Patient Self-reported Breast Cup Size and Resultant Mastectomy Specimen Weight: Implications for Reconstructive Breast Surgery

Kevin Perez, MSc
Sumeet S. Teotia, MD
Nicholas T. Haddock, MD

Background: Breast cup sizing irregularities exist due to discrepancy between garment manufacturers and patient reported measurements making it difficult to assess true preoperative and definitive postoperative breast cup size. This study aims to evaluate the association between patient self-reported breast cup size and mastectomy specimen weight as a way to determine postreconstruction breast cup size.

Methods: This is a retrospective study that evaluated patients who underwent bilateral mastectomy at an academic center between 2019–2021. Cup size and mastectomy weight were our only independent and dependent variables, respectively. Covariates that were assessed included chest circumference, surgical oncologist, BMI, race, and age.

Results: 243 patients were evaluated as a part of this study who underwent either total-simple (TS; 29), skin-sparing (SS; 146), or nipple-sparing (NS; 68) bilateral mastectomy. There were positively weak correlations using nonparametric correlation analysis for breast cup size to mastectomy weight in patients who underwent TS (r = 0.375; p = 0.004), SS (r = 0.353; p <0.001), and NS (r = 0.246; p = 0.004) mastectomy. The multivariate linear regression for TS (R_2=0.520; p < 0.001), SS (R_2=0.573; p < 0.001) and NS (R2=0.396; p < 0.001) mastectomy were significant. Covariates assessed in the regression showed BMI significant for all types, age for TS type, and SS type for breast surgeon and chest circumference.

Conclusions: There is a positively weak correlation between preoperative breast cup size and mastectomy weight, providing evidence for the difficulty of estimating postoperative breast cup size. Thus, the conversation with the patient should focus on breast appearance and quality of life rather than postreconstruction breast size. *(Plast Reconstr Surg Glob Open 2022;10:e4401; doi: 10.1097/GOX.0000000000004401; Published online 11 July 2022.)*

INTRODUCTION

Breast reconstruction is a critical part of the comprehensive care following mastectomy in patients diagnosed with breast cancer. The discussion of breast reconstruction revolves around type and candidacy of reconstruction, such as autologous versus implants, as well as desired breast size postreconstruction. It is important to address goals of desired postreconstruction breast size with patients as it is difficult to guarantee any one size.

One of the issues that arises for breast size determination is breast cup size discrepancy. There have been various studies citing that up to 70%–100% of women wear the incorrect bra size.[1–3] This is typically due to the nonstandard method of measuring breasts to acquire the proper bra that adequately supports and provides comfort. Another issue that can occur is due to brazier garment manufacturer sizing discrepancy. A study that measured breast size via hemicircumference (HC) correlated HC with breast cup size and noted that a sizing discrepancy often occurred with various garment manufacturers. For example, a B cup in manufacturer A bras filled 20.0-cm HC, whereas manufacturer B filled 19.1-cm HC.[4]

Physiological factors, such as variance of breast shape, tissue density, and degree of ptosis, can also make

Disclosure: *The authors have no financial interest to declare in relation to the content of this article.*

Related Digital Media are available in the full-text version of the article on www.PRSGlobalOpen.com.

it difficult to accurately measure breast size. There has been much debate on how to standardize breast size measurement that can take into account these factors such as anthropomorphic measurements, measurement algorithms, computer imaging software, clinic tools such as cups, and patient-reported breast cup size.[5–8] The results are the same in that these tools only offer a best estimate for postreconstruction breast size. Patients will often require revisions to reach aesthetic and breast size goals, and so, final breast size can be a continued discussion.

The difficulty of acquiring appropriate measurements of breast size postoperatively is highlighted by the same difficulty in the preoperative setting. This then creates an issue of being able to provide the patient with any one guaranteed size. The aim of this study was to explore the association of patient-reported preoperative breast cup size and mastectomy weight to show that current methods of clinical assessment do not provide adequate measurements of breast size. We then hope that this study will be able to provide information to patients to improve discussion about expectations for postoperative breast size as well as provide further insight to reconstructive surgeons.

METHODS

Study Design

The present study was approved by our institutional review board. The study retrospectively evaluated patients of two reconstructive surgeons who underwent bilateral breast reconstruction following mastectomy at an academic institution between January 2018 and June 2021. Mastectomy types included total-simple (TSM), skin-sparing (SSM), and nipple-sparing (NSM). Patients were not included in this study if they had undergone mastectomies at outside hospitals, undergone bilateral mastectomies asynchronously, or had a history of a previous breast procedure. Patients were referred by either of the four surgical oncologists included in this study to our plastic surgery clinic for preoperative evaluation. Evaluation at clinic included patient-reported breast cup size and chest circumference.

Mastectomy Specimen Weight

Mastectomy was performed by one of four surgical oncologists and was performed either as a total-simple, skin-sparing, or nipple-sparing mastectomy. Once the specimen was removed from the patient, it was weighed intraoperatively on an operating room scale.

Statistical Analysis

Scatter plots with linear regressions were performed to visualize the data. Nonparametric correlations were conducted on the primary outcome against the dependent variable. Analysis of variance (ANOVA) was conducted to compare means among groups on continuous variables. Univariate linear regressions on covariates were performed to show any association with the primary

Takeaways

Question: Is preoperative breast cup measurement a reliable way to determine true breast size, and is it able to be used to determine postoperative breast size?

Findings: Preoperative breast cup size is weakly correlated with mastectomy specimen weight with other patient factors, such as BMI and chest circumference, playing a large role in mastectomy specimen weight.

Meaning: The focus of postoperative breast reconstruction should be aesthetics and quality of life, rather than breast size.

outcome. Covariates that showed a P value less than 0.15 were then assessed in a multivariate linear regression for statistical significance. Descriptive statistics were reported as mean ± standard deviation. A two-sided P value of less than 0.05 was considered statistically significant. Data were collected, stored, and managed using the Research Electronic Data Capture (REDcap) electronic data capture tools.[9,10] Statistical analyses were performed using SPSS Version for Mac, version 28.0.[11]

RESULTS

In this retrospective study, 243 patients were evaluated. From this population, the average age was 50.57 ± 11.22 with an average body mass index (BMI) of 27.13 ± 5.71. The most common race was White (77.4%) and showed that cup size C (30.5%) and chest circumference 34 (36.6%) were the most frequent in patients. As for mastectomy types, 29 (11.9%) TSM, 146 (60.1%) SSM, and 68 (28%) NSM were performed. The average mastectomy weight was 644.76 ± 276.56 grams for TSM, 802.35 ± 354.08 grams for SSM, and 387.13 ± 188.33 grams for NSM. The remaining demographics and breast assessments of patients can be seen in Tables 1 and 2.

When comparing left to right mastectomy specimen weights, there was no significant difference noted ($P = 0.747$); thus, laterality of mastectomy was ignored, and each mastectomy was counted and analyzed independently. There was a statistically significant difference between mastectomy type and age ($P < 0.001$), BMI ($P < 0.001$), and mastectomy weight ($P < 0.001$) as determined by one-way ANOVA.

A Tukey post hoc test revealed that age was significantly lower in NSM (45.56 ± 12.03) compared with TSM (54.86 ± 11.36, $P < 0.001$) and NSM (52.05 ± 10.00, $P < 0.001$). No significant difference was noted between TSM and NSM. The Tukey post hoc test also exhibited that BMI was significantly lower in NSM (23.90 ± 3.75) compared with TSM (28.74 ± 6.68, $P < 0.001$) and SSM (28.30 ± 5.69, $P < 0.001$). No significant difference was noted between TSM and SSM. Mastectomy weight was significantly lower in NSM (387.13 ± 188.33, $P < 0.001$) compared with TSM (644.76 ± 276.56, $P < 0.001$) and SSM (802.35 ± 354.081, $P < 0.001$). It was also noted that mastectomy weight was significantly lower in TSM when compared with SSM ($P = 0.001$).

Table 1. Demographics of Patients

Demographics	Total-simple Mean ± SD	Range	Skin-sparing Mean ± SD	Range	Nipple-sparing Mean ± SD	Range	Total Mean ± SD	Range
Age	54.86±11.36	35–80	52.05±10.00	25–80	45.56±12.03	22–70	50.57±11.22	11–80
BMI	28.74±6.68	18.26–46.77	28.30±5.69	17.57–51.57	23.90±3.75	17.30–37.70	27.13±5.71	17.30–51.57
Race	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Asian	0	0	6	2.1	8	5.9	14	2.9
Black	6	10.3	48	16.4	6	4.4	60	12.3
Hispanic	4	6.9	10	3.4	8	5.9	22	4.5
White	46	79.3	216	74	114	8.4	376	77.4
Other	2	3.4	8	2.7	0	0	10	2.1
Unknown	0	0	4	1.4	0	0	4	8.2
Total	58	11.9	292	60.1	136	38	486	100

All recorded patient information that was included in this study for demographics was age, BMI, and race (total patients, n = 486). Age and BMI had listed mean and ±SD with range. Race was reported using frequency and percentage within mastectomy type.

Table 2. Assessment of Breast Size and Mastectomy Weights

Breast Size	Total-simple Mean ± SD	Range	Skin-sparing Mean ± SD	Range	Nipple-sparing Mean ± SD	Range	Total Mean ± SD	Range
Mastectomy weight	644.76±276.56	198–1134	802.35±354.08	156–1840	387.13±188.33	34–1142	667.35±356.56	34–184
Cup size	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
A	2	3.4	2	0.7	16	11.8	20	4.1
B	6	10.3	24	8.2	46	33.8	76	15.6
C	22	37.9	78	26.7	48	35.3	148	30.5
D	14	24.1	80	27.4	18	13.2	112	23
DD/E	10	17.2	74	25.3	6	4.4	90	18.5
DDD/F	4	6.9	16	5.5	2	1.5	22	4.5
DDDD/G	0	0	18	6.2	0	0	18	3.7
Total	58	11.9	292	60.1	136	28	486	100
Preoperative chest circumference	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
28	0	0	2	0.7	0	0	2	0.4
30	0	0	2	0.7	0	0	2	0.4
32	2	3.4	14	4.8	18	13.2	34	7
34	12	20.7	84	28.8	82	60.3	178	36.6
36	16	27.6	76	26	28	20.6	120	24.7
38	20	22.2	64	21.9	6	4.4	90	18.5
40	4	6.9	26	8.9	0	0	30	6.2
42	4	6.9	16	5.5	2	1.5	22	4.5
44	0	0	8	2.7	0	0	8	1.6
Total	58	11.9	292	60.1	136	28	486	100

Patient-reported breast cup size and chest circumference were recorded using frequency and percentage within mastectomy type. Mastectomy weight was recorded using mean ± SD with range of mastectomy weight within mastectomy type.

A scatter plot was then performed for each type of mastectomy that plotted breast cup size against mastectomy weight, shown in Supplemental Digital Content 1. (**See graph, Supplemental Digital Content 1,** which displays scatter plots of the different mastectomy types comparing mastectomy weight against breast cup size with linear regressions. Scatter plots were created comparing patient-reported breast cup size on the x-axis and mastectomy weight on the y-axis based on mastectomy type to visualize and assess the data for the proper correlation analysis. A linear regression was generated with $R^2 > 0.15$ being suitable for a parametric correlation model. Considering that all linear regressions were $R^2 < 0.15$, Spearman's rank-order nonparametric correlation was run to determine a relationship between breast mastectomy weight and breast cup size. Cup sizes: 1 = A, 2 = B, 3 = C, 4 = D, 5 = DD, 6 = DDD, **http://links.lww.com/PRSGO/C77**.) Linear regression for all mastectomies was performed and displayed $R^2 = 0.245$. Due to R^2 less than 0.15 in each mastectomy type, a nonparametric correlation was used to assess for any correlation

between breast cup size and mastectomy weight, which showed a positively weak correlation for TSM (ρ = 0.375; $P = 0.004$), SSM (ρ = 0.353; $P < 0.001$), and NSM (ρ = 0.246; $P = 0.004$).

Covariate analysis for mastectomy weight using a univariate linear regression showed statistical significance for age, BMI, and chest circumference in patients who received TSM. As for SSM race, BMI, chest circumference, and surgical oncologist were shown to be significant. In NSM, only BMI and chest circumference were significant; all values from the univariate analysis can be seen in Table 3. The multivariate linear regression for TSM was significant ($R^2 = 0.520$; $P < 0.001$) for age and BMI as significant covariates. As for SSM, the multivariate linear regression was noted to be significant ($R^2 = 0.573$; $P < 0.001$) for surgical oncologist, BMI, and chest circumference being significant covariates. The multivariate linear regression was significant ($R^2 = 0.411$; $P < 0.001$) in NSM with BMI being the only significant variable; all values from the multivariate analysis can be seen in Table 4.

Table 3. Contribution of Variables to Mastectomy Weight in Univariate Logistic Regression

Covariate	Total-simple		Skin-sparing		Nipple-sparing	
	R²	β	R²	β	R²	β
Age	0.100§*	-7.686	0.000	-0.240	0.000	0.205
Race	0.000	3.028	0.022§‡	-59.013	0.026	37.025
BMI	0.487§‡	28.918	0.481§‡	43.168	0.384§	31.153
Chest circumference	0.342§‡	67.436	0.362§‡	73.419	0.209§	51.242
Surgical oncologist	0.002	-12.434	0.027§‡	-42.948	0.005	9.893

The covariates age, race, BMI, chest circumference, and surgical oncologist were evaluated in a univariate linear regression to assess for individual associations with mastectomy specimen weight based on mastectomy type. A $P < 0.15$ was deemed significant in the univariate model to be used in the multivariate linear regression analysis.
*$P < 0.05$;
†$P < 0.01$;
‡$P < 0.001$.
§Variable is noted to be $P < 0.15$ and is used in the multivariate analysis.
β is coefficient for regression.
R² is the proportion of variance.

DISCUSSION

As a part of breast reconstruction, patients require clinical evaluation to gather baseline measurements of their preoperative breast size and discuss reconstruction options. Most often, measurement of breast size defaults to asking patients about their breast cup size and chest circumference. The issue with patient-reported breast cup size is that most often patients are wearing incorrect sizes or there is bra-sizing discrepancy from garment manufacturers (1–4). There have been attempts in standardizing this process such as anthropomorphic measurements, algorithms, and computer imaging software, but these have only been able to provide estimations at best.[5–7] Three-dimensional evaluation has been able to overcome some of these estimations, producing highly accurate models that are able to reduce operative time and provide better estimations for postoperative breast sizing.[12,13]

Estimation of breast size is a crucial part of the evaluation as the discussion of postreconstruction breast size is based on their preoperative size and desired postreconstruction breast size. Ultimately, postreconstruction breast size will depend on the mastectomy type, reconstruction choice, and revisions to ultimately reach desired aesthetic and size goals. Some studies have tried to provide algorithms for estimating postreconstruction breast size based on preoperative imaging. The current body of literature heavily revolves around patient postoperative satisfaction that focuses on quality of life and breast appearance

Our study showed that there is a positive correlation between breast cup size and mastectomy weight, though weak, in total-simple (TSM; ρ = 0.375; $P = 0.004$), skin-sparing (SSM; ρ = 0.353; $P < 0.001$), and nipple-sparing (NSM; ρ = 0.246; $P = 0.004$) mastectomies. Similar correlation was noted when combining all mastectomies. This correlation falls in line with the discrepancy of breast cup sizing due to incorrectly fitted bras and brazier garment manufacturers. Other physiological factors should then be considered such as breast shape, tissue density, and ptosis that breast cup size is unable to consider.

Mastectomy type also showed a statistical difference in mastectomy specimen weight, showing that nipple-sparing mastectomy had lower mastectomy specimen weights when compared with total-simple and skin-sparing. This significant difference is noted to be associated with the standard of care for patients who undergo NSM. The ideal candidate for NSM is a patient with a low BMI, small breasts, and absence of ptosis, which would result in smaller mastectomy specimen weights.[19] Based on this type of approach for candidacy of mastectomy type, there should have been a noted difference in patient BMI when comparing TSM versus NSM. These two groups had similar BMIs but resulted in a significant difference in mastectomy specimen weights showing NSM was larger than TSM. Mastectomy weight difference could potentially play a role in reconstruction since it may be a consideration the reconstructive surgeon takes into account for the final breast size.

Table 4. Contribution of Variables to Mastectomy Weight in Multivariate Logistic Regression

Covariate	Total-simple		Skin-sparing		Nipple-sparing	
	R²	β	R²	β	R²	β
Regression	0.52*		0.573*		0.411*	
Age		-1.194				
Race				-13.756		
BMI		32.119*		29.727*		27.077*
Chest circumference		32.82*		37.677*		15.236
Surgical oncologist				-53.438*		

The covariates that were analyzed in the univariate linear regression model and were deemed significant were then run in a multivariable linear regression model.
*$P < 0.001$.
β is coefficient for regression.
R² is the proportion of variance.

rather than solely breast size.[14–18]

Several covariates were studied to see how they may play a role in mastectomy weight. It was noted that all of the covariates we analyzed in our univariate linear regression were significant in at least one type of mastectomy (Table 3). When we analyzed the covariates in a multivariate linear regression that were significant in the univariate linear regression, BMI was seen to be significantly associated with all mastectomy types while chest circumference was only significant in TSM and SSM (Table 3). Breast surgeon also played a role in SSM. This analysis shows how mastectomy specimen weight can be affected by various factors besides breast cup size.

There are limitations to this study that should be addressed. One limitation is patient-reported breast cup size, as breast cup size can vary based on garment manufacturer. Having a standardized and peer-reviewed method of measuring breast size preoperatively can allow for a more robust correlation between preoperative breast size and mastectomy weight, which, in turn, can allow for better expectations of postreconstruction breast size. Another limitation is comparison of other methods of breast size measurements to provide a consensus for best use.

Future directions of this project include looking at other physiological variables such as ptosis degree, breast tissue density, and breast shape to provide a more standard approach at preoperative breast measurement to ensure a satisfied patient. Longitudinal follow-up for patients to assess satisfaction with breast size as well as providing a standardized method in assessing breast size may be another future direction of this project. Finally, we can also look into the quality of life and satisfaction of breast aesthetics in patients in this cohort.

We plan on using the information in the study to enhance our discussion with our patients on managing expectations for postoperative breast size. Considering that we found a weakly positive correlation between patient-reported breast cup size and mastectomy weight, we would emphasize to our patients that the focus of reconstruction should be on aesthetics and quality of life.

CONCLUSIONS

There is a positively weak correlation between preoperative breast cup size and mastectomy weight, providing evidence for the difficulty of estimating postoperative breast cup size. Thus, the conversation with the patient should focus on breast appearance and quality of life rather than postreconstruction breast size.

Nicholas T. Haddock, MD
1801 Inwood Rd
Dallas, TX 752390
E-mail: nicholas.haddock@utsouthwestern.edu

Sumeet S. Teotia, MD
1801 Inwood Rd
Dallas, TX 752390
E-mail: Sumeet.teotia@utsouthwestern.edu

REFERENCES

1. White J, Scurr J. Evaluation of professional bra fitting criteria for bra selection and fitting in the UK. *Ergonomics.* 2012;55:704–711.
2. McGhee DE, Steele JR. Optimising breast support in female patients through correct bra fit. A cross-sectional study. *J Sci Med Sport.* 2010;13:568–572.
3. Pechter EA. A new method for determining bra size and predicting postaugmentation breast size. *Plast Reconstr Surg.* 1998;102:1259–1265.
4. Bengtson BP, Glicksman CA. The standardization of bra cup measurements: redefining bra sizing language. *Clin Plast Surg.* 2015;42:405–411.
5. Zingaretti N, Miotti G, Maronese CA, et al. A prospective investigation of predictive parameters for preoperative volume assessment in breast reconstruction. *J Clin Med.* 2021;10:5216.
6. Kasielska-Trojan A, Mikołajczyk M, Antoszewski B. BreastIdea volume estimator: a new tool for breast volume estimation-presentation and validation for women. *Plast Reconstr Surg.* 2020;146:744e–748e.
7. Utsunomiya H, Kusano T, Sato N, et al. Estimating implant volume and mastectomy-specimen volume by measuring breast volume with a 3-dimensional scanner. *Ann Plast Surg.* 2017;79: 79–81.
8. Hansson E, Manjer J, Ringberg A. Reliability of plastic cups to measure breast volume. *J Plast Surg Hand Surg.* 2014;48:254–258.
9. Harris PA, Taylor R, Minor BL, et al; REDCap Consortium. The REDCap consortium: building an international community of software platform partners. *J Biomed Inform.* 2019;95:103208.
10. Harris PA, Taylor R, Thielke R, et al. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform.* 2009;42:377–381.
11. IBM. SPSS Statistics for Mac. Corp I. 28 Ed. Armonk, NY: IBM Corp; 2021.
12. Chen K, Feng CJ, Ma H, et al. Preoperative breast volume evaluation of one-stage immediate breast reconstruction using three-dimensional surface imaging and a printed mold. *J Chin Med Assoc.* 2019;82:732–739.
13. Killaars RC, Preuß MLG, de Vos NJP, et al. Clinical assessment of breast volume: can 3D imaging be the gold standard? *Plast Reconstr Surg Glob Open.* 2020;8:e3236.
14. Malter W, Bachmann BJ, Krug B, et al. Correlation analysis of resected breast tissue and implant volume after mastectomy and its association with breast density. *Arch Gynecol Obstet.* 2022;305:169–177.
15. García-Solbas S, Lorenzo-Liñán MÁ, Castro-Luna G. Long-term quality of life (BREAST-Q) in patients with mastectomy and breast reconstruction. *Int J Environ Res Public Health.* 2021;18:9707.
16. Shia WC, Yang HJ, Wu HK, et al. Implant volume estimation in direct-to-implant breast reconstruction after nipple-sparing mastectomy. *J Surg Res.* 2018;231:290–296.
17. Kazzazi F, Haggie R, Forouhi P, et al. A comparison of patient satisfaction (using the BREAST-Q questionnaire) with bilateral breast reconstruction following risk-reducing or therapeutic mastectomy. *J Plast Reconstr Aesthet Surg.* 2018;71:1324–1331.
18. Howes BH, Watson DI, Xu C, et al. 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.
19. Tousimis E, Haslinger M. Overview of indications for nipple sparing mastectomy. *Gland Surg.* 2018;7:288–300.