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Original Research Article

The Relationship Between Breast Size and Anthropometric Characteristics

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Objectives: Current clinical selection criteria for mammaplasty use weight-related parameters, and weight loss is recommended as a nonsurgical intervention to reduce breast size. However, research has not firmly established if breast size is related to body size and composition. This study aims to investigate anthropometric characteristics in smaller and larger breasted women and identify predictors of breast mass.

Methods: A bra fitter determined underband and cup size of 93 A to H cup size women (mean ± standard deviation, age 25.7 ± 5.6 years, height 1.67 ± 0.6 cm, and mass 65.6 ± 11.0 kg). Estimations of breast mass (g) were made, and participants were categorized as smaller (<500 g) or larger (>500 g) breasted. Restricted anthropometric profiles determined body mass, height, body mass index (BMI), waist-to-hip ratio, sum of eight skinfolds, subscapular to triceps skinfold ratio, somatotype, percent body fat, fat and fat-free mass, and suprasternal notch to nipple distance.

Results: All variables (excluding height, subscapular to triceps skinfold ratio, and age) were significantly greater in larger breasted women. Body mass-related parameters and suprasternal notch to nipple distance were positively related to breast mass, with BMI and suprasternal notch to nipple distance accounting for half of the variance in breast mass.

Conclusion: Smaller and larger breasted women demonstrate differences in anthropometry, with body mass and BMI demonstrating strong relationships to breast mass. Measures of BMI and suprasternal notch to nipple distance enable predictions of breast mass and suggest that weight-related parameters are not appropriate exclusion criteria for mammaplasty. Am. J. Hum. Biol. 24:158–164, 2012.

The dimension and mass of the female breast can vary substantially between individuals (Gefen and Dilmoney, 2007) with anatomic variation in the volume, width, length, projections, shape, and position on the chest wall (Avsar et al., 2010). The composition of the breast comprising fat, skin, and glandular and connective tissue also varies among individuals with these differences often attributed to variations in adipose tissue (Page and Steele, 1999). It has been identified that heritability plays a role in the development of breast size (Wade et al., 2010), and hormonal changes also influence breast size (Jemstrom and Olsson, 1997; Scheurnhammer et al., 2007); however, empirical research has not firmly established if breast size is related to body size and composition (Byrne and Spernak, 2005).

Surgeons routinely use body mass index (BMI) as a criterion for surgery for patients presenting with mammary hypertrophy (Atterhem et al., 1998; Blomqvist, 1996; Glatt et al., 1999), and weight loss is recommended as a nonsurgical intervention to patients above designated BMI thresholds to alleviate symptoms associated with mammary hypertrophy (Wraight et al., 2007). However, the appropriateness of BMI as a selection criterion and whether weight loss is an effective mechanism to reduce breast size remains unclear as research that has examined the influence of body size and composition on breast size has yielded inconsistent findings.

Some relationships between BMI and breast size (Beijerinck et al., 1995; Benditte-Klepetko et al., 2007), and body mass and breast size (Hasenburg et al., 2000), have been identified. When examining the impact of breast size on the vertebral column in 100 women with breast cup sizes ranging from A to D, Findikcioglu et al. (2007) identified that women with D cup breasts had significantly higher BMI compared with those with A to C cups. Conversely, Katch et al. (1980) identified poor correlations of body mass or height to breast size and found breast mass to account for no more than 4.4% of total body fat mass. Additionally, Vandeput and Nelissen (2002) found no correlation between body mass and breast size in a sample of 973 women awaiting breast augmentation. In a sample of 708 female twins, heritability of breast size was investigated and estimated to account for 56% of variation in breast size (Wade et al., 2010). One-third of this genetic variance was common with genes influencing BMI, with two-thirds (41% of total variance) unique to breast size. Thus, a large proportion of the variance in breast size is as yet unaccountable.

Distinct anthropometric measurements of the breasts and the relevant position of the breasts taken from fixed skeletal and soft tissue landmarks provide a useful tool to appraise breast aesthetics, evaluate patients preoperatively, and assess the outcome of surgical procedures to the breast (Khan and Bayat, 2008; Penn, 1955; Westreich, 1997). In a small sample of women aged 18–39 years, Penn (1955) reported a distance of 21 cm as the most aesthetically pleasing distance from the suprasternal notch to nipple. The distance from the suprasternal notch to nipple is reported as stable in normal-sized and shaped

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breasts, with normal young females presenting with distances of ~20 cm (Eisenmann-Klein, 2010). However, as acknowledged by Khan and Bayat (2008), increasing breast mass is associated with inferior migration of the nipple. In females with moderate to severe mammary hypertrophy, Mandrekas et al. (1996) and Nahabedian and Mehrdad (2002) report mean suprasternal notch to nipple distances of 30 cm (range 21–43 cm) and 37 cm (range 30–48 cm), respectively. In a case report of a 48-year-old woman presenting with gigantomastia, suprasternal notch to nipple distances of 55 and 51 cm were observed for the right and left breast, respectively (Ozcelik et al., 2009). A strong linear correlation has also been identified between suprasternal notch to nipple distance and the amount of tissue excised during breast reduction (Movasagghi et al., 2006). For example, in an evaluation of 25 women undergoing reduction mammaplasty to treat gigantomasty, the average resection mass on the right side was 1,227 ± 300 and 1,218 ± 343 g on the left side, equivalent to an average reduction of three cup sizes (Heine et al., 2008), resulting in reductions in suprasternal notch to nipple distance from 37.1 ± 4 to 23.4 ± 2.1 cm on the right side and from 37.4 ± 3.5 to 24 ± 2 cm on the left side.

No additional studies have investigated the relationship of any other anthropometric variables to breast size or mass. However, understanding factors that relate to breast size/mass may enable the development of models to predict these variables. Previous research has identified preadolescent obesity as an important predictor of age for onset of breast development in young women, and breast size after puberty (Biro et al., 2003; Kaplowitz et al., 2001; Wang, 2002). The prediction of breast size/mass based on modifiable variables such as body mass or somatotype would enable quantification of the magnitude of variance in one parameter necessary to change breast size/mass. This would determine the feasibility of achieving the magnitude of weight loss necessary to cause an acceptable change in breast size/mass, thus identifying whether weight loss as a nonsurgical intervention to reduce breast size is a plausible recommendation.

Accordingly, this exploratory article aims to examine anthropometric characteristics in smaller and larger breasted women, establish the relationship of these variables to breast mass, and establish whether any anthropometric indices can predict breast mass. It is hypothesized that

- H_1: smaller and larger breasted women will exhibit significant differences in anthropometric indices.
- H_2: breast mass will demonstrate significant relationships to anthropometric variables.
- H_3: body mass, BMI, and suprasternal notch to nipple distance will act as significant predictors of breast mass.

METHODS

Following full institutional ethical approval, 93 female volunteers were selected to participate in this study, and all participants gave written informed consent. Participants had an average age [±standard deviation (SD)] of 25.7 (±5.6 years), body mass 65.6 (±11.0 kg), and height 1.67 (±0.6 m). By design, all women were premenopausal, had not gone through pregnancy or breast-fed in the previous year, and had not experienced any surgical procedures to the breasts. Participants <18 years and >40 years of age were not selected to partake in the study.

Participants' breast size was determined by a trained bra fitter following the recommendations of McGhee and Steele (2006). Chest girth was determined underneath the breasts in line with the inframammary fold using an anthropometric tape. A chest measurement of >24 to 26, >26 to 28, >28 to 30, >30 to 32, and >32 to 34 inches equated to a 30-, 32-, 34-, 36-, and 38-inch underband size, respectively. Breast girth was measured around the fullest part of the bust. To establish cup size, the net difference between breast girth and chest girth was calculated, with a 1-inch difference equating to an A-cup size, 2 inches a B cup, 3 inches a C cup, and so on (Scurr et al., 2009).

The method employed for the estimation of breast mass (g) was that of Turner and Dujon (2005), which was also employed by Haake and Scurr (2010). These estimates were based on underband size and cup size, with 115 g per cup size for underbands of 32–34 inches and 215 g per cup size for underbands of 36–38 inches. Estimates of breast mass for 30-inch underbands were not reported by Turner and Dujon (2005); thus, to estimate breast mass for this size, a cross-grading system was used and the participants appropriate cup size (one smaller) for a 32-inch underband used to estimate breast mass. Participants with a breast mass <500 or >500 g were defined as smaller, or larger breasted, respectively (Gefen and Dilmoney, 2007).

To establish the suprasternal notch to nipple distance, retroreflective markers (5 mm diameter) were positioned on the suprasternal notch and the right nipple. Eight calibrated infrared motion capture cameras (200 Hz; Oqus, Qualisys) recorded the three-dimensional coordinates of the markers as each participant stood bare-breasted in the anatomical reference position for 2 s. Restricted anthropometric profiles were conducted in accordance with International Society for the Advancement of Kinanthropometry (ISAK) guidelines (Marfell-Jones et al., 2006) by accredited anthropometrists.

Data analysis

BMI (kg/m^2), sum of eight skinfolds ($\sum$8SF; mm), and somatotype subcomponents (endomorphy, mesomorphy, and ectomorphy) were calculated. To assess fat distribution, two indices were derived; the subscapular-to-triceps skinfold ratio (STR) provided a measure of subcutaneous fat on the trunk versus the periphery (central obesity), and the waist-to-hip circumference ratio (WHR) was used as an index of upper body or android obesity. Transformation of skinfold measures to body density was undertaken using Durnin and Womersley's (1974) equation. Siri's (1961) formula was used to calculate percent body fat (%BF) and fat-free mass. To assess the vertical suprasternal notch to nipple distance, markers were identified and 3D data reconstructed in the Qualisys Track Manager Software (Qualisys, Sweden). The vertical distance from the suprasternal notch to the right nipple was calculated (Westreich, 1997), filtered using a 10-Hz low-pass Butterworth filter, and then averaged across the 2-s capture.

All statistical analyses were performed using Predictive Analytic Software (PASW) statistics computer package with statistical significance set at $P < 0.05$. Examination of histograms, skewness and kurtosis values, and Shapiro–Wilk and Kolmogorov–Smirnov test statistics determined that data were not normally distributed. Therefore, nonparametric differences in anthropometric variables of smaller and larger breasted women were examined using multiple Mann–Whitney *U* tests, and Spearman's rho correlation coefficients (r_s) were calculated to determine the relationship between breast mass and anthropometric indices. Correlation coefficients <0.29 were defined as weak, between 0.3 and 0.49 moderate, and >0.5 strong (Cohen, 1988).

Stepwise regression analysis was conducted to identify potential predictors of breast mass. First, an enter method model was used; however, examination of tolerance levels and variance inflation factor scores indicated high levels of multicollinearity in the explanatory variables of the predictive model. It is often not possible to objectively select a collinear variable to delete (Slinker and Glantz, 1985), and the computational demands of evaluating all possible combinations of subset models are prohibitive (Atkinson and Nevill, 2001). Therefore, all anthropometric variables were entered using stepwise procedures to remove collinear variables and determine the most parsimonious model.

RESULTS

Descriptive statistics

Cup size ranged from an A cup to an H cup with underband size ranging from 30 to 38 inches. The frequency distribution of breast mass was positively skewed (Fig. 1), ranging from 115 to 1,935 g with a mode breast mass of 460 g (n = 32).

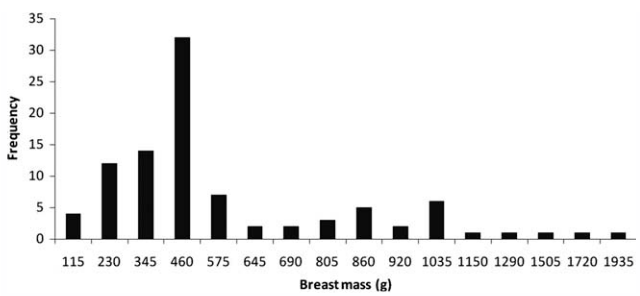

Fig. 1. Frequency distribution of participants' breast mass (n = 93).

Anthropometric differences between smaller (n = 61) and larger (n = 32) breasted women

Mann–Whitney *U* tests were conducted to evaluate the hypothesis that there would be significant differences in anthropometric variables between smaller and larger breasted women (Table 1). There was no significant difference in age, height and STR between groups. All other anthropometric variables were significantly greater in larger breasted women, with the exception of ectomorphy which was significantly great in smaller breasted women. Larger breasted women had a fat mass of 7.4 kg greater than smaller breasted women (+40%). The average suprasternal notch to nipple distance of larger breasted women was 3.1 cm greater than the average distance observed in smaller breasted women ($z = -4.286$, $P < 0.001$).

Relationship of breast mass with anthropometric variables

Correlation analysis was conducted to evaluate hypothesis two, that breast mass would demonstrate significant relationships to anthropometric variables (Table 2).

Table 2 shows body mass was strongly correlated with breast mass indicating that heavier women had larger breasts (r_s = 0.660, P < 0.001). Individual skinfolds (not reported) all showed significant moderate correlations with breast mass, with the strongest positive correlation to breast mass observed in the triceps skinfold (r_s = 0.535, P < 0.001). A predominance of upper body fat, as indicated by WHR, was moderately associated with breast mass (r_s = 0.357, P < 0.001); however, when examined independently, waist circumference and hip circumference (not reported) demonstrated strong positive associations with breast mass (r_s = 0.658, P < 0.001 and r_s = 0.610, P < 0.001, respectively). Age demonstrated no significant association with breast mass (r_s = −0.063, P > 0.05).

TABLE 1. Comparison of anthropometric variables and age between smaller and larger breasted women (n = 93)

	Mean ± SD		Mann–Whitney *U*		Percentage change from smaller to larger breasted (%)
	Smaller breasted (n = 61)	Larger breasted (n = 32)	*P*	*Z*	
Ectomorphy	2.5 ± 1.0	1.1 ± 0.8[a]	<0.001	−5.814	−56
Fat mass (kg)	18.5 ± 4.3	25.9 ± 6.0[a]	<0.001	−5.536	40
Mesomorphy	3.7 ± 1.0	5.1 ± 1.4[a]	<0.001	−4.909	37
∑8SF(mm)	139.7 ± 40.4	177.9 ± 37.6[a]	<0.001	−4.040	27
Endomorphy	4.4 ± 1.2	5.6 ± 1.2[a]	<0.001	−4.309	27
Body mass (kg)	60.8 ± 7.2	74.6 ± 11.3[a]	<0.001	−5.807	23
BMI (kg/m^2)	21.9 ± 2.0	26.5 ± 3.4[a]	<0.001	−6.228	21
Suprasternal notch to nipple distance (cm)	16.5 ± 2.12	19.5 ± 2.72[a]	<0.001	4.286	18
Fat free mass (kg)	42.3 ± 4.4	48.8 ± 6.0[a]	<0.001	−4.933	15
BF (%)	30.1 ± 4.7	34.4 ± 3.8[a]	<0.001	−4.084	14
WHR	0.73 ± 0.03	0.77 ± 0.05[a]	<0.001	−4.015	5
Underband size (inches)	33.0 ± 1.0	34.3 ± 2.0[a]	<0.001	−3.855	4
Height (cm)	166.4 ± 6.3	167.6 ± 5.6	0.505	−0.667	NS
STR	0.73 ± 0.16	0.81 ± 0.33	0.514	−0.652	NS
Age (years)	25.8 ± 6.2	25.6 ± 4.4	0.547	−0.602	NS

[a]Denotes significant difference at <0.05 level.∑8SF: sum of eight skinfolds; BMI: body mass index; BF: body fat; WHR: waist-to-hip circumference ratio; STR: subscapular-to-triceps skinfold ratio; NS: nonsignificant.

Prediction modeling

Stepwise regression analysis was conducted to evaluate hypothesis three. All anthropometric indices displayed in Table 2 were entered as independent variables, with breast mass as the dependent variable. This resulted in two models (Table 3). The first model incorporated BMI and accounted for 43% of the explained variance in breast mass ($R^2_{adj} = 0.43$) and was significant ($F = 55.398$, $P < 0.001$). The second model included BMI and suprasternal notch to nipple distance and was also significant ($F = 35.651$, $P < 0.001$), increasing the explained variance significantly to 49% ($R^2_{change} = 0.066$, $P < 0.05$). All other variables were excluded from the model.

Unstandardized β coefficients in model two indicate that an individual with a BMI of 28 kg/m^2, with a suprasternal notch to nipple distance of 180 mm, would have a breast mass of 700 g. With other variables held constant, breast mass was positively related to BMI and suprasternal notch to nipple distance, increasing 39 g for every one unit increase in BMI, and by 3 g for every 1 mm increase in suprasternal notch to nipple distance. The effect of both predictors was significant ($\beta = 0.472$, $t = 4.509$, $P < 0.001$ and $\beta = 0.320$, $t = 3.061$, $P < 0.001$).

DISCUSSION

Investigations on the influence of body size and composition on breast size/mass have yielded inconsistent findings yet current clinical selection criteria for breast surgery commonly use weight-related parameters. Therefore, this article aimed to examine anthropometric differences between smaller and larger breasted women, establish the relationship of these variables to breast mass, and establish whether any anthropometric indices could predict breast mass. The results of this study found that the anthropometric variables measured were significantly greater in larger breasted women, accepting hypothesis one.

In the results of the current study, fat mass demonstrated the greatest increase from smaller breasted women to larger breasted women (40%). Additionally, ectomorphy was 56% lower in larger breasted women, which is expected as ectomorphs generally display a lower preponderance of fat mass (Norton and Olds, 1996). These results support previous research, which hypothesize that differences in breast size and mass are attributed to variations in adiposity (Mason et al., 1999; Page and Steele, 1999; Sherwood, 1993). In agreement with previous research (Findikcioglu et al., 2007; Katch et al., 1980), the present study also shows a significantly greater body mass and BMI in larger breasted women compared with smaller breasted women (23% and 21% increases, respectively), supporting the modification of controllable variables such as fat mass and BMI to alter breast size.

A significantly higher WHR was found in larger breasted women compared with smaller breasted women. It is acknowledged that WHR is an index of upper body obesity, and therefore, it is likely that this measure not only reflects abdominal fat but also breast fat, therefore this result is to be expected. It is interesting to note that the STR, representing central (trunk) to peripheral (extremities) subcutaneous fat distribution, displayed no difference between smaller and larger breasted women. However, both groups displayed a mean STR <0.81, indicating a more peripheral distribution (Ioannou et al., 2005). It is reported that females tend to have a more peripheral distribution of fat in early adulthood (Wells, 2007) and that through the aging process, a tendency of central accumulation occurs with a decrease in fat-free mass and increase in fat mass (Chang et al., 2000). As the mean age of the study population was 25.7 ± 5.6 years, the lower STR observed in both groups is in line with expectations.

The differences reported in this study in underband size between smaller and larger breasted women should be viewed with caution as the difference was less than one size (33 to 34.3 inches). The bra cross-grading system uses both cup and underband size to determine

TABLE 2. Spearman's rho correlation coefficients between breast mass, anthropometric indices, and age (n = 93)

	Spearman's rho correlations to breast mass
Cup size	0.909[a]
Body mass	0.660[a]
BMI	0.658[a]
Suprasternal notch to nipple distance	0.649[a]
Fat mass	0.620[a]
Ectomorphy	−0.580[a]
Fat free mass	0.563[a]
∑8SF	0.472[a]
Endomorphy	0.466[a]
BF	0.462[a]
Underband size	0.442[a]
Mesomorphy	0.425[a]
WHR	0.357[a]
Height	0.184
STR	0.087
Age	−0.063

[a]Denotes significance at <0.05 level.BMI: body mass index; ∑8SF: sum of eight skinfolds; BF: percent body fat; WHR: waist-to-hip circumference ratio; STR: subscapular-to-triceps skinfold ratio.

TABLE 3. Regression analysis: breast mass and anthropometric measures, displaying regression coefficients and model fit statistics of each model (n = 93)

Variable	R	R^2_{adj}	Unstandardized coefficient β	Standardized coefficient β	t
Model 1					
Constant	–	–	−756.042 (171.265)		−4.414[a]
and BMI	0.438[a]	0.430[a]	54.374 (7.305)	0.662	7.443[a]
Model 2					
Constant	–	–	−893.752 (168.113)	0.472	−5.316[a]
and BMI	0.505[a]	0.49[a]	38.743 (8.591)	0.320	4.509[a]
and suprasternal notch to nipple distance			2.869 (0.937)		3.061[a]

[a]Denotes significance at <0.05 level.Estimated coefficients are given with standard errors in parentheses.

breast volume (Scurr et al., 2011) with breast volume reported to vary between individuals of the same cup size due to changes in underband size (McGhee and Steele, 2006). Interestingly, the results of this study suggest that cup size, as opposed to underband size, is the more discerning of the two measures in relation to breast mass.

Previously reported anthropometric data on suprasternal notch to nipple distance in normal populations range from 20 to 21 cm (Penn, 1955; Westreich, 1997). The values reported in these previous studies are measures of resultant distance and are therefore affected by the projection of the breast, making inferences about inferior migration of the nipple across different breast-sized women difficult. Therefore, the present study reported vertical suprasternal notch to nipple distance to eliminate the projection of the breast. Thus, the mean distance of 16.5 and 19.5 cm for smaller and larger breasted women, respectively, may not be directly comparable with previous literature. However, in agreement with Khan and Bayat (2008), larger breasted women had a significantly greater suprasternal notch to nipple distance, and this measure showed a strong relationship with breast mass suggesting that as breast mass increases so does the inferior migration of the nipple. This increased incidence of breast ptosis in females with greater breast mass may lead to an increased desire for mammaplasty or breast augmentation procedures.

Breast mass demonstrated significant relationships to the majority of anthropometric variables, accepting hypothesis two. As expected (based on the algorithm used to calculate breast mass), breast cup size demonstrated a strong correlation to breast mass ($r_s = 0.9$). The algorithm only categorizes three underband sizes, thus the relationship of breast mass to underband size is weaker ($r_s = 0.4$). The results of the present study identify a strong positive relationship between body mass and breast mass ($r_s = 0.7$), and BMI and breast mass ($r_s = 0.7$) but no relationship between height and breast mass, supporting previous literature (Beijerinck et al., 1995; Benditte-Klepetko et al., 2007; Findikcoglu et al., 2007; Hasenburg et al., 2000).

Although weaker in comparison with the positive relationship identified between body mass related parameters and breast mass, measures of body fat (fat mass, $\sum$8SF, %BF, and endomorphy) also showed positive associations with breast mass. Page and Steele (1999) hypothesized a link between breast mass and levels of adiposity, with Sherwood (1993) reporting strong correlations between breast fat and total body fat. Of all individual anthropometric measures, triceps skinfolds, and waist and hip circumferences showed the strongest relationships to breast mass. The advantage of these measures in comparison with more technical body composition analysis techniques lies in their practical use, requiring minimal equipment and having a low measurement error (Bean, 1996; Sharp, 1995).

One of the most important findings of this study is that two simple measures, namely BMI and suprasternal notch to nipple distance, make a substantial contribution in explaining the phenotypic diversity of the breast. Body mass was not a significant predictor, thus hypothesis three was only partially accepted. Literature has concluded that the benefits of breast reduction in patients presenting with mammary hypertrophy are evident regardless of BMI; however, surgeons routinely use BMI as a criteria for breast reduction surgery (Atterhem et al., 1998; Blomqvist, 1996; Glatt et al., 1999). There is large variation in the BMI threshold for surgical selection criteria used in the NHS, ranging from 25 to 35 kg/m^2, with weight loss recommended as a nonsurgical intervention to patients above these thresholds to alleviate symptoms associated with mammary hypertrophy (Wraight et al., 2007). Using the results of the present study, it can be estimated that for a woman with an average height of 1.61 m (Health Survey for England, 2008), a BMI of 28 kg/m^2, a suprasternal notch to nipple distance of 300 mm (moderate mammary hypertrophy), and a 36-inch underband size, a 14.7 kg loss in body mass (a 20% reduction of total body mass) would be required to achieve a 215-g (one cup size) reduction in breast mass (assuming all other variables remain constant). The mean mass of breast tissue excised per side in a study of 75 patients (mean age 36 years, mean BMI 28 kg/m^2) undergoing bilateral reduction mammaplasty was reported as 774.9 g (Turner and Dujon, 2005). For the same hypothetical patient previously described to achieve a 775 g reduction in breast mass would necessitate a body mass reduction of 51 kg (70% reduction of total body mass), resulting in a BMI of 8.3 kg/m^2. This is below the mean BMI of 12 kg/m^2 proposed as the lower limit of female survival to starvation (Henry, 2001). These results highlight the need for evidence based, standardized selection criteria for reduction mammaplasty.

Additionally, as BMI and suprasternal notch to nipple distance contribute to half of the variance in breast mass, and correlations have been identified between a range of body mass and fat related-parameters with breast mass, it is plausible to suggest that body composition and differences in fat patterning may affect the movement of the breast and consequently the breast support requirements. While breast kinematics research has progressed from uniplanar to multiplanar, giving a better understanding of breast support requirements (Scurr et al., 2007, 2008, 2009, 2011; White et al., 2009, 2010), the influence of anthropometric variables has not yet been considered and could be an important avenue of research.

The relationship between age and breast size is inconclusive (Bowles et al., 2008; Tonkelaar et al., 2004); however, studies that have identified a positive relationship have relied upon self-report to establish breast size. As identified by Greenbaum et al. (2003) and Pechter (1998), a large proportion of females reportedly wear the incorrect bra size. Therefore, self-report may not be an accurate way of assessing changes in breast size, suggesting that these studies should be interpreted with caution. Because of the study populations' narrow age range, it was not possible to make any firm conclusions about the relationship between age and breast size. Additionally, the study sample consisted predominantly of active Caucasian females that had not been through pregnancy and did not represent a random sample of individuals but rather a convenient sample of volunteers. This group therefore cannot be considered representative of the whole female population and precludes insight into the influence of other variables such as ethnicity and pregnancy on the relationship between breast size and anthropometric characteristics. Future research should assess differences in breast mass over a greater age range, using objective measures to firmly establish the relationship between breast mass and age. Additionally, a larger heterogeneous sample of females may aid the generalization of results to a wider female population.

CONCLUSIONS

In conclusion, the results of the present study have identified significant anthropometric differences between smaller and larger breasted women and significant correlations between anthropometric variables and breast mass, particularly body mass and BMI. The results also indicate that half of the variance in breast mass can be explained by BMI and suprasternal notch to nipple distance. Current surgical selection criteria for mammaplasty may exclude women with greater BMI (Wraight et al., 2007); however, the results of this study show that these women are likely to have a greater breast mass, indicating that BMI is an inappropriate selection criteria. Additionally, the results of this study identify that using weight loss as an alternative to surgery for women with greater breast mass is unfeasible because of the magnitude of weight loss necessary to produce an acceptable change in breast mass making weight loss an inappropriate alternative to surgery recommendation.

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