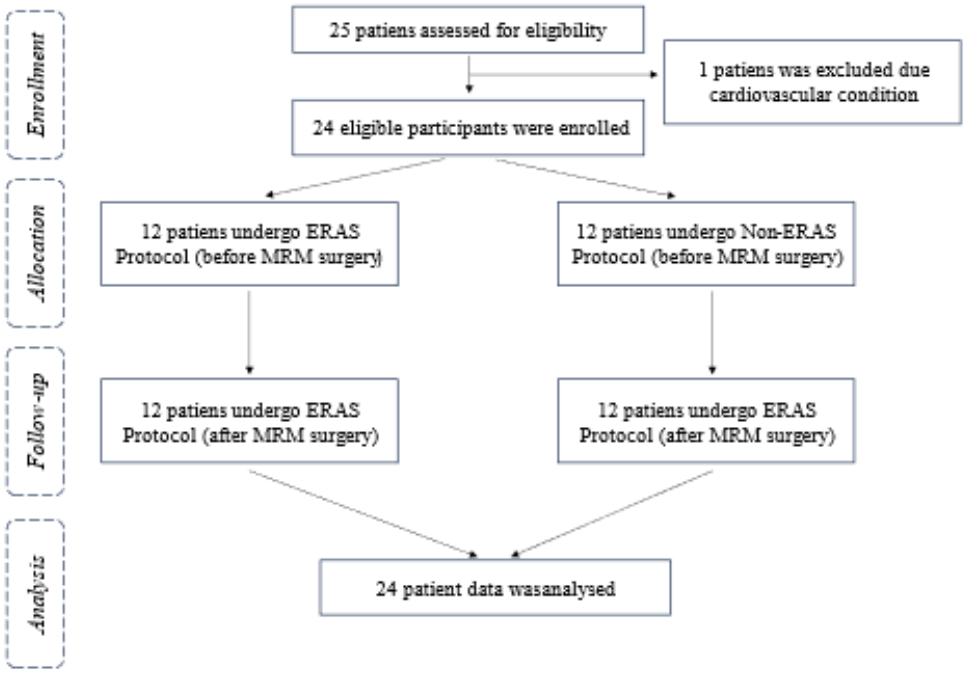

Figure 2. Modified CONSORT Flowchart for Non-randomized Trial Design Participants Enrollment

Table 1. Research Subjects Distribution

Characteristic	Frequency (n)	Percentage (%)
Sex		
Female	24	100
Age		
30–49 years	12	50
≥50 years	12	50
Eras Group (n=12)		
30–49 years	7	58.3
≥50 years	5	41.7
Non-Eras Group (n=12)		
30–49 years	5	41.7
≥50 years	7	58.3

The normality test showed that the Quick-DASH Score data were normally distributed. Therefore, within-group comparisons were analyzed using paired t-tests, while between group comparisons of score changes were analyzed using an independent t-test.

In the Non-ERAS group, a significant reduction in Quick-DASH Score was observed between the first and fourth postoperative weeks. The mean Quick-DASH Score decreased from 67.08 ± 2.68 at week 1 to 35.67 ± 4.98 at week 4. Paired t-test analysis showed that this reduction was statistically significant ($t = 34.273$; $p < 0.001$), indicating improved shoulder function after conventional postoperative rehabilitation.

In the ERAS and upper limb-specific exercise group, the Quick-DASH score also decreased significantly from week 1 to week 4 after surgery. The mean score decreased from 48.08 ± 6.80 at week 1 to 12.50 ± 6.74 at week

Table 2. Quick-DASH Score in The Non-ERAS Group

Outcome	Week 1 (Mean ± SD)	Week 4 (Mean ± SD)	T	p-value
Quick-DASH Score	67.08 ± 2.68	35.67 ± 4.98	34.273	<0.001

4. Paired t-test analysis demonstrated a statistically significant improvement in functional ability ($t = 34.273$; $p < 0.001$). This finding indicates that patients receiving ERAS combined with upper limb specific exercise experienced marked improvement in postoperative shoulder, arm, and hand function.

Table 3. Quick-DASH Score in The ERAS and Upper Limb Specific Exercise Group

Outcome	Week 1 (Mean ± SD)	Week 4 (Mean ± SD)	T	p-value
Quick-DASH Score	48.08 ± 6.80	12.50 ± 6.74	34.273	<0.001

The magnitude of Quick-DASH Score reduction was compared between the ERAS and Non-ERAS groups. The ERAS group and the upper-limb-specific exercise group showed a greater mean reduction in Quick-DASH Score than the Non-ERAS group. The mean score reduction was 35.58 ± 3.26 in the ERAS group and 31.42 ± 3.18 in the Non-ERAS group. Independent t-test analysis showed a statistically significant difference between groups ($t = 3.172$; $p = 0.002$).

Table 4. Comparison of Quick-DASH Score Reduction Between The ERAS and Non-ERAS Groups

Outcome	ERAS + upper limb exercise	Non-ERAS	t	P
Quick-DASH score reduction	35.58 ± 3.26	31.42 ± 3.18	3.172	0.002

These findings indicate that ERAS combined with upper limb-specific exercise resulted in significantly greater improvement in shoulder functional ability than conventional postoperative rehabilitation.

Discussion

This study demonstrated that both conventional postoperative rehabilitation and ERAS combined with upper limb specific exercise improved shoulder functional ability in patients with breast cancer following MRM. However, the magnitude of improvement was greater in the ERAS group. The Non-ERAS group showed a significant reduction in Quick-DASH Score from 67.08 at the first postoperative week to 35.67 at the fourth postoperative week, whereas the ERAS group showed a greater decrease from 48.08 to 12.50 during the same observation period. Between-group analysis further confirmed that the reduction in Quick-DASH Score was significantly greater in the ERAS group than in the Non-ERAS group, with a mean reduction of 35.58 versus 31.42, respectively. These findings indicate that ERAS combined with upper limb specific exercise provides additional benefits beyond conventional postoperative rehabilitation in restoring upper-extremity function after MRM.

The improvement observed in the Non-ERAS group suggests that conventional postoperative rehabilitation and the natural healing process still contribute to functional recovery after surgery. As postoperative pain gradually decreases and patients resume movement, shoulder, arm, and hand function may improve. Nevertheless, the mean Quick-DASH Score at the fourth postoperative week remained relatively high in the Non-ERAS group, indicating that residual upper-extremity disability persisted. This may be related to postoperative pain, limited shoulder range of motion, soft-tissue tightness, and fear of moving the operated-side arm, all of which may restrict the patient's ability to perform daily activities. Previous evidence has shown that exercise intervention are important in managing upper-limb dysfunction related to breast cancer treatment, particularly in improving functional recovery and reducing disability.[9]

In contrast, patients who received ERAS combined with upper-limb-specific exercise showed more pronounced functional improvement. The decrease in Quick-DASH Score to 12.50 at the fourth postoperative week suggests that most patients in this group approached minimal disability. This finding is clinically important because the Quick-DASH

Score reflects the patient's ability to perform activities involving the shoulder, arm, and hand. The greater improvement in the ERAS group may be explained by integrating several perioperative components, including patient education, prehabilitation, multimodal pain control, early mobilization, and structured upper-limb exercises. The report describes ERAS as a multidisciplinary and multimodal perioperative approach, with prehabilitation introduced before surgery to optimize function and improve tolerance to surgical stress.

Upper-limb-specific exercise appears to be a central component of the observed improvement. After breast surgery, shoulder dysfunction may result from pain inhibition, soft-tissue adhesions, chest wall tightness, reduced range of motion, and altered scapulohumeral movement. Structured shoulder range-of-motion exercises, stretching, and strengthening may help prevent stiffness, maintain neuromuscular activation, and restore functional movement patterns. This interpretation aligns with previous studies showing that progressive exercise programs and early upper-limb exercises after breast cancer surgery can improve range of motion, grip strength, pain control, and kinetic-functional recovery.[4,14]

The findings of this study can also be interpreted using the International Classification of Functioning, Disability and Health (ICF) framework. MRM may affect body structure and body function through surgical trauma to the breast, axilla, shoulder girdle, and surrounding soft tissues. These impairments may lead to activity limitations, such as difficulty combing hair, dressing, lifting objects, or performing household tasks, which are reflected in the Quick-DASH Score.[11] The greater reduction in Quick-DASH Score in the ERAS group suggests that the intervention did not merely improve physical impairment but also contributed to better activity performance and potentially earlier participation in daily life.

From a rehabilitation medicine perspective, the significant difference between the ERAS and Non-ERAS groups is clinically meaningful. Although both groups improved, the lower Quick-DASH Score in the ERAS group indicates faster recovery of functional independence. This may allow patients to return earlier to self-care, domestic activities, and instrumental activities of daily living. In breast cancer care, such functional recovery is important because postoperative disability may delay return to daily roles and may affect quality of life. The report's conclusion also emphasizes that ERAS integrated with upper limb-specific exercise significantly improved shoulder, arm, and hand function and helped reduce activity limitation after MRM.

The results are consistent with previous literature on ERAS and breast surgery. Muetterties et al. reported that implementation of an ERAS protocol in microvascular breast reconstruction was associated with a shorter hospital stay and reduced postoperative narcotic use, without increasing perioperative complications.[9] Lombana et al. also emphasized that ERAS protocols in breast plastic surgery improve pain control, reduce opioid consumption, shorten length of stay, and support recovery.10 Although those studies focused mainly on perioperative and surgical outcomes, the present study extends the clinical relevance of ERAS by demonstrating its benefit on upper-extremity functional recovery as measured by Quick-DASH Score.

The role of prehabilitation in this study is also supported by previous evidence. Casanovas-Alvarez et al. reported that an exercise and education based prehabilitation program before breast cancer surgery helped maintain arm function, improved functional capacity, and reduced cancer-related fatigue.[11] In the present study, prehabilitation was delivered before surgery in the ERAS group and included aerobic exercise, stretching, and strengthening components. This may have improved patients' physical readiness before MRM and enhanced their ability to participate in postoperative rehabilitation. Therefore, the benefit observed in the ERAS group likely reflects the combined effect of preoperative optimization and postoperative functional exercise.

This study highlights the importance of involving rehabilitation medicine early in the perioperative pathway. ERAS should not be viewed only as a surgical protocol but also as a rehabilitation-oriented strategy. Early assessment of baseline function, education, individualized exercise prescription, pain control, and progressive postoperative training should be integrated into the care pathway for patients undergoing MRM. Such integration may reduce the risk of persistent shoulder dysfunction, frozen shoulder, chronic postoperative pain, and long-term upper-extremity disability.

Several limitations should be considered. First, the sample size was relatively small, with 12 patients in each group, which may limit the generalizability of the findings. Second, the follow-up period was limited to

four weeks, so the long-term effect of ERAS combined with upper limb specific exercise on shoulder function, pain, quality of life, and return to social participation could not be evaluated. Third, this study focused primarily on Quick-DASH Score; future studies should include additional outcomes such as shoulder range of motion, muscle strength, pain intensity, lymphedema incidence, length of stay, quality of life, and long-term functional independence.

Despite these limitations, this study provides clinically relevant evidence that ERAS combined with upper limb specific exercise improves shoulder functional recovery after MRM more effectively than conventional postoperative rehabilitation. These findings support the implementation of a multidisciplinary ERAS-based rehabilitation pathway for patients with breast cancer undergoing MRM, particularly to minimize upper-extremity disability and optimize postoperative functional outcomes.

Conclusion

ERAS combined with upper limb specific exercise significantly improved shoulder functional ability in breast cancer patients following Modified Radical Mastectomy. Although both ERAS and Non-ERAS groups showed significant improvement in Quick-DASH Score, the ERAS group demonstrated a greater reduction in disability and achieved better functional recovery at four weeks postoperatively. These findings support the integration of ERAS and structured upper-limb rehabilitation as a perioperative rehabilitation strategy to optimize postoperative shoulder function after MRM.

Conflict of Interest

None

Acknowledgement

The author expresses gratitude to all participants and staff who offered support and assistance during the study.

Funding

This study was funded by the Prof. Dr. R. D. Kandou Hospital through its research funding program.

Referencess

1. Jagsi R, King TA, Lehman C, Morrow M, Harris JR, Burstein HJ. Malignant tumors of the breast. In: DeVita VT Jr, Lawrence TS, Rosenberg SA, et al. DeVita, Hellman, and Rosenberg's Cancer: Principles and Practice of Oncology. 12th ed. Philadelphia: Lippincott Williams & Wilkins; 2023. p. 968-1007.
2. Henry NL, Shah PD, Haider I, Freer PE, Jagsi R, Sabel MS. Cancer of the breast. In: Abeloff's Clinical Oncology. Elsevier; 2020. p. 1560–603.
3. International Agency for Research on Cancer. Global Cancer Observatory: Cancer Today [Internet]. Lyon: International Agency for Research on Cancer; 2020 [cited 2026 Aug 23]. Available from: https://gco.iarc.who.int/media/globocan/factsheets/populations/360-indonesia-fact-sheet.pdf
4. Macdonald ER, Amorim NLM, Hagstrom AD, Markovic K, Simar D, Ward RE, et al. Evaluating the effect of upper-body morbidity on quality of life following primary breast cancer treatment: a systematic review and meta-analysis. J Cancer Surviv. 2024;18(5):1517-47.
5. Akbas A, Dagmura H, Daldal E, Dasiran FM, Deveci H, Okan I. Association between shoulder range of motion and pain catastrophizing scale in breast cancer patients after surgery. Breast Care. 2021;16(1):66–71.
6. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2024;74(3):229–63.
7. Korde LA, Somerfield MR, Carey LA, Crews JR, Denduluri N, Hwang ES, et al. Neoadjuvant chemotherapy, endocrine therapy, and targeted therapy for breast cancer: ASCO guideline. J Clin Oncol. 2021;39(13):1485-505.
8. Jogerst K, Thomas O, Kosiorek HE, Gray R, Cronin P, Casey 3rd W, et al. Same-day discharge after mastectomy: breast cancer surgery in the era of ERAS®: K. Jogerst et al. Ann Surg Oncol. 2020;27(9):3436–45.
9. Muetterties CE, Taylor JM, Kaeding DE, Morales RR, Nguyen AV, Kwan L, et al. Enhanced recovery after surgery protocol decreases length of stay and postoperative narcotic use in microvascular breast reconstruction. Plast Reconstr Surg Glob

Open. 2023;11(12):e5444
10. Lombana NF, Mehta IM, Zheng C, Falola RA, Altman AM, Saint-Cyr MH. Updates on enhanced recovery after surgery protocols for plastic surgery of the breast and future directions. In: Baylor University Medical Center Proceedings. Taylor & Francis; 2023. p. 501–9.
11. Casanovas-Alvarez A, Estanyol B, Ciendones M, Padros J, Cuartero J, Barnadas A, et al. Effectiveness of an exercise and educational-based prehabilitation program in patients with breast cancer receiving neoadjuvant chemotherapy (PREOptimize) on functional outcomes: a randomized controlled trial. Phys Ther. 2024;104(12):pzae151.
12. Araya S, Webster TK, Egleston B, Amadio GM, Panichella JC, Elmer NA, et al. Significant reduction in length of stay in deep inferior epigastric perforator flap breast reconstruction with implementation of multimodal ERAS protocol. Ann Plast Surg. 2023;91(1):90–5.
13. Al-Onazi MM, Yurick JL, Harris C, Nishimura K, Suderman K, Pituskin E, et al. Therapeutic ultrasound for chemotherapy-related pain and sensory disturbance in the hands and feet in patients with colorectal cancer: a pilot randomized controlled trial. J Pain Symptom Manage. 2021 Jun 1;61(6):1127–38.
14. de Almeida Rizzi SKL, Haddad CAS, Giron PS, Figueira PVG, Estevao S, Elias S, et al. Early free range-of-motion upper limb exercises after mastectomy and immediate implant-based reconstruction are safe and beneficial: a randomized trial. Ann Surg Oncol. 2020;27(12):4750–9.