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Cosmetic

Brassiere Cup Size Agreement between Patients and Plastic Surgeons: Do Surgeons and Patients Speak the Same Size Language?

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Background: Patients undergoing plastic surgery of the breasts often communicate their size expectations as a brassiere cup size. However, multiple factors may cause a miscommunication between the surgeon and patient when brassiere cup size is used as a measure of results. The aim of this study was to determine the degree of agreement between disclosed and estimated brassiere cup size and also interrater agreement.

Methods: Three-dimensional (3D) scans of 32 subjects were evaluated by 10 plastic surgeons estimating cup size using the American brassiere system. The surgeons were blinded to all parameters, including the 3D surface software-derived volume measures of the Vectra scan. The 3D scans of the anterior torsos were viewed. The plastic surgeons' estimations were compared with the cup sizes stated by the subjects (disclosed cup size), using simple and weighted Kappa statistics.

Results: Agreement between the estimated and disclosed brassiere sizes was only slight (0.1479 ± 0.0605) using a simple Kappa analysis. Even when a Fleiss-Cohen–weighted comparison was used, only moderate agreement (0.6231 ± 0.0589) was found. The interrater agreement intraclass correlation coefficient was 0.705. Rater accuracy varied. The percentage of time spent in cosmetic practice and gender were not significantly correlated with accuracy.

Conclusions: Agreement between cup size disclosed by subjects and estimates by plastic surgeons was low. A miscommunication between the surgeon and patient may occur when using brassiere sizes to communicate wishes and estimates in procedures that involve changes in breast volume. *(Plast Reconstr Surg Glob Open 2023; 11:e5046; doi: 10.1097/GOX.0000000000005046; Published online 9 June 2023.)*

INTRODUCTION

Breast size is colloquially communicated in brassiere cup sizes. For this reason and because of the lack of other easily communicable parameters, cup size is frequently used in preoperative surgical consultations.[1–5] However, brassiere cup systems and sizes are nonstandardized measures. Different brassiere cup systems, such as the European, French, English, and US systems, are in parallel use in most markets. The manufacturers, in turn, also use different measures for the different cup sizes.

The patterns for brassieres were an inspiration for early breast reduction methods,[6] and thus, brassieres have been written into plastic breast surgery history. Brassiere systems and brands are, however, aimed at consumers for purchases of brassieres and not for determining breast size after surgery. A miscommunication about size between the surgeons and patients can occur when using cup size in preoperative consultations. Miscommunications can result in patient dissatisfaction and ultimately reoperations.[4] No previous studies analyzing agreement about bra sizes are known to us. Our hypothesis is that cup size is a nonstandardized, imprecise measure, without agreement between the surgeon and patient, despite its common use in practice.

The aim of this study was to determine the correlation between the disclosed cup size worn by the subject

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and the cup size estimated by the surgeon using three-dimensional (3D) images.

METHODS

In this prospective cross-sectional study, subjects were recruited from nursing students enrolled at the University of Southeastern Norway. IRB approval was granted (REK2015/962, NSD2015/44059). Informed consents were obtained. Inclusion criteria were women 18–35 years of age with exclusion of subjects with previous chest wall or breast surgery, except cosmetic surgery.[7] Recruitment was done after a lecture by the corresponding author, where inclusion and exclusion criteria were explained.

Five virtual subjects were created from existing real subjects with the intention to increase the number of subjects with large-volume breasts.[7] These subjects were chosen based on small breast sizes that allowed for simulation with a change substantial enough to create a new subject. These virtual subjects did not have a real-life brassiere size for comparison and were only included in the interrater agreement assessment.

Three-dimensional scanning of the subjects' breasts was performed using the Vectra system (Canfield Scientific Inc., Parsippany, N.J.). Scanning was performed in a standardized position. The subjects were interviewed about their cup size. To avoid bias, the subjects were not given instructions on how to choose a brassiere, and the cup size was merely registered. In cases where two different sizes were given by the subject, the first given cup size was recorded. For example, an answer of "D-C" was recorded as D. The extreme values of cup sizes disclosed by the subjects (E, G, and J) (Table 1) were converted to the category DDD+ cup in the US system for comparison and analysis.

Ten plastic surgeons were tutored in 3D image review. They were blinded to all parameters, including Vectra volume estimates. The disclosed cup sizes were compared with the cup sizes estimated by the surgeons based on the US system: A, B, C, D, DD, or DDD+ (Table 2).

Takeaways

Question: Do patients and plastic surgeons have the same understanding of brassiere cup size?

Findings: In a cross-sectional study using 3D scans of breasts, we found that agreement between plastic surgeons' estimates of brassiere cup size and actual brassiere cup size worn by volunteer subjects was low. When comparing the true cup sizes with the estimates from the 10 raters, the Kappa agreement value was 0.15, indicating that the true brassiere cup size and estimated brassiere cup size rarely agreed.

Meaning: A miscommunication between the surgeon and patient may occur if brassiere cup size is used to communicate preoperative expectations in breast surgery involving volumetric changes.

After evaluating all the subjects, the surgeons were asked to rate on a Likert scale (1-5) how comfortable they felt evaluating breasts using 2D photographs, 3D photographs, or clinical examination.[7]

Breast volumes were calculated for each breast (N = 64) using Vectra software. The paired breast volumes for each subject were divided by 2, and the average value was used to analyze volumes for each cup size category.

Statistical Analysis

Agreement between disclosed and estimated cup size was quantified with Kappa statistics. Simple Kappa considered the disagreement based on any unmatched category. Weighted Kappa analysis was used to assess categories that were close. A close faulty brassiere estimation was considered more relevant, and categories far from each other were considered less relevant.

Kappa statistics were also used to calculate the agreement for each rater. Intraclass correlation was used to

Table 1. Distribution of Disclosed Cup Sizes Based on All and Any Brassiere Systems and Brassiere Brands Used by the Subjects (N = 32)

Disclosed Cup Size (Any System and Brand)	Frequency (N)	Percent (%)	Cumulative Frequency (N)	Cumulative Percent (%)
A	2	6.25	2	6.25
B	10	31.25	12	37.50
C	8	25.00	20	62.50
D	6	18.75	26	81.25
DD	1	3.13	27	84.38
E*	2	6.25	29*	90.63*
G*	2	6.25	31*	96.88*
J*	1	3.13	32*	100.00*
E+G+J combined into US system DDD in analysis	5	15.63	32	100.00

*The extreme values that were disclosed; cup sizes E, G, and J were converted to the US system and analyzed cumulatively in the single category DDD+.

Table 2. Brassiere Cup Conversion Chart

Europe	A	B	C	D	E	F	G	H
USA	A	B	C	D	DD or E	DDD or F	G	H
UK	A	B	C	D	DD	E	F	FF

Based on the conversion chart from the website Finallybra.com.

Table 3. Rater Characteristics

Rater	N	Mean ± SD	Range
Raters total	10		
Age	10	49.4 ± 7.72	43–71
Gender	10		
Male	7		
Female	3		
Nationality	10		
Finland	2		
Norway	3		
Iceland	1		
Sweden	2		
Denmark	2		
Vectra use	10		
Regular	3		
Not regular	7		

evaluate the interrater agreement. Pearson correlation was used to determine whether surgeon age, gender, or time spent in different types of practice correlated with the level of agreement.

RESULTS

Study Subjects

Thirty-two women were enrolled in the study. None were excluded. The median age was 22.1 ± 2.5 years (range, 19–29), and BMI was 22.8 ± 3.1. Four subjects had given birth to one child, and three of these had breastfed. Seven (21.9%) subjects had undergone previous breast surgery (one breast reduction, five breast augmentations, and one augmentation mastopexy).

Five subjects used more than one cup size: two subjects used B or C cup, two used C or D cup, and one used G or F cup, and these subjects were registered as B, C, and G cups, respectively, in the disclosed cup results (Table 1).

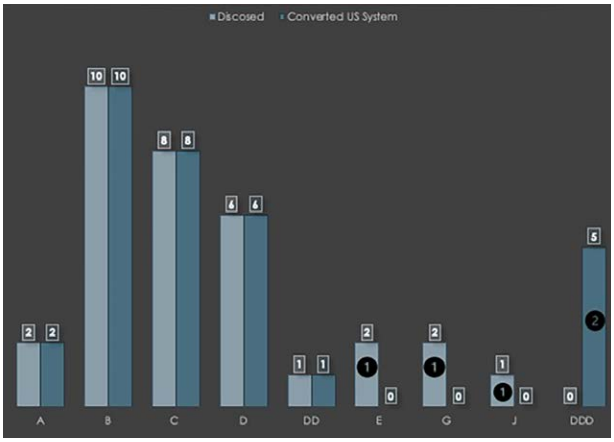

Fig. 1. Disclosed assorted brassiere cup size (gray) and converted cup size—US system (green) (N = 32). Columns marked 1 are assorted cup sizes not represented in the US system. Columns marked 2 are cup sizes E, G, and J converted to DDD in the US system.

Raters

All 10 surgeons trained and practiced in Scandinavia[7] (Table 3).

Cup Size

The disclosed cup sizes ranged from A cup to J cup (Table 1). These disclosed cup sizes were converted from different systems to the US system for analysis (Fig. 1; Table 4).

When comparing the disclosed cup sizes with the estimates, the Kappa agreement value was 0.1479 ± 0.0605, indicating that disclosed and estimated size rarely agreed. Using Cohen's interpretation of Kappa, the agreement was "none."[8] When Fleiss-Cohen–weighted Kappa analysis was used, the agreement level was moderate at 0.6231 ± 0.0589, indicating that the estimates were close to the disclosed cup sizes,[9] but not the same (Table 5). For example, a C cup was more likely rated a B cup than an A cup. The intraclass correlation coefficient was 0.705, which indicated moderate to good interrater agreement.

Cup size A had the highest rate of agreement (14/20; 70%), and cup size C was second (33/80; 41%). DDD or larger cup sizes had the least agreement (9/50; 18%) (Table 6). The trend in rating was toward underestimating the cup size (Fig. 2).

The Vectra-derived 3D volumes were significantly different between the disclosed and estimated cup size (P = 0.001, Kruskal Wallis test) (Table 4). The average volume of each disclosed cup size successively increased, except for the DD cup size (N = 1), which was still higher than the smallest D cup. D cup size and larger had a large range of volumes. None of the breasts scanned had significant ptosis that impeded scanning or volume estimates.

Rater Performance

The level of agreement differed between the individual raters. Using simple Kappa analysis, the lowest agreement for a rater was 0%, and the highest agreement was 41.3% (Table 7).

Increasing age of the rater was negatively correlated with accuracy (Pearson correlation coefficient = −0.8, P = 0.005). No significant difference was seen in agreement comparing surgeon gender or time spent in cosmetic practice.

Three of the raters used Vectra on a regular basis. When comparing clinical examination, 3D scans, and 2D photographs, using a Likert scale from 1 to 5, the raters scored clinical examination as superior 4.9 (0.32 SD) to 3D scans 3.9 (0.57), and to 2D photographs 3.0 (0.82) (P > 0.001). Three-dimensional evaluation was rated as being superior to 2D images with a strong trend (P = 0.067).[7]

DISCUSSION

In this cross-sectional study, we analyzed brassiere cup size agreement between disclosed and estimated values using 3D scans. The agreement was very low using Kappa nonweighted analysis. Fleiss-Cohen–weighted Kappa analysis showed moderate agreement. The interrater agreement was moderate to good.

Table 4. Breast Volume by Disclosed Brassiere Cup Size (N = 32 Subjects, Average Breast Volume per Subject N = 32) as Measured by Vectra 3D Scanner

Bra Cup Size Disclosed	N	Breast Volume (mL)	
		Mean ± SD	Median (IQR)
A	2	158.75 ± 69.65	158.75 (109.5–208)
B	10	269.65 ± 70.82	246.25 (216.5–298.5)
C	8	416.88 ± 113.52	431.75 (325.25–470.25)
D	6	517.43 ± 137.45	558.75 (371.5–627.35)
DD	1	440.40 ±	440.4 (440.4–440.4)
*E	2	641.40 ± 9.33	641.4 (634.8–648)
*G	2	702.38 ± 1.73	702.38 (701.15–703.6)
*J	1	920.00 ±	920 (920–920)
Bra cup size converted to US from E, G, J	N	Mean ± SD	Median (IQR)
DDD	5	674.72 ± 140.79	701.15 (634.8–920.00)

IQR, interquartile range.

Table 5. Kappa Agreement between Disclosed and Estimated Brassiere Cup Size

Method	Level of Agreement	Kappa Agreement	95% CI
Simple Kappa	"Slight"	0.1479	(0.087–0.208)
Fleiss-Cohen–weighted Kappa	"Moderate"	0.6231	(0.5642–0.6820)

The breast is a moldable structure that is hard to describe with words. In a low-tech consultation setting, cup size may serve as a rudimentary proxy for postoperative expectations. Our study, however, shows that patients and surgeons very likely speak different languages when cup sizes are concerned.

The strong disagreement likely has multiple causes, but ultimately could translate into dissatisfied patients and reoperations.[4] Incorrect use of brassieres is common; 70%–80% of women wear brassieres "incorrectly."[3,10,11] Wearing an inadequate cup size can be compensated for by changing strap size, resulting in a poorly fitting brassiere with wrong cup sizes.[10] It was decided that our analysis would focus on cup size only, since this is what usually is communicated during a preoperative consultation.

Multiple nonstandardized brassiere cup size systems are used. The systems are similar but not identical (Table 2). All these systems are used parallelly in different markets.

In addition, different brassiere manufacturers use different volume standards for each particular cup size, since no standardization exists.[1] Manufacturers may intentionally make cup sizes smaller to "upgrade" customers in cup size for ego purposes. Variations in volume padding, wiring, and materials can add to these differences.[1] The estimates of cup size by the plastic surgeons cannot be regarded as correct or incorrect since no standard exists. Not surprisingly, 16% of our described population used two different cup sizes.

Contrary to Bengtson and Glicksman[1] and Pechter,[3] who also have recognized the importance of the brassiere cup disparity, we do not believe that reeducating the patient and translating their disclosed brassiere cup sizes to "true and standardized" sizes is the solution to this miscommunication. The patients' concepts of their own cup sizes are likely deeply seated.[12,13]

Preoperative communication and patient education are imperative.[1,2,4,5] Changes communicated in volume measures will be hard for many patients to grasp. Patients communicating their wishes in milliliters may also have unrealistic expectations. Bengtson and others before him[13] have tried to translate mL measures to brassiere size. Bengtson found that 205 mL constitutes the difference in one brassiere cup[1]; however, this relies on the flawed brassiere system with its imperfections and lack of standardization.

A somewhat heated debate has surrounded the concept of "bra stuffing" in preoperative augmentation planning.[4,14–17] Bra stuffing is a simple, interactive, tangible method that has the benefit of simulating weight and to some extent the postoperative appearance in a brassiere.[4,18,19] It also establishes an ownership with implant choice by the patient. However, the actual appearance of the naked breast is not visualized or mimicked. "Implant

Table 6. Agreement between Disclosed and Estimated Brassiere Cup Size (N = 320)

Analyzed Disclosed Cup Size	Estimated Cup Size						
	A	B	C	D	DD	DDD+	Total
A	14	5	1	0	0	0	20
B	63	29	7	1	0	0	100
C	5	35	33	7	0	0	80
D	4	17	16	13	9	1	60
DD	0	2	4	2	2	0	10
DDD+	0	3	13	16	9	9	50
Total	86	91	74	39	20	10	320

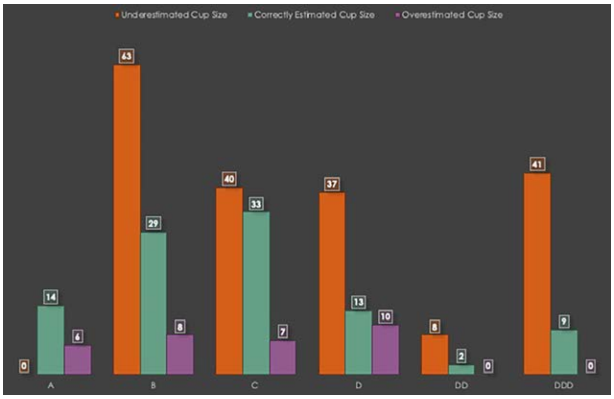

Fig. 2. Trends in estimating brassiere cup size. Categories: underestimation, correct estimation, overestimation (N = 320).

Table 7. Kappa Agreement between Disclosed and Estimated Bra Cup Size for Each Rater (N = 10 Raters and N = 32 Subjects)

Rater	Simple Kappa	Fleiss-Cohen–weighted Kappa
1	0.2587	0.5071
2	0.1007	0.7097
3	0.036	0.036
4	0	0.266
5	0.2447	0.7514
6	0.2742	0.5643
7	0.1776	0.7776
8	0.1907	0.5718
9	0.1299	0.6008
10	0.4132	0.7791

volume affects not just size but also soft tissue envelope fill and thereby shape."[15] Stuffing a brassiere will displace the underlying tissue and also overestimate the volume in breast augmentation planning.[20]

Standardized formulas for measures, such as base diameter or "notch to nipple" as a choice for implant size[21] or breast reduction,[22] are standardized, but not individualized. Such methods also leave the decision of breast size completely in the hands of the surgeon,[4] thus failing the shared decision-making model used by most in medicine.

Showing 2D pictures of previous results[23] requires a varied portfolio and patient imagination. It also requires the surgeon to find similar cases to present. Both patients and surgeons benefitted from 3D imaging in breast augmentation simulation consultations.[24] Volume in these 3D simulation estimates is 90.8% accurate.[25] 3D simulations of today may need additional manual manipulation for adequate results, adding to consultation time.[23] Currently, the geometric-based simulations neglect the biomechanics of the breast, thus allowing results that are not physically possible. Upgrading and further developing software may offer a way forward in planning for surgery.

Surgeons may be intimidated by new technology, and changing practice patterns requires effort. There are also litigious aspects to using simulations, as the patient may consider the simulation an "implied aesthetic result." However, we believe that this is outweighed by the consensus in expectations that is reached.

Limitations

The inherent nonstandardized brassiere cup situation creates multiple methodological challenges for any study, where reasonable compromises must be made.

Recruitment of volunteers to studies involving photography of unclothed breasts is always challenging. Nursing students are medically trained and also represent a selected limited socioeconomic status. The age range of the subjects represents a young, youthful appearance to detect aesthetics, without the effects of aging. This age range is, however, younger than patients undergoing both cosmetic mammaplasties and breast reconstructions. Previous studies regarding brassiere fitting are based on both younger and older ages. Age should not affect subject brassiere use or comparative analysis.[11,12]

Our population had a high prevalence of cosmetic operations 18.75% and 3.1% breast reduction, which may lead to a bias, since these subjects have changed their brassiere size after volume-changing procedures. The subject's brassiere choice, compared to surgeon estimates, however, should not affect the analysis. Little is known about the actual prevalence of breast implants, especially when stratified by age and indication. In a study from the Netherlands using chest X-rays to detect implants (likely underestimating the prevalence), a 3% prevalence in the population of 20–70 years of age is seen.[26] The wide variety of ethnicity, weight, height, breast size, and aesthetic scores in this population speaks for an otherwise well-represented sample.[7] All of the subjects were Norwegian citizens, albeit of different ethnic origins. The raters were all Scandinavian. International differences could potentially limit the generalization of the results.[27]

For adequate brassiere cup estimations, only one system at a time can be used. The US system was chosen since it is likely the best known and most used. Converting the systems to enable comparison is an inevitable limitation in the study. By analyzing extreme sizes together in category DDD+, we were also able to incorporate all the large-size outliers from the different brassiere systems into one group.

Estimating a cup size based on 3D scans is not a common activity for the plastic surgeon. It is, however, a way to show how differently a patient and a surgeon can perceive cup size for a given pair of breasts. The mental image of a cup size may vary widely.[12]

This study used 3D scanning technology, which captured a standardized image of the anterior torso and not the whole body. This potentially could affect size estimates. Only three of the raters used Vectra regularly, but simple evaluation of images on Vectra is very intuitive. A clinical examination may have improved the chances to correctly estimate cup size. However, the logistics of a clinical examination would not have allowed a pan-Scandinavian evaluation, and blinding to cup size also could have been compromised. Photographic estimations of postoperative results and aesthetics are a common and accepted method in plastic surgery instead of physical examination where this is not possible.[28] Lately, 3D scanning has started revolutionizing clinical and academic photography.[28] The plastic surgeons felt almost as comfortable evaluating 3D scans as with performing clinical examinations.[7]

All anthropometric volume measures of the breast are complex to perform and always represent estimates[29–34] and volume measures using 3D scans likewise. When used appropriately for 3D simulation, volume estimates can, however, be accurate.[23,25]

Using the average volume measure of both breasts to estimate cup size is an estimation. One could argue that the largest breast volume measure of the two breasts should be used instead, since the largest breast must fit inside the cup. However, a smaller breast that does not fill a cup will fit equally poorly.[12] The cup volume measures in this study were only added to describe the population further, and any measuring imperfections should not affect brassiere cup agreement, since volume was not used to decide brassiere cup size.[25,28]

CONCLUSIONS

Brassiere systems and brands are aimed at consumers for purchases of brassieres and not for determining breast size after surgery. Agreement between brassiere cup size worn by female subjects and plastic surgeons' estimates was low. Cup size language is not universal, and a miscommunication between surgeon and patient may occur if it is used to communicate postoperative expectations. Digital 3D scanning solutions may offer a more efficient communication alternative.

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DISCLOSURES

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