




National long-term patient-reported outcomes following mastectomy with or without breast reconstruction: The Swedish Breast Reconstruction Outcome Study Part 2 (SweBRO 2)

Rojda Gümüşcü^{1,*}, Dmytro Unukovych^{1,2} , Fredrik Wärnberg^{1,3}, Jana de Boniface^{4,5} , Malin Sund^{6,7} , Kristina Åhsberg^{8,9}, Emma Hansson^{10,11}, Folke Folkvaljon¹² and Maria Mani^{1,13}

¹Department of Surgical Sciences, Uppsala University, Uppsala, Sweden

²Department of Plastic and Craniofacial Surgery, Karolinska University Hospital, Stockholm, Sweden

³Department of Surgery, Sahlgrenska University Hospital, Institute of Clinical Sciences, Sahlgrenska Academy at Gothenburg University, Gothenburg, Sweden

⁴Department of Surgery, Capio S:t Göran's Hospital, Stockholm, Sweden

⁵Department of Medicine and Surgery, Karolinska Institutet, Stockholm, Sweden

⁶Department of Surgery and Perioperative Sciences, Umeå University, Umeå, Sweden

⁷Department of Surgery, University of Helsinki and Helsinki University Hospital, Helsinki, Finland

⁸Department of Surgery, Halland Hospital, Halmstad, Sweden

⁹Department of Clinical Sciences, Lund University, Lund, Sweden

¹⁰Department of Plastic Surgery, Institute of Clinical Sciences, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden

¹¹Department of Plastic and Reconstructive Surgery, Region Västra Götaland, Sahlgrenska University Hospital, Gothenburg, Sweden

¹²Sveastat AB, Göteborg, Sweden

¹³Department of Plastic and Reconstructive Surgery, Uppsala University Hospital, Uppsala, Sweden

*Correspondence to: Rojda Gümüşcü, Department of Plastic and Reconstructive Surgery, Uppsala University Hospital, 751 85 Uppsala, Sweden (e-mail: rojda.gumuscu@surgsci.uu.se)

Some of the current data were presented as an oral presentation at the 30th EURAPS annual meeting, 23–25 May 2019 at Finlandia Hall, Helsinki, and at the National Surgery Week in Sweden, 27 August 2021.

Abstract

Background: The Swedish Breast Reconstruction Outcome Study (SweBRO) initiative is a nationwide study with the primary aim of assessing long-term outcomes after mastectomy with and without breast reconstruction (BR). The current part (SweBRO 2) is designed to evaluate health-related quality of life (HRQoL), with the hypothesis that BR has a positive impact on patient-reported HRQoL in the long-term.

Methods: Women who underwent mastectomy in Sweden in 2000, 2005, or 2010 and were alive at the time of the survey were identified through the National Breast Cancer Registry. Eligible participants received formal invitation letters to take part in a survey evaluating their HRQoL at 5, 10, or 15 years post-mastectomy. The EORTC QLQ-C30, EORTC QLQ-BR23, and EQ-5D-3L questionnaires were employed.

Results: Of 2904 respondents (50% of 5853 invited), 895 (31%) had received BR. Among them, 516 (58%) were reconstructed with implants and 281 (31%) with autologous tissue. Women with BR scored significantly better in the EORTC QLQ-C30 physical functioning domain (mean 90 versus 81 points), fatigue (mean 21 versus 25), and dyspnoea (mean 16 versus 22) compared to non-reconstructed women. The EORTC QLQ-BR23 revealed that women with BR experienced favourable sexual functioning compared with non-reconstructed women (mean 26 versus 14). The EQ-5D-3L visual analogue scale score was similar between groups.

Conclusion: The current study underscores the benefits of BR for long-term well-being, for example, in terms of physical and sexual functioning. These underline the importance of informing women undergoing mastectomy about BR alternatives and its potential benefits in enhancing long-term well-being.

Introduction

Oncological outcomes of breast cancer care have improved over time as a consequence of earlier detection by national screening programmes, improved diagnostic modalities, as well as therapy advancements. Currently, the reported 5-year survival after breast cancer diagnosis is over 80% in developed countries, 60% in developing countries, and around 40% in low-income

countries¹. As a result, an increasing number of women live with a history of breast cancer and their long-term health-related quality of life (HRQoL) is of great importance².

Breast cancer surgery has been shown to be associated with reduced self-esteem, affected body image and sexuality, as well as anxiety and depression³. Previous studies have found that from a short-term perspective (<5 years post surgery) both

Received: November 08, 2023. Accepted: December 14, 2023

© The Author(s) 2024. Published by Oxford University Press on behalf of BJS Foundation Ltd.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact journals.permissions@oup.com

breast-conserving surgery and breast reconstruction (BR) following mastectomy can lead to improved cosmesis, better psychosocial well-being⁴, improved HRQoL and better self-image compared to mastectomy alone³. A number of previous studies evaluated clinical- and patient-reported outcomes^{5–8}; however, studies analysing HRQoL after mastectomy from a long-term perspective of up to 15 years, at a national level, are lacking.

Consequently, the Swedish Breast Reconstruction Outcome (SweBRO) study was initiated⁹ with the aim of assessing long-term HRQoL among women who had undergone a mastectomy with or without BR in Sweden and to analyse the impact of BR on long-term HRQoL after mastectomy.

Patients and methods

This survey was conducted between 20 April 2016 and 22 September 2016. All women diagnosed with breast cancer who underwent a total mastectomy in Sweden during the years 2000, 2005, or 2010 were eligible for the study, identified through the National Breast Cancer Registry, which has a coverage of 99%¹⁰. The specific years were chosen as they allowed for assessment 5, 10, and 15 years after mastectomy. All potential study participants were checked against the National Cause of Death registry and those deceased were excluded. The final list of patients comprising the survey population was then generated and invitation letters to participate were sent out. The women were given the option to answer the survey on paper or online. All questions were in Swedish. The survey process has previously been described in detail⁹.

Tumour characteristics and treatment data including surgery, chemotherapy, radiotherapy, and endocrine treatment were retrieved from the National Breast Cancer Registry. The survey included self-reported information on sociodemographic characteristics and provided health care, breast reconstructive surgery, and validated patient-reported outcomes (PROs). The current study reports data from EORTC QLQ-C30, EORTC QLQ-BR23, and EQ-5D-3L.

The European Organization for Research and Treatment of Cancer (EORTC) instrument used in the current study includes 30 cancer-specific questions (QLQ-C30) targeting five functioning domains (physical, emotional, role, cognitive, and social), nine symptom domains (fatigue, nausea, vomiting, pain, dyspnoea, insomnia, appetite loss, constipation, and diarrhoea), as well as questions regarding global health status, quality of life, and financial difficulties¹⁰. The breast cancer-specific EORTC QLQ-BR23 includes 23 questions representing two distinct sets of domains, for function and symptoms, respectively. The functional domains include body image, sexual functioning, future perspective, and sexual enjoyment domains whereas the symptom domains include arm symptoms, breast symptoms, side effects of systematic therapy, and hair loss¹¹.

The EQ-5D is a well-established instrument that has been used for more than 20 years to describe general health status¹². It includes one question for each of five different dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. The EQ-5D-3L was used in the current study^{12,13}. For all instruments, validated Swedish versions were used^{14–16}.

Ethical approval

The study was approved by the regional ethics committee, Uppsala University (Dnr 2014/354 and Dnr 2014:354/1).

Statistical analysis

Descriptive statistics for the study cohort and distribution of missing data have previously been reported by Unukovych et al.⁹. Statistical hypothesis testing was done comparing survey responses by groups defined according to self-reported BR status (reconstructed versus non-reconstructed). Due to the ordinal nature of the PRO scores and observed non-normality in their distribution, all comparisons were based on the Wilcoxon rank sum test of equal distribution between reconstructed and non-reconstructed women. No causality claims are made and reported values of *P* are only interpreted as indicating differences between the observed distributions of study data. The overall type I error (alpha) was controlled using an unweighted Bonferroni approach and was set to 0.05, split equally across four clusters defined by questionnaires: EORTC QLQ-C30, EORTC QLQ-BR23, EORTC QLQ-BRECON23, and BREAST-Q postoperative module (Fig. S1). Of these, the current study only reports the results from the EORTC QLQ-C30 and EORTC QLQ-BR23. Each questionnaire contains several domains with varying directionality (Table S1), which were analysed overall and in 16 prespecified subgroups, defined by demographics and baseline characteristics (Fig. S1). Comparisons were made between women with reconstruction versus non-reconstructed women. Due to the alpha split, questionnaires with more domains to test had more stringent limits for statistical significance in each hypothesis test (lower *P* for statistical significance). The limit for statistical significance was hence set to $P < 0.000016339$ for EORTC QLQ-C30 and $P < 0.000030637$ for EORTC QLQ-BR23 (Fig. S1). All tests were two-sided and R version 4.1.1 (R Foundation for Statistical Computing, Vienna, Austria) was used for all statistical analyses.

Clinically meaningful difference

The size of a clinically meaningful difference for a PRO score is specific to the scale and population from where it is derived, and is generally not transferable to other scales or populations. While 10 points is sometimes used as a threshold for clinically meaningful differences in all EORTC QLQ-C30 domains, this threshold has not been demonstrated for each domain or specifically for women with breast cancer¹⁷. In women with advanced breast cancer, a clinically meaningful change in the different domains has been estimated to vary between –18 and +12 points, for deterioration and improvement, respectively¹⁸. No predefined thresholds for clinically meaningful differences were available for the EORTC QLQ-BR23¹⁹. The EQ-5D-3L was analysed descriptively in terms of categorical responses and mean visual analogue scale (VAS) scores; no utility scores were calculated.

Results

As previously reported, 5853 women were eligible for inclusion in the study: 1259, 1976, and 2618 from the years 2000, 2005, and 2010, respectively. In total, 2904 (50%) women responded to the questionnaires. The baseline distribution of variables available for both questionnaire responders and non-responders shows that characteristics were generally comparable between the groups, except that women who responded to the questionnaire were younger, more likely to have T0/Tis disease at mastectomy, and more likely to have received adjuvant radiotherapy and chemotherapy (Table S2).

Of those who responded to the questionnaire, 895 (31%) reported having a BR, of whom 516 (58%) reported being

Table 1 QLQ-C30 scores by breast reconstruction status and different subgroups, only showing domains and subgroups with statistically significant differences

	Total	Reconstructed	Not reconstructed	P
All women (n)	2904	895	2009	
QLQ-C30: physical functioning	84(19)	90(14)	81(21)	<0.000016339*
QLQ-C30: fatigue	24(23)	21(21)	25(23)	<0.000016339*
QLQ-C30: dyspnoea	20(25)	16(23)	22(25)	<0.000016339*
Subset: selected 2005 (n)	943	286	657	
QLQ-C30: physical functioning	85(19)	91(13)	82(20)	<0.000016339*
Subset: selected 2010 (n)	1368	438	930	
QLQ-C30: physical functioning	84(20)	90(14)	81(21)	<0.000016339*
Subset: age ≥50 years at selection (n)	2109	444	1665	
QLQ-C30: physical functioning	82(20)	87(16)	80(21)	<0.000016339*
Subset: T1 (n)	901	279	622	
QLQ-C30: physical functioning	84(19)	90(15)	82(20)	<0.000016339*
Subset: T2–T4 (n)	1106	354	752	
QLQ-C30: physical functioning	83(20)	90(13)	80(22)	<0.000016339*
Subset: N0 (n)	1576	533	1043	
QLQ-C30: physical functioning	84(19)	90(14)	82(21)	<0.000016339*
Subset: N+ (n)	460	133	327	
QLQ-C30: physical functioning	83(20)	90(15)	81(21)	<0.000016339*
Subset: RT– (n)	1815	556	1259	
QLQ-C30: physical functioning	84(19)	91(14)	81(21)	<0.000016339*
QLQ-C30: dyspnoea	20(24)	16(22)	21(25)	<0.000016339*
Subset: RT+ (n)	1089	339	750	
QLQ-C30: physical functioning	84(19)	89(15)	81(20)	<0.000016339*
Subset: ET– (n)	1637	526	1111	
QLQ-C30: physical functioning	85(18)	91(13)	82(20)	<0.000016339*
Subset: ET+ (n)	1267	369	898	
QLQ-C30: physical functioning	83(20)	89(15)	80(22)	<0.000016339*
Subset: CT– (n)	2057	587	1470	
QLQ-C30: physical functioning	83(20)	90(14)	81(21)	<0.000016339*
QLQ-C30: fatigue	24(23)	21(21)	26(23)	<0.000016339*
QLQ-C30: dyspnoea	20(25)	16(22)	22(26)	<0.000016339*
Subset: CT+ (n)	847	308	539	
QLQ-C30: physical functioning	86(18)	90(13)	83(19)	<0.000016339*

Data are mean(s.d.) unless otherwise stated. Distribution of continuous variables was tested using Wilcoxon rank sum test. Due to the Bonferroni adjustment for multiplicity, only $P < 0.000016339$ was statistically significant. *Statistically significant. CT, chemotherapy; EORTC, European Organization for Research and Treatment of Cancer; ET, endocrine therapy; QLQ-C30, Quality of Life Questionnaire Core-30; RT, radiotherapy.

reconstructed with implants and 281 (31%) with autologous tissue. In 20 (2%) women a combination of techniques had been used and in 78 (9%) the technique was not reported. Of these, 176 women reported receiving immediate BR and 719 delayed BR. Patient characteristics of the reconstructed and non-reconstructed groups are presented in [Table S3](#).

In the EORTC QLQ-C30, women with a BR reported significantly better physical functioning (mean 90 versus 81 points) compared to women with no BR. Reconstructed women also reported significantly less fatigue (mean 21 versus 25) and dyspnoea (mean 16 versus 22) compared to non-reconstructed women. Significantly better physical functioning was reported 5 and 10 years post-mastectomy and across categories of tumour stage, nodal status, radiotherapy, endocrine therapy, and chemotherapy ([Table 1](#), [Table S4](#)). The subgroups where differences in physical functioning, in favour of reconstructed women, were not statistically significant were women diagnosed with T0/Tis disease (mean 91 versus 84), women selected 15 years post-mastectomy (mean 88 versus 82), and women aged <50 years at selection (mean 92 versus 87).

In the EORTC QLQ-BR23, reconstructed women reported significantly better sexual functioning than women with no BR (mean 26 versus 14; [Table 2](#), [Table S5](#)). Significantly higher scores for sexual functioning were also reported in women selected 5 or 10 years post-mastectomy and across categories of age, tumour stage, nodal status, radiotherapy, endocrine therapy, and chemotherapy ([Table 2](#)). The subgroups where differences in

sexual functioning, in favour of reconstructed women, were not statistically significant were women diagnosed with T0/Tis disease (mean 26 versus 17) and women selected 15 years post-mastectomy (mean 21 versus 14). In the subgroup diagnosed with T2–T4 disease, women with a reconstruction scored significantly worse in body image compared to women without a BR (mean 69 versus 77). This difference was not statistically significant in the whole study population or in other subgroups.

For EQ-5D-3L, issues with mobility were less common in women with a BR than in non-reconstructed women (92% versus 77% reporting 'I have no problems in walking about'). The observed differences in all other EQ-5D-3L items, including the VAS score, were small ([Table 3](#)).

Discussion

The SweBRO initiative is a nationwide study aimed at assessing long-term outcomes after mastectomy with and without BR⁹. The current survey found that from a long-term perspective (5–15 years after mastectomy) women with a BR generally reported higher scores in certain aspects of HRQoL compared to women with mastectomy alone. The result for sexual functioning was consistent across almost all subgroups by demographics and baseline characteristics, as was the result for physical functioning. Body image scores were statistically significantly higher in the non-reconstructed group, only in the

Table 2 QLQ-BR23 scores by breast reconstruction status, only showing domains with statistically significant differences

	Total	Reconstructed	Not reconstructed	P
All women (n)	2904	895	2009	
QLQ-BR23: sexual functioning	18(23)	26(25)	14(20)	<0.000030637*
Subset: selected 2005 (n)	943	286	657	
QLQ-BR23: sexual functioning	17(22)	24(24)	14(20)	<0.000030637*
Subset: selected 2010 (n)	1368	438	930	
QLQ-BR23: sexual functioning	20(23)	29(25)	15(21)	<0.000030637*
Subset: age <50 years at selection (n)	795	451	344	
QLQ-BR23: sexual functioning	27(25)	31(25)	21(23)	<0.000030637*
Subset: age ≥50 years at selection (n)	2109	444	1665	
QLQ-BR23: sexual functioning	15(21)	22(24)	13(20)	<0.000030637*
Subset: T1 (n)	901	279	622	
QLQ-BR23: sexual functioning	18(23)	29(26)	13(19)	<0.000030637*
Subset: T2–T4 (n)	1106	354	752	
QLQ-BR23: body image	75(27)	69(29)	77(25)	<0.000030637*
QLQ-BR23: sexual functioning	18(23)	24(24)	15(21)	<0.000030637*
Subset: N0 (n)	1576	533	1043	
QLQ-BR23: sexual functioning	19(23)	27(25)	14(21)	<0.000030637*
Subset: N+ (n)	460	133	327	
QLQ-BR23: sexual functioning	18(23)	27(26)	14(20)	<0.000030637*
Subset: RT– (n)	1815	556	1259	
QLQ-BR23: sexual functioning	18(23)	26(25)	14(20)	<0.000030637*
Subset: RT+ (n)	1089	339	750	
QLQ-BR23: sexual functioning	19(23)	27(25)	15(21)	<0.000030637*
Subset: ET– (n)	1637	526	1111	
QLQ-BR23: sexual functioning	19(23)	27(24)	15(21)	<0.000030637*
Subset: ET+ (n)	1267	369	898	
QLQ-BR23: sexual functioning	17(23)	26(26)	14(20)	<0.000030637*
Subset: CT– (n)	2057	587	1470	
QLQ-BR23: sexual functioning	17(22)	25(25)	14(20)	<0.000030637*
Subset: CT+ (n)	847	308	539	
QLQ-BR23: sexual functioning	21(23)	28(25)	16(21)	<0.000030637*

Data are mean(s.d.) unless otherwise stated. Distribution of continuous variables was tested using Wilcoxon rank sum test. Due to the Bonferroni adjustment for multiplicity, only $P < 0.000030637$ was statistically significant. *Statistically significant. CT, chemotherapy; EORTC, European Organization for Research and Treatment of Cancer; ET, endocrine therapy; QLQ-BR23 Quality of Life Questionnaire Breast Cancer-23; RT, radiotherapy.

subgroup diagnosed with T2–T4 disease but not in other subgroups or overall.

The current study adds to existing knowledge of HRQoL after mastectomy by being an exclusive nationwide long-term follow-up study. Previous studies were mainly based on short-term data. Al-Ghazal *et al.* retrospectively studied a population of 577 women with breast cancer undergoing local excision, mastectomy, or BR, with a follow-up time of 39.5 months, and found that women who had a BR recalled less psychological distress and had significantly higher scores regarding sexual attractiveness compared to women who had undergone mastectomy alone²⁰. These findings correspond well to the findings of the current study.

An article summarizing findings of a national audit of mastectomy and BR in the UK concluded that overall well-being scores were higher among women with BR compared to mastectomy only⁸. The study included 150 NHS trusts in England, 6 NHS trusts in Wales and Scotland, and 114 independent hospitals and was designed as a prospective cohort study including data from 16 485 women who had undergone mastectomy with or without BR between 1 January 2008 and 31 March 2009 with a follow-up time of 18 months. In another retrospective patient-reported survey of 1871 women operated during a 10-year period (2008–2018), Kouwenberg *et al.* found favourable HRQoL scores among women who had undergone a BR compared to mastectomy alone, as assessed by EQ-5D and the EORTC QLQ-C30, EORTC QLQ-BR23, and BREAST-Q²¹. Similar to the current study, BR was associated with better physical functioning. The study by Kouwenberg *et al.* included 3804 reconstructed and non-reconstructed women with a

response rate of 49%, similar to the current study, yet without national coverage and with a shorter follow-up (mean 6 months, maximum 10 years).

In a case-controlled cohort study consisting of 237 patients over a period of 4 years, Howes *et al.* suggested that women who undergo mastectomy and BR achieve good HRQoL^{22–24}. In another study consisting of 55 women with a response rate of 93% conducted in a time period of 1 year, Zhong *et al.* demonstrated improved breast satisfaction, as well as psychosocial and sexual well-being, in patients undergoing immediate autologous BR compared to women undergoing mastectomy alone²⁵.

A systematic review by Cordova *et al.*²⁶ including 42 studies published in 2000–2018 with a total of 6600 patients with BR and 9700 patients with mastectomy alone identified 30 studies reporting significantly improved HRQoL among women who had a BR. These findings were specifically pertinent for sexual well-being, body image, and breast satisfaction. These findings correspond well to the current study except for body image, which was found to be lower among women with advanced disease (T2–T4) with a BR in the current study. This may be attributed to the reconstruction modality, as 58% of the reconstructions in the current cohort were implant-based and thus the long-term results and potential problems with the prosthetic devices may play a role in body image perception 5–15 years after mastectomy. A long-term follow-up study comparing unilateral breast cancer patients choosing between contralateral prophylactic mastectomy (CPM) or not showed that reconstructed women reported improvement in self-esteem, body appearance, and

Table 3 EQ-5D-3L items by breast reconstruction status

	Total	Reconstructed	Not reconstructed
All women (n)	2904	895	2009
EQ-5D-3L: mobility			
Available	2812 (97)	877 (98)	1935 (96)
Not available	92 (3)	18 (2)	74 (4)
'I have no problems in walking about'	2288 (81)	806 (92)	1482 (77)
'I have some problems in walking about'	514 (18)	71 (8)	443 (23)
'I am confined to bed'	10 (0)	0 (0)	10 (1)
EQ-5D-3L: self-care			
Available	2817 (97)	881 (98)	1936 (96)
Not available	87 (3)	14 (2)	73 (4)
'I have no problems with self-care'	2730 (97)	871 (99)	1859 (96)
'I have some problems washing or dressing myself'	68 (2)	9 (1)	59 (3)
'I am unable to wash or dress myself'	19 (1)	1 (0)	18 (1)
EQ-5D-3L: usual activities			
Available	2808 (97)	880 (98)	1928 (96)
Not available	96 (3)	15 (2)	81 (4)
'I have no problems with performing my usual activities'	2441 (87)	795 (90)	1646 (85)
'I have some problems with performing my usual activities'	321 (11)	79 (9)	242 (13)
'I am unable to perform my usual activities'	46 (2)	6 (1)	40 (2)
EQ-5D-3L: pain/discomfort			
Available	2811 (97)	877 (98)	1934 (96)
Not available	93 (3)	18 (2)	75 (4)
'I have no pain or discomfort'	1507 (54)	496 (57)	1011 (52)
'I have moderate pain or discomfort'	1186 (42)	357 (41)	829 (43)
'I have extreme pain or discomfort'	118 (4)	24 (3)	94 (5)
EQ-5D-3L: anxiety/depression			
Available	2807 (97)	883 (99)	1924 (96)
Not available	97 (3)	12 (1)	85 (4)
'I am not anxious or depressed'	1929 (69)	597 (68)	1332 (69)
'I am moderately anxious or depressed'	837 (30)	270 (31)	567 (29)
'I am extremely anxious or depressed'	41 (1)	16 (2)	25 (1)
EQ-5D-3L: general state (VAS)			
Available	2243 (77)	787 (88)	1456 (72)
Not available	661 (23)	108 (12)	553 (28)
Mean(s.d.)	74(26)	75(26)	73(25)

Values are n (%) unless otherwise stated. EQ-5D-3L, European Quality of Life 5 Dimensions 3 Level Version; VAS, visual analogue scale.

feeling of femininity^{27,28}. This retrospective study included 621 unilateral breast cancer patients with a family history of breast cancer who underwent CPM between 1960 and 1993. Of these, 403 women underwent BR with a mean follow-up of 10.7 years for the first survey and 20.2 years for the second, where 269 patients answered the questionnaires. According to the study, reconstructed women were less satisfied with CPM than non-reconstructed in the long term and were less inclined to choose CPM again. Less satisfaction among reconstructed patients regarding choice of surgery could be explained by a higher reoperation rate among reconstructed patients. Still, BR had a positive psychosocial impact on women compared to those who chose not to have any BR, similar to the finding of the current study.

Despite a positive impact on HRQoL after BR only about 30% of women living with a history of breast cancer in Sweden have had a BR⁹, which is comparable to 31% in England⁸ and 40% in the United States. Today's life expectancy following breast cancer diagnosis is high and is steadily increasing²⁹. According to the Swedish guidelines, the minimum recommended follow-up time post-diagnosis is 5 years; thereafter, women return to the mammography screening programme, and little is known about their health status and long-term HRQoL.

The current study has limitations: the cross-over design only provides a snapshot of participants' HRQoL at a specific point in time and cannot fully account for differences at the time of treatment. The observational design also means that confounding factors cannot be ruled out, and no multivariable

analysis was performed to identify whether observed associations could be explained by potential confounders. Furthermore, the reliance on participant recall of treatment details up to 15 years after surgery may introduce recall bias, potentially affecting data accuracy. Furthermore, the study's reliance on self-reported responses may introduce selection bias, as certain groups of women may be more or less likely to participate, limiting the generalizability of the results, although no obvious selection was observed. The timing of reconstruction may impact health status after BR. Another limitation of the study is that the number of deceased women at each time point was not available.

Earlier studies from the SweBRO group identified that an independent predictor of not receiving BR was radiotherapy, when adjusting for age, tumour size, nodal status, and other adjuvant therapies in multivariable analysis⁹, which may explain why women with BR would report higher scores. In Sweden, women with a history of radiotherapy after breast cancer are usually discussed for autologous BR, which is provided at university hospitals by reconstructive plastic surgeons. A long distance to institutions with plastic surgery competence may affect the low rate of BR in the current population.

The potential effects of adjuvant and/or neoadjuvant therapy on the outcomes of BR have been reported with ambiguity and they remain unclear. Some studies report that BR may lead to improved patient satisfaction and quality of life regardless of adjuvant treatment^{30,31}, whereas others demonstrate the negative effect radiotherapy may have on both complication rates and aesthetic outcomes of BR³²⁻³⁵. Adjuvant therapies

have oncological benefits, but on the other hand may cause systemic and local tissue toxicity which may lead to postoperative complications such as delayed wound healing, postoperative infection, fat necrosis, etc. These complications in themselves may compromise patients' HRQoL, although reports from the literature are conflicting^{32,36,37}.

Like the study by Chao *et al.*, the current study identified the positive effect of BR also among women with previous radiotherapy³¹. The response rate in long-term follow-up studies is a known challenge. The current study lacks information on whether all women who had a mastectomy had been offered and discussed a BR. The reconstruction rate may be a consequence of if, and at what time point, BR is offered, as well as other individual factors such as personal wish or priority. Another weakness of the current study is lack of preoperative data for comparison, which makes it difficult to establish participants' baseline HRQoL before mastectomy and reconstruction. Analogous surveys and national assessments in other areas of healthcare rely on a response rate of 40–70% compared to 50% in the current study^{38–40}. Incorporating PRO measures as a clinical routine, especially long term, most likely may improve the response rate and data availability for future studies. However, for the long-term outcomes very few longitudinal studies have reached a long enough follow-up time^{21,39}. As such, the current study is, to our knowledge, unique with its long-term follow-up at a national level assessing HRQoL among women surviving breast cancer.

The study adopted a long-term perspective, evaluating HRQoL at multiple time points (5, 10, and 15 years post-mastectomy). This extended follow-up period offers valuable insights into the enduring impact of BR on various aspects of well-being. Furthermore, the study employed well-established and validated instruments, such as the EORTC QLQ-C30, EORTC QLQ-BR23, and EQ-5D-3L, to assess HRQoL. These tools have been widely used in research and clinical settings, ensuring reliability and comparability of the results with other studies.

This is a unique national long-term study of women who had had a mastectomy due to breast cancer up to 15 years previously, assessing the impact of BR on long-term HRQoL. Women with BR reported higher levels of physical functioning and sexual functioning compared to non-reconstructed women. These results support the importance of informing women undergoing mastectomy about BR alternatives and highlight the potential benefits of the procedure in enhancing long-term well-being.

Author contributions

Rojda Gümüşcü (Writing—review & editing), Dmytro Unukovych (Writing—review & editing), Fredrik Warnberg (Writing—review & editing), Jana de Boniface (Writing—review & editing), Malin Sund (Writing—review & editing), Kristina Ahsberg (Writing—review & editing), Emma Hansson (Writing—review & editing), Folke Folkvaljon (Formal analysis, Writing—review & editing), and Maria Mani (Supervision, Writing—review & editing)

Funding

The study was funded by ALF (Agreement on Medical Education and Research) grants

Disclosure

The authors declare no conflicts of interest.

Supplementary material

Supplementary material is available at BJS Open online.

Data availability

The data can be made available upon reasonable request.

References

1. Maajani K, Jalali A, Alipour S, Khodadost M, Tohidinik HR, Yazdani K. The global and regional survival rate of women with breast cancer: a systematic review and meta-analysis. *Clin Breast Cancer* 2019;**19**:165–177
2. Montazeri A. Health-related quality of life in breast cancer patients: a bibliographic review of the literature from 1974 to 2007. *J Exp Clin Cancer Res* 2008;**27**:32
3. Hsiao F-H, Kuo W-H, Jow G-M, Wang M-Y, Chang K-J, Lai Y-M *et al.* The changes of quality of life and their correlations with psychosocial factors following surgery among women with breast cancer from the post-surgery to post-treatment survivorship. *Breast* 2019;**44**:59–65
4. Cochrane RA, Valasiadou P, Wilson AR, Al-Ghazal SK, Macmillan RD. Cosmesis and satisfaction after breast-conserving surgery correlates with the percentage of breast volume excised. *Br J Surg* 2003;**90**:1505–1509
5. Tsoi B, Ziolkowski NI, Thoma A, Campbell K, O'Reilly D, Goeree R. Systematic review on the patient-reported outcomes of tissue-expander/implant vs autologous abdominal tissue breast reconstruction in postmastectomy breast cancer patients. *J Am Coll Surg* 2014;**218**:1038–1048
6. Guyomard V, Leinster S, Wilkinson M. Systematic review of studies of patients' satisfaction with breast reconstruction after mastectomy. *Breast* 2007;**16**:547–567
7. Potter S, Brigid A, Whiting PF, Cawthorn SJ, Avery KN, Donovan JL *et al.* Reporting clinical outcomes of breast reconstruction: a systematic review. *J Natl Cancer Inst* 2011;**103**:31–46
8. Jeevan R, Cromwell DA, Browne JP, Caddy CM, Pereira J, Sheppard C *et al.* Findings of a national comparative audit of mastectomy and breast reconstruction surgery in England. *J Plast Reconstr Aesthet Surg* 2014;**67**:1333–1344
9. Unukovych D, Gümüşcü R, Wärnberg F, de Boniface J, Eriksen C, Sund M *et al.* Breast reconstruction patterns from a Swedish nation-wide survey. *Eur J Surg Oncol* 2020;**46**:1867–1873
10. Löfgren L, Eloranta S, Krawiec K, Asterkvist A, Lönnqvist C, Sandelin K. Validation of data quality in the Swedish National Register for Breast Cancer. *BMC Public Health* 2019;**19**:495
11. Sprangers MA, Groenvold M, Arraras JI, Franklin J, te Velde A, Muller M *et al.* The European Organization for Research and Treatment of Cancer breast cancer-specific quality-of-life questionnaire module: first results from a three-country field study. *J Clin Oncol* 1996;**14**:2756–2768
12. EuroQol Group. EuroQol—a new facility for the measurement of health-related quality of life. *Health Policy*. 1990;**16**:199–208
13. Rabin R, de Charro F. EQ-5D: a measure of health status from the EuroQol group. *Ann Med* 2001;**33**:337–343
14. Winters ZE, Balta V, Thomson HJ, Brandberg Y, Oberguggenberger A, Sinove Y *et al.* Phase III development of the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire module for women undergoing breast reconstruction. *Br J Surg* 2014;**101**:371–382

15. Winters ZE, Afzal M, Rutherford C, Holzner B, Rumpold G, da Costa Vieira RA et al. International validation of the European Organisation for Research and Treatment of Cancer QLQ-BRECON23 quality-of-life questionnaire for women undergoing breast reconstruction. *Br J Surg* 2018;**105**:209–222
16. Kouwenberg CAE, Kranenburg LW, Visser MS, Busschbach JJ, Mureau MAM. The validity of the EQ-5D-5L in measuring quality of life benefits of breast reconstruction. *J Plast Reconstr Aesthet Surg* 2019;**72**:52–61
17. Osoba D, Rodrigues G, Myles J, Zee B, Pater J. Interpreting the significance of changes in health-related quality-of-life scores. *J Clin Oncol* 1998;**16**:139–144
18. Musoro JZ, Coens C, Fiteni F, Katarzyna P, Cardoso F, Russell NS et al. Minimally important differences for interpreting EORTC QLQ-C30 scores in patients with advanced breast cancer. *JNCI Cancer Spectr* 2019;**3**:pkz037
19. Gebert P, Dordevic AD, Roehle R, Hage AM, Karsten MM. Data of real-world reference scores for EORTC QLQ-C30 and QLQ-BR23 at baseline in women with early breast cancer and other breast diseases. *Data Brief* 2022;**43**:108347
20. Al-Ghazal SK, Fallowfield L, Blamey RW. Comparison of psychological aspects and patient satisfaction following breast conserving surgery, simple mastectomy and breast reconstruction. *Eur J Cancer* 2000;**36**:1938–1943
21. Kouwenberg CAE, de Ligt KM, Kranenburg LW, Rakhorst H, de Leeuw D, Siesling S et al. Long-term health-related quality of life after four common surgical treatment options for breast cancer and the effect of complications: a retrospective patient-reported survey among 1871 patients. *Plast Reconstr Surg* 2020;**146**:1–13.
22. Howes BH, Watson DI, Xu C, Fosh B, Canepa M, Dean NR. Quality of life following total mastectomy with and without reconstruction versus breast-conserving surgery for breast cancer: a case-controlled cohort study. *J Plast Reconstr Aesthet Surg* 2016;**69**:1184–1191
23. McCarthy CM, Hamill JB, Kim HM, Qi J, Wilkins E, Pusic AL. Impact of bilateral prophylactic mastectomy and immediate reconstruction on health-related quality of life in women at high risk for breast carcinoma: results of the mastectomy reconstruction outcomes consortium study. *Ann Surg Oncol* 2017;**24**:2502–2508
24. Sisco M, Johnson DB, Wang C, Rasinski K, Rundell VL, Yao KA. The quality-of-life benefits of breast reconstruction do not diminish with age. *J Surg Oncol* 2015;**111**:663–668
25. Zhong T, McCarthy C, Min S, Zhang J, Beber B, Pusic AL et al. Patient satisfaction and health-related quality of life after autologous tissue breast reconstruction: a prospective analysis of early postoperative outcomes. *Cancer* 2012;**118**:1701–1709
26. Cordova LZ, Hunter-Smith DJ, Rozen WM. Patient reported outcome measures (PROMs) following mastectomy with breast reconstruction or without reconstruction: a systematic review. *Gland Surg* 2019;**8**:441–451
27. Frost MH, Hoskin TL, Hartmann LC, Degnim AC, Johnson JL, Boughey JC. Contralateral prophylactic mastectomy: long-term consistency of satisfaction and adverse effects and the significance of informed decision-making, quality of life, and personality traits. *Ann Surg Oncol* 2011;**18**:3110–3116
28. Boughey JC, Hoskin TL, Hartmann LC, Johnson JL, Jacobson SR, Degnim AC et al. Impact of reconstruction and reoperation on long-term patient-reported satisfaction after contralateral prophylactic mastectomy. *Ann Surg Oncol* 2015;**22**:401–408
29. Zielonke N, Gini A, Jansen EEL, Anttila A, Segnan N, Ponti A et al. Evidence for reducing cancer-specific mortality due to screening for breast cancer in Europe: a systematic review. *Eur J Cancer* 2020;**127**:191–206
30. Atisha D, Alderman AK, Lowery JC, Kuhn LE, Davis J, Wilkins EG. Prospective analysis of long-term psychosocial outcomes in breast reconstruction: two-year postoperative results from the Michigan Breast Reconstruction Outcomes Study. *Ann Surg* 2008;**247**:1019–1028
31. Chao L-F, Patel KM, Chen S-C, Lam H-B, Lin C-Y, Liu H-E et al. Monitoring patient-centered outcomes through the progression of breast reconstruction: a multicentered prospective longitudinal evaluation. *Breast Cancer Res Treat* 2014;**146**:299–308
32. Tallet AV, Salem N, Moutardier V, Ananian P, Braud AC, Zalta R et al. Radiotherapy and immediate two-stage breast reconstruction with a tissue expander and implant: complications and esthetic results. *Int J Radiat Oncol Biol Phys* 2003;**57**:136–142
33. Cordeiro PG, Albornoz CR, McCormick B, Hu Q, Van Zee K. The impact of postmastectomy radiotherapy on two-stage implant breast reconstruction: an analysis of long-term surgical outcomes, aesthetic results, and satisfaction over 13 years. *Plast Reconstr Surg* 2014;**134**:588–595
34. Ho AL, Bovill ES, Macadam SA, Tyldesley S, Giang J, Lennox PA. Postmastectomy radiation therapy after immediate two-stage tissue expander/implant breast reconstruction: a University of British Columbia perspective. *Plast Reconstr Surg* 2014;**134**:1e–10e
35. Rogers NE, Allen RJ. Radiation effects on breast reconstruction with the deep inferior epigastric perforator flap. *Plast Reconstr Surg* 2002;**109**:1919–1924; discussion 1925–6
36. Nahabedian MY, Tsangaris T, Momen B, Manson PN. Infectious complications following breast reconstruction with expanders and implants. *Plast Reconstr Surg* 2003;**112**:467–476
37. Li L, Chen Y, Chen J, Chen J, Yang B, Li J et al. Adjuvant chemotherapy increases the prevalence of fat necrosis in immediate free abdominal flap breast reconstruction. *J Plast Reconstr Aesthet Surg* 2014;**67**:461–467
38. Mohler MJ, Coons SJ, Hornbrook MC, Herrinton LJ, Wendel CS, Grant M et al. The health-related quality of life in long-term colorectal cancer survivors study: objectives, methods and patient sample. *Curr Med Res Opin* 2008;**24**:2059–2070
39. Santosa KB, Qi J, Kim HM, Hamill JB, Wilkins EG, Pusic AL. Long-term patient-reported outcomes in postmastectomy breast reconstruction. *JAMA Surg* 2018;**153**:891–899
40. Metcalfe KA, Zhong T, Narod SA, Quan ML, Holloway C, Hofer S et al. A prospective study of mastectomy patients with and without delayed breast reconstruction: long-term psychosocial functioning in the breast cancer survivorship period. *J Surg Oncol* 2015;**111**:258–264