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Does breast reduction surgery improve health-related quality of life? A prospective cohort study in Australian women

Tamara Crittenden ,[1,2] David I Watson,[2] Julie Ratcliffe ,[3] Philip A Griffin,[1] Nicola R Dean ,[1,2] on behalf of the AFESA Research Group

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[1]Department of Plastic and Reconstructive Surgery, Flinders Medical Centre, Bedford Park, South Australia, Australia
[2]Discipline of Surgery, College of Medicine and Public Health, Flinders University, Bedford Park, South Australia, Australia
[3]Caring Futures Institute, College of Nursing and Health Sciences, Flinders University, Adelaide, South Australia, Australia

Correspondence to
Dr Nicola R Dean;
nicola.dean@sa.gov.au

ABSTRACT

Objectives To assess the health burden of breast hypertrophy and the comparative effectiveness of breast reduction surgery in improving health-related quality of life.

Design Prospective cohort study.

Setting A major public tertiary care hospital in Australia.

Participants Women with symptomatic breast hypertrophy who underwent breast reduction surgery were followed for 12 months. A comparison control cohort comprised women with breast hypertrophy who did not undergo surgery.

Interventions Bilateral breast reduction surgery for women in the surgical cohort.

Main outcome measures The primary outcome measure was health-related quality of life measured preoperatively and at 3, 6 and 12 months postoperatively using the Short Form-36 (SF-36) questionnaire. Secondary outcome measures included post-surgical complications.

Results 209 patients in the surgical cohort completed questionnaires before and after surgery. 124 patients in the control hypertrophy cohort completed baseline and 12-month follow-up questionnaires. At baseline, both groups had significantly lower scores compared with population norms across all scales ($p<0.001$). In the surgical cohort significant improvements were seen across all eight SF-36 scales ($p<0.001$) following surgery. Within 3 months of surgery scores were equivalent to those of the normal population and this improvement was sustained at 12 months. SF-36 physical and mental component scores both significantly improved following surgery, with a mean change of 10.2 and 9.2 points, respectively ($p<0.001$). In contrast, SF-36 scores for breast hypertrophy controls remained at baseline across 12 months. The improvement in quality of life was independent of breast resection weight and body mass index.

Conclusion Breast reduction significantly improved quality of life in women with breast hypertrophy. This increase was most pronounced within 3 months of surgery and sustained at 12-month follow-up. This improvement in quality of life is comparable to other widely accepted surgical procedures. Furthermore, women benefit from surgery regardless of factors including body mass index and resection weight.

Strengths and limitations of this study

- ► This large prospective longitudinal study reports 12-month follow-up using a validated patient-reported outcome measure for health-related quality of life assessment.
- ► The completion rate of the study was 83% for participants who underwent surgery.
- ► Comparisons were made with a control cohort of women with breast hypertrophy not undergoing surgery, and also to a normative female reference population.
- ► This was a non-randomised study design.

INTRODUCTION

Breast reduction surgery is a common plastic surgery procedure and it has previously been shown to be effective for relieving pain and functional problems associated with breast hypertrophy,[1–5] whereas conservative approaches to treatment such as physiotherapy, hormonal therapy and weight loss have much less impact.[6 7] However, despite clear published evidence to the contrary, breast reduction surgery is often regarded more as a cosmetic rather than a functional procedure by the general public and many medical professionals.[1 8 9] This is in spite of the finding that breast hypertrophy is a chronic health problem and relief of physical symptoms is the primary motivator for most women who are pursuing breast reduction surgery.[10]

The increasing demand for breast reduction surgery and increasing pressure to constrain healthcare spending have led to lengthy waiting times and restrictions placed on surgery in numerous countries and jurisdictions worldwide.[4 11–15] While 'rationing' of healthcare is an essential process in public healthcare systems globally, it has the potential to threaten equity of access to surgical

treatment. Within the Australian public hospital system, access to breast reduction surgery for patients is ultimately reliant on state and local policies.[16–21] Similarly, in the UK, reports on the rationing of surgery by the National Health Service (NHS) on the basis of geographical location have resulted in a 'postcode lottery'.[22 23] In 2018, reports from the NHS England 'Evidence-Based Interventions Programme' proposed to restrict funding for procedures it considers 'unnecessary', to save money and eliminate unwarranted clinical variation.[24] The inclusion of breast reduction surgery as a 'procedure of limited effectiveness' implies that it is a marginal and low priority procedure in comparison to other medical interventions.[25] However, labelling breast reduction surgery an 'ineffective' and 'unnecessary' procedure might be misleading and inaccurate, with little evidence to support this claim. Furthermore, restrictive access policies are in place in both public and private sectors in many countries and jurisdictions worldwide; often these restrictions are based on body mass index (BMI) or a minimum weight of breast resection at surgery.[4 8 9 11–15 22 23 25] The validity of such criteria might not be evidence-based, resulting in women with a medical need for surgery being denied access to it.

The primary aim of this study was to longitudinally assess health-related quality of life (HRQoL) in women with breast hypertrophy before and after breast reduction surgery, and to compare these outcomes to control groups of women with breast hypertrophy not undergoing surgery, and also to a normative female reference population. The Short Form-36 (SF-36) is a well-established indicator of patient-reported outcome for evaluating the burden of disease states and the outcomes of medical interventions and was therefore chosen as the primary outcome measure for this study. Second, this study aimed to assess the impact of patient demographics and surgical characteristics including, but not limited to, those commonly used as selection criteria for access to surgery and insurance coverage on preoperative HRQoL scores and the long-term improvement in HRQoL following surgery.

METHODS

Design and participants

A prospective cohort study was performed at Flinders Medical Centre in Adelaide, Australia. All women aged 18 years and over with symptomatic breast hypertrophy who were assessed for bilateral breast reduction surgery between April 2007 and February 2018 were informed of the study. Patients who underwent breast reduction surgery comprised the surgery cohort. Patients who were referred for surgery and were placed on the waiting list but were not expected to undergo surgery within 12 months comprised the controls.

All participants who consented to the study were asked to complete the SF-36 questionnaire at set time points. For the surgical patients this was preoperatively and 3, 6 and 12 months postoperatively. For the control patients, the questionnaire was completed at baseline and again 12 months after enrolment. Data including age, height, weight, bra cup size, health status and smoking status were determined for all patients at baseline and again at follow-up. Women who were unable to complete written questionnaires or were enrolled in the control group and had breast reduction surgery within 12 months of enrolment, or who did not return study questionnaires, were excluded from the study.

Outcome measures

The SF-36 V.2 was used to measure the general HRQoL.[26] This contains 36 items which assess health across eight subscales. Questionnaire responses were transformed as per the SF-36 V.2 scoring manual to provide the eight subscales, each with a score between 0 and 100, with higher scores indicating better health.[27] The subscales were converted into two summary scores: Physical Component Summary (PCS) score and Mental Component Summary (MCS) score using norm-based methods and scoring coefficients from the Australian population.[28] For comparison purposes, general female population normative scores were obtained from the 2008 South Australian Health Omnibus Survey and scores weighted to correspond to the age distribution of the study participants.[29]

Sample size was determined a priori and a minimum sample size of 98 patients per group was calculated to give 80% power at a two-sided significance level of 5% to detect a mean difference of 10-points with an estimated SD of 25-points in the SF-36 questionnaire score.

Study-specific questionnaires, which asked about time off work and consumption and expenditure on medications, were administered at the baseline and 12-month postoperative time points. Participants in the surgical cohort were asked postoperatively whether they would have the surgery again if they had their time over. Additional data were collected pertaining to the surgical technique used, and the weight of breast tissue removed. Hospital records were used to determine the length of hospital stay, number of outpatient clinic appointments relating to the surgery and complications leading to re-hospitalisation, or a further operative procedure within the 12 months follow-up period. A comprehensive complications checklist was completed prospectively during the study by the treating doctor. Three-dimensional laser body scanning was performed preoperatively and at 12 months postoperatively using a Cyberware WBX scanner (Cyberware) and Cyslice software (Headus Pty Ltd). Breast and body volume were measured from the scan according to a protocol described previously.[30 31]

Statistical analysis

Statistical analyses were performed using SPSS V.25.0 statistical software (IBM Corp). Descriptive statistics including mean, SD and 95% CI were computed for continuous variables. Comparisons between groups were

made using t-tests for continuous data and χ^2 tests for categorical data, with Fisher's exact test as appropriate. Linear mixed models were used to assess the significance of changes in SF-36 subscale scores over multiple time points. For each SF-36 scale an improvement score was calculated using the score obtained at the last available assessment, with a higher score representing a greater improvement from baseline. Pearson correlation coefficients were calculated to assess the linear association between SF-36 scores and baseline participant and clinical characteristics; variables that showed a significant association were entered into the regression model. Candidate variables included age, BMI, preoperative breast volume, bra cup size, tissue resection weight (grams), breast asymmetry and ratio of breast to body volume. Variables were continuous except for bra cup size which was categorised into six groups as follows: D, DD, E, F, G and ≥H cup. Multiple linear regression was used to assess whether any of the collected sociodemographic or clinical variables were associated with first, SF-36 PCS score at baseline, and second, with the change in SF-36 PCS scores from baseline to 12 months after surgery. Statistical significance was accepted at a p value of less than 0.05.

Patient and public involvement

At the design stage of the study two group meetings were held with women with breast hypertrophy to discuss their perspective on the condition, deliver education material and discuss this study. In addition, one consumer was more extensively involved with the design of the study and trialling different methods of breast volume measurement. Study results will be disseminated to the public through presentations and local health newsletter.

Table 1 Baseline characteristics of participants

Characteristic	Surgical cohort (n=209)	Hypertrophy control cohort (n=124)	P value of difference*
Mean (SD; range) age (years)	42.6 (13.4; 18 to 72)	45.3 (13.1; 20 to 79)	0.079
Age group (years):			
18–24	24 (12)	12 (10)	
25–34	38 (18)	15 (12)	
35–44	64 (31)	26 (21)	
45–54	41 (20)	43 (34)	
55–64	31 (15)	21 (18)	
≥65	11 (5)	7 (6)	
Mean (SD) BMI (kg/m^2)	32.7 (6.0)	32.2 (6.1)	0.468
Obesity status:			
Non-obese (<30)	71 (34)	48 (39)	0.326
Obese (≥30)	138 (66)	74 (61)	
Missing	0 (0)	2 (0)	
Smoking status:			
Non-smoker	108 (52)	78 (63)	0.243
Current smoker	35 (17)	14 (11)	
Ex-smoker <12 months	15 (7)	5 (5)	
Ex-smoker >12 months	47 (23)	25 (20)	
Missing	4 (0)	2 (0)	
Bra cup size:			
≤D	13 (6)	4 (3)	
DD	43 (21)	13 (11)	
E	50 (24)	19 (15)	
F	46 (22)	27 (22)	
G	35 (17)	37 (30)	
≥H	19 (10)	19 (15)	
Missing	3 (0)	5 (0)	

Values are numbers (percentages) unless stated otherwise.
*Using independent samples t-test or χ^2 test as appropriate.
BMI, body mass index.

RESULTS

Surgical cohort

Of 251 participants who completed a baseline assessment and underwent bilateral breast reduction surgery, 209 (83.3%) completed at least one postoperative follow-up assessment and were included in the study group for analysis. Missing data were due to participants repeatedly not attending appointments or choosing to not complete and return the study questionnaires at some time points. Twenty-three participants formally withdrew from the study following surgical intervention. Baseline characteristics were compared between participants who were lost to follow-up and those who completed at least one postoperative assessment. No difference was observed for age, BMI, tissue weight resected or preoperative SF-36 scales and summary scores except for the mental health scale, where non-respondents had a lower mean score of 6.8 points less than responders (p=0.034).

Participant demographics for the surgical cohort are summarised in table 1. Preoperatively, mean total breast volume measured by 3D laser scanner was 3391 mL (range 1472–9622 mL). At 12 months postoperatively, mean total breast volume was 2184 mL (range 963 to 4392 mL). The mean total weight of breast tissue resected at surgery was 1338 g±817 g. An inferior pedicle breast reduction technique was the most commonly used approach (161/209, 77%), followed by a superior pedicle technique (35/209, 17%). The average hospital stay was 2.3 days. Fifty-nine patients (28%) experienced at least one surgical complication. Eight patients (3.8%) had subsequent procedures for revision of surgical scars or to correct 'dog-ears'.

The majority of participants (204/209, 97.6%) responded in the postoperative questionnaire that they would have the surgery again, while others were either unsure (4/209, 1.9%) or would not have surgery again (1/209, 0.5%). Following surgery, participants on average spent less money on medications and treatments (AU$26.41 vs AU$5.73 per month, p<0.001) and took fewer days off work (4.5 days vs 0.1 days in the previous 6-month period, p=0.009) when compared with before surgery. Using bivariate analysis, obesity was not associated with an increased incidence of surgical complications (p=0.323), with the incidence of complications in non-obese participants (17/71, 24%) and obese participants (42/138, 30%). Furthermore, there were no differences in the incidence of major complications based on obesity status.

The SF-36 was completed preoperatively and at least once postoperatively by 209 surgical participants; 191 (91%) completed the postoperative questionnaires at 3 months, 183 (88%) at 6 months and 193 (92%) at 12 months. When compared with previously published age-adjusted normative data for the female Australian population,[29] mean baseline SF-36 scores for the surgical cohort were significantly lower across all scales (p<0.001) (table 2). A comparison of mean preoperative and 3-month postoperative SF-36 scores showed that scores were significantly higher across all eight SF-36 subscales (p<0.001) (table 2) such that they reached the level of the normative population (figure 1). Mean SF-36 PCS and MCS scores significantly improved following surgery, increasing by 10.2 (95% CI; 8.2 to 12.1) and 9.2 (95% CI; 6.9 to 11.6) points, respectively (p<0.001) (figure 2 and online supplementary table S1). The mean change in SF-36 PCS and MCS scores was in excess of the developer-recommended 3-point minimal important difference (MID) threshold.[32 33] SF-36 scores were stable at 6 and 12 months post-surgery and linear mixed-model analysis showed no significant difference from those at 3 months post-surgery. The mean change in SF-36 scores from baseline to 12 months following surgery was in excess of MID threshold estimates based on a rule of thumb 10-point change on 100-point quality of life scales[34] or 0.5 SD default value for patient-perceived important change[35] in all eight SF-36 subscales (figure 2). SF-36 scores for obese women improved equally, if not greater than their non-obese counterparts following surgery, reaching statistical significance for the physical functioning subscale (table 3).

Breast hypertrophy control cohort

Study questionnaires were initially posted to 350 women with breast hypertrophy who were not scheduled for surgery; 160 (46%) completed and returned the questionnaires at baseline, and of these 124 responded again 12 months later. Twenty-four of those contacted to participate in the study underwent breast reduction surgery during the study time frame and were therefore excluded. Participant demographics for the hypertrophy control cohort are summarised in table 1. No significant differences were observed when comparing spending on medications and number of days off work between baseline and 12 months following enrolment, with both remaining significantly higher than postoperative surgical participants (p<0.001).

Mean baseline SF-36 scores for women in the breast hypertrophy control group were significantly lower than the normative population across all dimensions (table 2). At 12 months post-baseline, SF-36 scores showed no significant improvement and remained significantly lower than population norms (table 2) and postoperative scores for women in the surgical cohort (figure 2). Mean SF-36 PCS and MCS summary scores for women in the breast hypertrophy control group were significantly lower than those who underwent breast reduction surgery, with a mean difference of 10.6 (95% CI; 8.3 to 12.8) and 11.1 points (95% CI; 8.2 to 13.9), respectively (p<0.001) (table 2).

Comparing the improvement in HRQoL with other surgical interventions

The improvement in SF-36 physical and mental summary scores in women who underwent surgery in our study was compared with existing studies which describe 12-month postoperative outcomes from other surgical interventions

Table 2 Mean (95% CI) SF-36 scores for participants in the surgical cohort, hypertrophy control cohort and normative female population

SF-36 scale	Normative* (n=1551)	Hypertrophy control cohort		Surgical cohort			
		Baseline (n=160)	12 months (n=124)	Preoperative (n=209)	3 months postoperative (n=190)	6 months postoperative (n=181)	12 months postoperative (n=191)
PF	84.2 (83.2 to 85.2)	64.7 (60.9 to 68.6)	61.1 (56.7 to 65.7)	61.0 (57.6 to 64.5)	80.1 (76.9 to 83.3)	80.8 (77.3 to 84.4)	83.4 (80.2 to 86.5)
RP	82.0 (80.7 to 83.3)	58.3 (53.8 to 62.8)	58.1 (53.0 to 63.0)	56.0 (52.2 to 59.9)	79.5 (76.1 to 82.9)	81.1 (77.4 to 84.8)	81.3 (77.7 to 84.9)
BP	73.0 (71.9 to 74.1)	39.8 (36.3 to 40.4)	37.9 (34.2 to 41.7)	38.5 (35.6 to 41.5)	67.4 (63.9 to 70.8)	67.6 (63.6 to 71.7)	71.6 (67.9 to 75.2)
GH	70.2 (69.1 to 71.4)	49.7 (46.3 to 53.1)	49.8 (46.0 to 54.0)	57.9 (55.0 to 60.9)	69.1 (66.3 to 72.0)	69.5 (66.6 to 72.4)	70.4 (67.7 to 73.1)
VT	57.3 (56.2 to 58.3)	36.7 (33.6 to 39.8)	35.1 (31.3 to 38.8)	39.7 (37.0 to 42.5)	57.7 (54.8 to 60.6)	58.6 (55.8 to 61.3)	58.9 (56.1 to 61.7)
SF	82.6 (81.3 to 83.8)	55.2 (50.6 to 59.8)	55.1 (50.1 to 59.9)	57.1 (53.3 to 60.9)	78.8 (75.0 to 82.5)	79.4 (75.6 to 83.2)	81.4 (78.1 to 84.7)
RE	88.3 (87.2 to 89.3)	62.8 (58.0 to 67.5)	60.2 (55.4 to 65.7)	61.7 (57.8 to 65.7)	80.1 (76.5 to 83.7)	82.3 (78.9 to 85.7)	84.6 (81.4 to 87.7)
MH	77.0 (76.1 to 78.0)	58.8 (55.2 to 62.5)	56.1 (52.4 to 59.9)	59.8 (57.0 to 62.5)	73.7 (71.0 to 76.4)	73.8 (71.1 to 76.5)	74.3 (71.6 to 76.9)
PCS	49.7 (49.2 to 50.2)	39.6 (38.1 to 41.1)	39.3 (37.5 to 41.1)	39.7 (38.4 to 41.0)	48.9 (47.6 to 50.3)	49.0 (47.5 to 50.5)	49.9 (48.4 to 51.3)
MCS	47.6 (47.0 to 48.2)	36.2 (33.8 to 38.6)	35.1 (32.7 to 37.6)	37.0 (35.2 to 38.8)	45.4 (43.6 to 47.1)	45.7 (44.0 to 47.4)	46.2 (44.5 to 47.9)

*Source: age-standardised normative data from the South Australian female population.[29]
BP, Bodily pain; GH, General health; MCS, Mental Component Summary; MH, Mental health; PCS, Physical Component Summary; PF, Physical function; RE, Role emotional; RP, Role physical; SF-36, Short Form-36; SF, Social function; VT, Vitality.

(table 4). Breast reduction surgery provided a greater gain in SF-36 PCS scores than a coronary artery bypass graft and hernia repair and the improvement was similar to that experienced by patients undergoing total knee replacement surgery. The improvement in SF-36 MCS scores following breast reduction surgery exceeded that of all other surgical procedures.

The impact of participant characteristics on HRQoL and benefit of surgical intervention

There was a significant positive correlation between baseline BMI and the total amount of breast tissue resected at surgery. That is, as the BMI increased there was an associated increase in the amount of breast tissue removed (Pearson's r=0.641, p<0.001). When exploring baseline SF-36 PCS scores, a significant negative correlation was found between SF-36 PCS scores and age (r=−0.13), BMI (r=−0.30), tissue resection weight (r=−0.26), degree of breast hypertrophy (r=−0.28) and ratio of breast to body volume (r=−0.19). Multivariate linear regression of candidate variables against baseline SF-36 PCS scores found BMI to be the only variable significantly related to preoperative SF-36 PCS scores (R^2=0.16, p<0.001). Multivariate regression analysis was also used to analyse predictors of the change in SF-36 PCS score following surgery and showed that improvement in SF-36 PCS scores was not significantly associated with any of these factors.

DISCUSSION

Principal findings

Findings from this study demonstrate that women with symptomatic breast hypertrophy have impaired quality of life compared with those in the general population. At baseline, participants in both the surgical and control breast hypertrophy groups scored significantly lower than the female general population in all SF-36 subscales, with pain being the most prominent. Surgical participants quality of life improved following breast reduction to such an extent that the health deficits were eliminated at 3 months following surgery and quality of life was 'normalised' to levels equivalent to that of the general population across all dimensions. This normalisation effect was stable across 12 months follow-up. The SF-36 health gain ranged from 14.5 to 33.1 points, and this exceeded the minimally important difference threshold estimates of one-half a SD approach[35] or a rule-of-thumb of a 10-point change on 100-point subscales,[34] supporting the contention that breast reduction surgery provides a clinically relevant health benefit.

Secondary aims of this study were to investigate factors that have the potential to influence the level of improvement in quality of life following surgery: BMI, degree of hypertrophy, bra cup size, age, preoperative breast symmetry and weight of tissue resection at surgery. Several of these factors are frequently used to restrict access to breast reduction surgery, none of which are based on high-quality evidence. In our study the improvement in

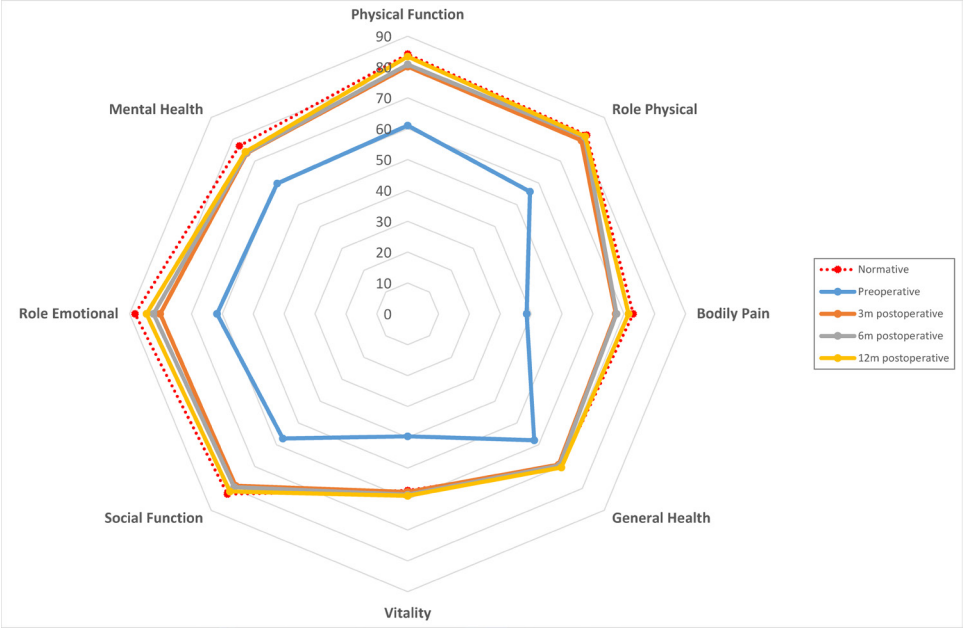

Figure 1 Comparison of mean preoperative and postoperative Short Form-36 scores with age-standardised female population norms (South Australian Health Omnibus Survey).[29]

HRQoL was independent of these factors, suggesting that all women with symptomatic breast hypertrophy can benefit from this surgery regardless of commonly scrutinised factors. This is of clinical relevance as it highlights that women with a higher BMI or those with a lower weight of resection benefit equally and should not be discriminated against based on criteria-based restrictions. Furthermore, there was no increase in the complication rate in the obese participants.

Comparison with other studies

The finding that women with symptomatic breast hypertrophy have a considerable health deficit and impaired quality of life compared with women in the general population is supported by existing studies within the literature.[4 14 36–39] These studies also report that surgical intervention provides symptomatic relief and improves HRQoL to levels of the general population. Our findings support those of Blomqvist *et al* and demonstrate that the improvement in quality of life is stable for up to 1 year after surgery, enabling women to return to levels of HRQoL that are similar to the normal population.[1]

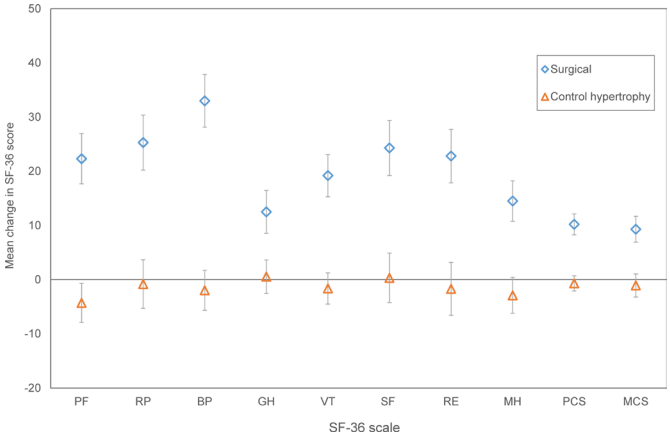

Figure 2 Mean change in Short Form-36 (SF-36) scores from baseline to 12 months for surgical and breast hypertrophy control groups. Error bars represent 95% CI. BP, bodily pain; GH, general health; MCS, mental component summary; MH, mental health; PCS, physical component summary; PF, physical function; RE, role emotional; RP, role physical; SF, social function, VT, vitality.

Our study demonstrated that symptom relief and improvement in HRQoL are not impacted by BMI or the removal of a minimum weight of resection. This finding is consistent with existing studies using the SF-36; however, two of these studies were potentially biased due to the BMI restrictions on their study populations.[6 40 41] Our study also supports previous findings of no significant difference in the complication rate based on obesity status.[41–43] In spite of these findings access restrictions for breast reduction surgery are in place in many countries, despite a lack of supporting evidence.

The intervention effect of breast reduction surgery in our study was well in excess of the minimal clinically important difference for SF-36 PCS and MCS scores, which has been recommended by the developers as a 3-point change.[32 33] The improvements in the SF-36 PCS score at 1 year following surgery were comparable to those of other widely accepted surgical interventions such as total hip and total knee replacement,[44] spinal fusion,[45] bariatric surgery[46] and coronary artery bypass graft surgery.[47] The improvements in the mental component score following breast reduction surgery actually exceeded those of all other interventions cited. Breast reduction surgery is a relatively inexpensive procedure, and the improvement in HRQoL provides evidence as to the comparative effectiveness of this intervention in

Table 3 Comparison of mean change (95% CI) in SF-36 scores following surgery in non-obese and obese participants

SF-36 subscale	Non-obese (n=71)	Obese (n=138)	Difference in means (95% CI)	P value of difference*
Physical function	16.1 (11.2 to 22.1)	23.4 (19.5 to 27.3)	6.8 (0.03 to 13.5)	0.050
Role physical	19.4 (12.4 to 26.3)	25.9 (21.2 to 30.5)	6.5 (–1.7 to 14.7)	0.121
Bodily pain	28.6 (22.8 to 34.5)	32.3 (27.8 to 36.9)	3.7 (–3.9 to 11.4)	0.337
General health	10.2 (6.0 to 14.3)	12.2 (8.4 to 16.0)	2.0 (–4.1 to 8.2)	0.516
Vitality	18.9 (14.8 to 23.1)	18.3 (14.2 to 22.4)	–0.7 (–7.2 to 5.9)	0.842
Social function	23.6 (17.8 to 29.4)	21.9 (16.6 to 27.2)	–1.7 (–10.2 to 6.8)	0.701
Role emotional	18.9 (12.8 to 25.0)	22.5 (17.2 to 27.8)	3.6 (–5.0 to 12.2)	0.409
Mental health	14.9 (11.4 to 18.5)	13.0 (9.2 to 16.9)	–1.9 (–7.9 to 4.1)	0.532

Obesity status: non-obese (<30 kg/m^2), obese (≥30 kg/m^2).
*Using an independent t-test.
SF-36, Short Form-36.

relieving the health burden and the functional symptoms of breast hypertrophy.

Strengths and limitations of this study

A potential limitation of our study was that the participant response rate for the breast hypertrophy control cohort was relatively low at 46%, which may be due to the recruitment process via postal questionnaire. Furthermore, while the total follow-up period for this cohort was 12 months, the intermediate time points of 3 and 6 months that were collected in the surgical cohort were not included in this cohort, although the consistency of outcomes at baseline and 12 months suggest that 3 and 6 month outcomes are likely to have been similar.

The strengths of our study were the prospective design, the relatively large sample size and the inclusion of a non-surgical control sample of women with breast hypertrophy who were recruited from the same waiting list as those in the surgical cohort. In addition, the postoperative outcomes described in this study included multiple time points over a 12-month period. In addition, our surgical cohort was not biased by restrictions that have been reported in previous studies based on a minimum weight of resection or BMI and therefore includes a broad spectrum across these variables. This is particularly important as it enables the accurate assessment of these factors as potential predictors of the change in HRQoL and outcomes of surgery and overcomes these limitations.

CONCLUSIONS AND POLICY IMPLICATIONS

Breast hypertrophy is a painful condition which is effectively treated by breast reduction surgery. The marked improvement in quality of life following breast reduction surgery is comparable to other widely accepted and approved surgical interventions. This study highlights that the improvement in quality of life following surgery is independent of traditionally used criteria based on BMI or a minimum weight of resection and demonstrates the health benefits of surgery regardless of these factors. This confirms the clinical effectiveness of breast reduction surgery and supports the contention that there is no justification for excluding women based on criteria such as BMI or the extent of breast hypertrophy.

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Table 4 Mean improvement in SF-36 PCS and MCS scores between surgical interventions

Reference	Surgical intervention	Preop PCS	Postop PCS	ΔPCS	Preop MCS	Postop MCS	ΔMCS	N
This study	Bilateral breast reduction	39.7	49.9	10.2	37.0	46.2	9.2	191
Pivec *et al*[44]	Total knee replacement	33.0	47.8	14.8	52.9	55.9	3.0	281
Stickles *et al*[48]	Total hip replacement	28.0	41.2	13.2	51.2	53.9	2.7	551
Muller-Nordhorn *et al*[47]	Coronary artery bypass grafting	36.0	43.0	7.3	45.0	50.0	4.3	412
Polly *et al*[45]	Lumbar fusion (spine)	26.6	40.0	13.4	n/a	n/a	n/a	1826
Rogmark *et al*[49]	Incisional hernia repair	41.6	49.5	8.1	50.2	52.3	1.7	124
Faulconbridge *et al*[46]	Bariatric surgery	37.7	46.4	8.7	43.1	45.5	2.4	36

Δ, mean change in SF-36 score from preoperative to 12 months postoperative; MCS, Mental Component Summary; N, number of participants; n/a, not applicable; PCS, Physical Component Summary; SF-36, Short Form-36.

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ORCID iDs
Tamara Crittenden http://orcid.org/0000-0002-6484-3977
Julie Ratcliffe http://orcid.org/0000-0001-7365-1988
Nicola R Dean http://orcid.org/0000-0001-7084-2359

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