

The Impact of Tuberous Breast on Adolescents: A Cross-sectional Study

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Background: Tuberous breast deformity is a nondiagnostic, descriptive term for a congenital breast difference that becomes apparent at puberty. Although the negative physical and psychosocial effects of macromastia and breast asymmetry are established, no studies to date have explored the impact of tuberous breasts on health-related quality of life (HRQoL) outcomes using a robust sample size.

Methods: In this cross-sectional study, HRQoL surveys were administered to adolescent women with tuberous breasts and healthy female controls, aged 12–21 years. Surveys included the Short-Form 36v2, Rosenberg Self-Esteem Scale, and Eating Attitudes Test-26. Demographics were compared, and linear regressions were fit to determine the effect of tuberous breast deformity on survey scores, with body mass index (BMI) category as a covariate.

Results: Thirty-four patients with tuberous breasts and 264 controls participated. Patients with tuberous breasts had higher mean BMI than controls ($P < 0.05$). After adjusting for differences in BMI category, patients with tuberous breasts scored lower than controls on the Rosenberg Self-Esteem Scale and in Short-Form 36v2 domains related to physical and psychological health ($P < 0.05$, all). Compared with controls, patients with tuberous breasts had a higher mean score on the Eating Attitudes Test-26 ($P < 0.05$).

Conclusions: Tuberous breast deformity may negatively impact patients' physical and psychosocial HRQoL and increase their risk for disordered eating and higher BMIs. It is imperative that healthcare providers and third-party payors understand tuberous breast deformity is not just a cosmetic issue and tailor care and coverage policies accordingly. (*Plast Reconstr Surg Glob Open* 2024; 12:e5530; doi: [10.1097/GOX.0000000000005530](https://doi.org/10.1097/GOX.0000000000005530); Published online 24 January 2024.)

INTRODUCTION

The term tuberous breast deformity was first used by Rees and Aston in 1976 to describe a congenital breast difference that emerges around the time of puberty.¹ Although there is marked variation in the size and shape

of tuberous breasts, most plastic surgeons agree on general defining features: a narrow breast base, inferior pole hypoplasia of the subareola, a high inframammary fold, and glandular protrusion causing nipple-areolar complex enlargement—often accompanied by ptosis.²

The negative psychosocial impact of other benign breast conditions, such as macromastia and breast asymmetry, is well described.^{3–5} In particular, baseline studies in young women with macromastia have found patients to have negatively affected health-related quality of life (HRQoL) outcomes, self-esteem, physical symptoms, and eating behaviors.^{3,4} Similarly, baseline studies in young women with breast asymmetry have featured lower psychosocial well-being and self-esteem in these patients compared with their unaffected peers.^{6,7} Macromastia and breast asymmetry also associate with higher BMIs, and the relationships above hold true even when adjusting for this association.

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These findings underscore that physical and psychosocial well-being is closely tied to the form of the breast. Despite the prior research concerning the HRQoL outcomes of patients with macromastia and breast asymmetry, no studies to date have explored the effect of tuberous breast deformity using more than 10 participants.^{6,7} In addition, these existing studies only describe postoperative changes in HRQoL outcomes after patients with tuberous breasts undergo surgical correction, whereas the baseline impact of the condition warrants its own focus in the literature, especially in the adolescent population. Thus, there is motivation to dedicate formal investigation strictly to the baseline impact of tuberous breast deformity on HRQoL outcomes, as it is a common congenital breast condition that is likely undertreated due to a lack of proper clinical attention and restrictive policies imposed by third-party payors.^{7,8}

Most studies investigating the impact of tuberous breast deformity have found that affected women are more likely to have lactation difficulties compared with unaffected women, and several studies have evaluated the postoperative satisfaction of women undergoing corrective procedures.^{5,9–15} However, there are no reports on the impact of tuberous breast deformity on HRQoL, especially in a younger population. The aim of the current study was to quantify the physical and psychosocial effects of tuberous breast deformity, using a cross-sectional analysis from a prospective study inclusive of adolescent female controls.

METHODS

Participants

Approval for the study was granted by our institution's Committee on Clinical Investigation (Boston Children's Hospital institutional review board; protocol X08-10-0492). Eligibility requirements included being a young woman aged 12 to 21 years with at least one tuberous breast identified by a plastic surgeon (B.I.L.). Assessment was based on physical examination. A three-tier classification system originally proposed by Meara et al and refined by Kolker and Collins was used to characterize the degree and type of tuberous breast deformity based on anatomical considerations and severity.^{14,16} Type I refers to hypoplasia of the lower medial quadrant, type II refers to hypoplasia of the lower medial and lateral quadrants, and type III refers to severe breast constriction and global hypoplasia.¹⁴ Patients were prospectively enrolled during initial consultation at our institution from August 2008 through July 2022.

Healthy female control participants of the same age range were also prospectively and concurrently enrolled at the same institution during their regularly scheduled visits for nonbreast-related concerns in the department of plastic and oral surgery clinics, or division of adolescent/young adult medicine. Control participants were deemed eligible if they or their medical records reported a present state of good health without significant medical history, surgical history, a current breast complaint or previous breast diagnosis, an eating disorder, or a psychiatric disorder. Written informed consent was obtained prospectively from all patients 18 years or older, and from a parent or guardian if the patient was under the age of 18 years.

Takeaways

Question: What is the impact of tuberous breast deformity on health-related quality of life (HRQoL) outcomes of affected adolescents?

Findings: Both patients with tuberous breast deformity seeking surgery and healthy age-matched female controls completed surveys to assess HRQoL: the SF-36, RSES, and EAT-26. Tuberous breast patients demonstrated poorer HRQoL outcomes, increased risk for disordered eating, and higher body mass indices.

Meaning: Patients with tuberous breast deformity may be at risk of poorer HRQoL outcomes, similar to other benign breast conditions like asymmetry and macromastia, which suggests that this condition is not solely a cosmetic issue and warrants greater attention from providers and third-party payors.

Demographics and Clinical Presentation

Clinical staff obtained height and weight on patients. Body mass index (BMI) categories were determined for patients 20 years or older by using the Centers for Disease Control and Prevention Adult BMI calculator.¹⁷ For patients younger than 20 years, BMI percentiles and categories were found by using the Centers for Disease Control and Prevention Child and Teen BMI calculator.¹⁸ Due to the significant difference in the distributions of BMIs between patients with tuberous breasts and controls, BMI category (eg, underweight, healthy weight, overweight, obese) was used as a covariate in subsequent analyses.

Survey Measures

All patients completed three self-administered psychometric measures at baseline. Baseline was considered to be before surgical correction for patients with tuberous breasts, and time of first survey completion for controls. The surveys included the Short-Form 36v2 (SF-36), the Rosenberg Self-Esteem Scale (RSES), and the Eating Attitudes Test-26 (EAT-26).^{19–21} These surveys were chosen for their reliability, validity, and extensive use in other studies focused on female adolescents and adults in benign matters of the breast.^{3,4,22–30} The SF-36 measures HRQoL in eight domains: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health.¹⁹ Raw scores in these domains are transformed to a 0–100 scale in which higher scores correspond to more favorable HRQoL. The RSES assesses global self-esteem using a 10-item scale.²⁰ Scores are on a 10–40 scale in which higher scores indicate greater self-esteem.³¹ The EAT-26 assesses disordered eating behaviors and attitudes, and higher scores associate with disordered eating, thoughts, and behaviors.²¹

Data Management and Statistical Methods

Demographic and survey data were gathered before surgery using REDCap (Research Electronic Data Capture), a secure, internet-based application hosted at Boston Children's Hospital.³² Patients with tuberous breast

deformity were included in the analysis, as long as data were present for age and BMI, and they had completed a baseline survey before undergoing surgery. Controls were included as long as data were present for age and BMI, and they had completed a baseline survey. Statistical analyses were run using R, version 4.2.1 (R Foundation for Statistical Computing, Vienna, Austria). Baseline demographic and clinical data were compared using independent two-sample *t* tests or Fisher exact tests, as appropriate. SF-36, RSES, and EAT-26 baseline scores were generated using algorithms developed by Ware et al, Rosenberg, and Garner et al, respectively.^{21,33,34} Linear regressions were fit to determine the effect of tuberous breast deformity on baseline survey scores, with BMI category as a covariate. A logistic regression was fit to determine the effect of tuberous breasts on the odds of exhibiting disordered eating behaviors and thoughts (ie, EAT-26 score ≥ 20) before surgery, with BMI category as a covariate. Our analysis allowed for up to 10% missing data for baseline surveys. Power calculations demonstrated that our sample of 298 patients reached the standard of power (0.8) to detect an R^2 of 2.6%. A *P* less than 0.05 was considered significant for all analyses.

RESULTS

Demographics

Thirty-four female patients with unilateral ($N=2$; 6%) or bilateral ($N=32$; 94%) tuberous breasts, and 264 female controls participated in this study. Based on the three-tier classification schema of tuberous breast deformity, 21 patients had the same type bilaterally, whereas 13 patients differed in type bilaterally. With each breast classified individually, there were 31 type I breasts (45.6%), 27 type II breasts (39.7%), and 10 type III breasts (14.7%). Participants in these two cohorts were of similar ages (mean of 16.7 years versus mean of 16.8 years, $P=0.78$; Table 1). Patients with tuberous breast deformity had a significantly higher mean BMI than controls (27.5 kg/m² versus 24.2 kg/m², $P<0.001$). Similarly, a higher proportion of patients with tuberous breasts were overweight or obese ($N=25$, 74%) compared with controls ($N=85$, 32%; $P<0.001$; Fig. 1).

Survey Comparisons

Mean baseline scores were significantly lower among patients with tuberous breasts compared with controls on the RSES and in five of eight SF-36 domains: general

Table 1. Demographic Characteristics of Patients with Tuberous Breast Deformity and Control Participants

| | Tuberous Breast Patients ($N=34$) | Control Patients ($N=264$) | <i>P</i> |
|---|-------------------------------------|------------------------------|----------|
| Mean (SD) age, y | 16.7 (1.7) | 16.8 (2.8) | 0.78* |
| Mean (SD) BMI, kg/m ² | 27.5 (4.2) | 24.2 (6.2) | <0.001* |
| Mean (SD) BMI percentile (only applicable to patients aged <20 y) | 87.3 (10.7) | 67.2 (25.9) | <0.001* |
| BMI category, <i>N</i> (%) | | | <0.001† |
| Underweight | 0 (0) | 2 (1) | |
| Healthy | 9 (26) | 177 (67) | |
| Overweight | 17 (50) | 48 (18) | |
| Obese | 8 (24) | 37 (14) | |
| Race/Ethnicity, <i>N</i> (%) | | | 0.01† |
| White | 18 (53) | 157 (59) | |
| Hispanic | 3 (9) | 12 (5) | |
| Black or African American | 2 (6) | 46 (17) | |
| Asian | 0 (0) | 8 (3) | |
| Other | 0 (0) | 12 (5) | |
| Declined/unable to answer or unknown | 11 (32) | 29 (11) | |

*Two-sided independent samples *t* test.

†Fisher exact test.

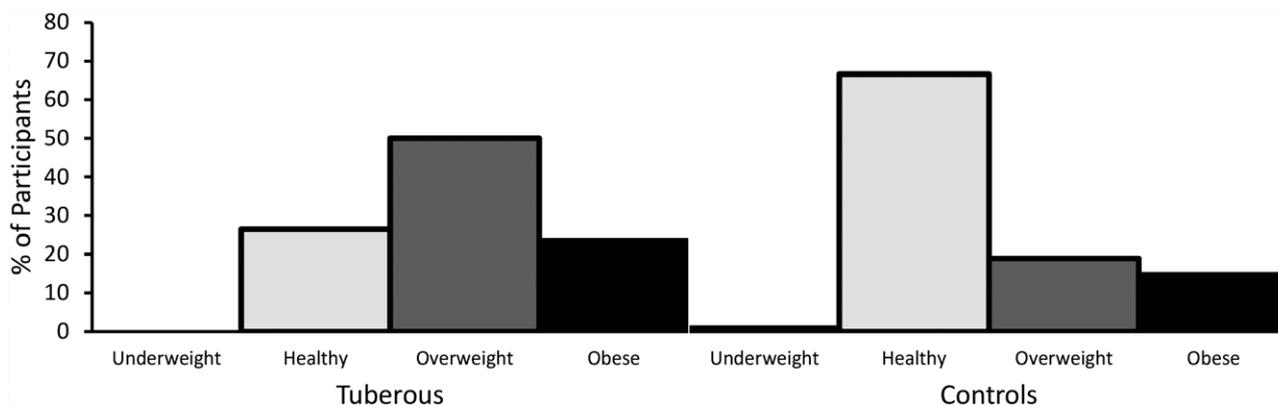


Fig. 1. BMI category distributions for tuberous breast and control groups.

Table 2. Regression Models for the Effect of Tuberous Breasts on Mean Survey Score and Prevalence of Disordered Eating Behaviors and Thoughts

| | Tuberous Breast Patients (N = 34) | Control Patients (N = 264) | P* | β (95% CI) | R ² † | P‡ | β (95% CI) | R ² § |
|---|--------------------------------------|-------------------------------|------------------|----------------------------|------------------|------------------|----------------------------|------------------|
| SF-36 Domains, Mean (SD) | | | | | | | | |
| Physical functioning | 86.8 (22.5) | 90.8 (20.6) | 0.29 | -4.0 (-11.5 to 3.5) | 0.004 | 0.59 | -2.1 (-9.8 to 5.6) | 0.043 |
| Role: physical | 85.2 (21.4) | 90.3 (16.9) | 0.11 | -5.1 (-11.4 to 1.2) | 0.009 | 0.15 | -4.6 (-10.8 to 1.7) | 0.110 |
| Bodily pain | 77.4 (18.0) | 75.7 (18.4) | 0.62 | 1.6 (-4.9 to 8.2) | 0.001 | 0.60 | 1.8 (-5.0 to 8.7) | 0.021 |
| General health | 70.6 (18.6) | 79.1 (18.5) | 0.01 | -8.5 (-15.1 to -1.8) | 0.022 | 0.04 | -6.7 (-13.7 to -0.1) | 0.074 |
| Vitality | 44.6 (16.2) | 51.2 (15.6) | 0.02 | -6.7 (-12.3 to -1.0) | 0.019 | 0.04 | -5.8 (-11.6 to -0.1) | 0.060 |
| Social functioning | 71.0 (23.2) | 84.6 (20.7) | <0.001 | -13.6 (-21.2 to -6.1) | 0.041 | 0.01 | -10.8 (-18.4 to -3.2) | 0.108 |
| Role: emotional | 70.8 (26.8) | 86.1 (18.9) | <0.001 | -15.5 (-22.4 to -8.1) | 0.057 | <0.001 | -14.6 (-22.0 to -7.1) | 0.083 |
| Mental health | 65.0 (19.5) | 75.7 (18.0) | 0.001 | -10.7 (-17.2 to -4.2) | 0.035 | 0.01 | -8.5 (-15.2 to -1.8) | 0.084 |
| RSES, mean (SD) | 28.3 (6.5) | 33.7 (5.4) | <0.001 | -5.4 (-7.4 to -3.4) | 0.088 | <0.001 | -5.3 (-7.4 to -3.2) | 0.119 |
| EAT-26, mean (SD) | 11.4 (11.6) | 6.0 (6.9) | <0.001 | 5.4 (2.6-8.2) | 0.051 | 0.004 | 4.2 (1.4-7.1) | 0.117 |
| | | | P¶ | OR (95% CI) | | P | OR (95% CI) | |
| Disordered eating (EAT-26 ≥ 20), N (%) | 4 (12) | 10 (4) | 0.05 | 3.4 (0.89-10.8) | — | 0.20 | 2.3 (0.58-8.2) | — |

CI, confidence interval; SF-36, Short-Form 36v2.

*P value for linear regression coefficient (β), unadjusted.

†coefficient of determination from linear regression, unadjusted.

‡P value for linear regression coefficient (β), adjusted for BMI category.

§coefficient of determination from linear regression, adjusted for BMI category.

¶P value for logistic regression odds ratio, unadjusted.

||P value for logistic regression odds ratio, adjusted for BMI category.

health, vitality, social functioning, role-emotional, and mental health ($P < 0.05$, all; Table 2). compared with controls, patients with tuberous breasts had a higher mean EAT-26 score (6.0 ± 6.9 versus 11.4 ± 11.6 , $P < 0.001$). A higher proportion of the tuberous breast cohort indicated disordered eating (defined as EAT-26 score ≥ 20), but this difference ($N = 4$, 12% versus $N = 10$, 4%) was not significant ($P = 0.05$). Additionally, the odds of reaching the cutoff for disordered eating did not significantly vary between groups (OR: 3.4; 95% CI: 0.9-10.8; $P = 0.05$). When this logistic regression was performed again after randomly splitting the data 70/30 into training and testing sets, the area under the receiver operating characteristic curve was 0.55.

After adjusting for differences in BMI category between cohorts, baseline scores on the RSES and in five of eight SF-36 domains remained significantly lower among patients with tuberous breasts compared with controls ($P < 0.05$, all). These included general health, vitality, social functioning, role-emotional, and mental health. Additionally, the difference in mean EAT-26 scores between groups remained significant ($P = 0.004$), and the odds of demonstrating disordered eating remained comparable between cohorts (OR: 2.3; 95% CI: 0.6-8.2; $P = 0.20$). When this logistic regression was performed again after randomly splitting the data 70/30 into training and testing sets, the area under the receiver operating characteristic curve was 0.67.

DISCUSSION

To our knowledge, the current study is the first to characterize the HRQoL impact of tuberous breast deformity in adolescents and young women using previously validated surveys, a relatively large sample, and age-matched controls.

This study supports the long-held anecdotal belief that tuberous breast deformity is associated with negative self-perception and lower emotional and psychosocial well-being in affected adolescents and young women relative to unaffected peers.^{2,35-37} In five of the eight SF-36 domains—general health, vitality, social functioning, role-emotional, and mental health—patients with tuberous breast deformity scored lower than controls. These results correspond with negative mental health findings from Papadopoulous et al 2021, the only prior study that has preoperatively collected information on psychosocial well-being specifically in patients with tuberous breasts, though this study only characterized 10 patients.⁵ BMI category did not affect the impact of tuberous breast deformity on these five SF-36 categories. Therefore, the effects of tuberous breast deformity are not mediated solely by weight. The BMI-independent impact of tuberous breast deformity on HRQoL mirrors the psychosocial ramifications of macromastia and breast asymmetry, which have been found to negatively affect emotional well-being and social functioning (among other HRQoL metrics assessed in the SF-36 survey).^{3,4,6,7} These findings provide preliminary evidence that tuberous breast deformity may be associated with similar HRQoL decrements as those of macromastia and breast asymmetry, and therefore, warrants additional care and attention as a potentially harmful “benign” breast difference.

Women with tuberous breast deformity are also thought to experience embarrassment and poor self-image due to their congenital breast difference. Thus far, no objective measurements of these self-esteem issues have been published for either adults or adolescents with tuberous breasts. Our patients with tuberous breast deformity manifested lower RSES scores than controls. This finding

parallels the negative psychosocial scores seen in the SF-36 domains and suggests a possible quantitative connection between tuberous breast deformity and lower self-esteem compared with peers without tuberous breast deformity. After adjusting for BMI category, RSES scores remained significantly lower in patients with tuberous breasts, which suggests that decreased self-esteem in these patients relative to controls is not explained by differences in BMI alone.

There is evidence that young women with other breast differences and conditions, such as breast asymmetry and macromastia, have an increased likelihood of exhibiting disordered eating relative to their unaffected peers.^{3,7} However, a similarly strong association has not been observed in adolescents and young women with tuberous breast deformity. We found patients with tuberous breasts to have a higher mean EAT-26 score than controls, but the odds of exhibiting disordered eating behaviors and thoughts (EAT-26 \geq 20) did not differ between the groups. Notably, EAT-26 scores remained significantly higher in patients with tuberous breasts compared with controls, independent of BMI category, yet both means remained below the threshold indicative of disordered eating attitudes and behaviors. Thus, this association is influenced by factors other than differences in BMI, and further exploration into the roles of self-esteem and body perception are warranted. These findings highlight the importance of screening for disordered eating in patients with tuberous breast deformity regardless of their presenting BMI, especially if similar results of poorer eating attitudes and behaviors manifest from future studies.

To date, there has been no formal analysis of the relationship between BMI and tuberous breasts in adults or adolescents, but several studies report mean BMIs that range from healthy to overweight.^{5,9,10,38,39} Authors have also postulated that the anxieties induced by tuberous breast deformity make affected women less likely to engage in physical activities that involve socialization, such as sports.⁴⁰ Our results associate tuberous breast deformity with higher BMIs, as the majority of affected patients were overweight (50%) and obese (24%), while the minority of controls presented in these categories (18% and 14%, respectively). Therefore, we controlled for BMI category in analyzing HRQoL baseline survey scores.

The impact of tuberous breast deformity on HRQoL, self-esteem, eating behaviors, and BMI elevates the potential value of early corrective interventions in ameliorating these negative health effects. Surgery has been shown to substantially improve HRQoL in women with macromastia or breast asymmetry, which suggests those with tuberous breasts could potentially see similar benefits.^{4,6} In terms of treatment, there is an array of options that depend on a variety of physical features. Procedures are largely divided into two categories (implant-based and autologous), with the latter involving dermoglandular rearrangement and/or fat grafting. Several studies have attempted to compare the postoperative psychosocial benefits of these procedures using the BREAST-Q augmentation and/or reduction/mastopexy modules, as no specific psychometric

measure presently exists for tuberous breast deformity.^{5,9-14} Some of these adult cohort studies have found autologous correction (relative to implant-based) to be associated with greater psychosocial well-being, sexual well-being, and satisfaction with outcomes.^{5,10} However, other evidence suggests psychosocial well-being is greater following implant-based interventions rather than autologous methods.^{10,12} Although these studies offer insight into patients' perspectives on outcomes, in practice, the most appropriate procedure depends heavily on patient-specific factors, such as degree of deformity, grade of asymmetry, age, BMI, and patient expectations regarding volume changes. An often-mentioned limitation of these tuberous correction studies is that they lack preoperative or normative data with which to compare postoperative results.^{12,14} Normative BREAST-Q values for the augmentation and reduction/mastopexy modules have recently been generated, but they are comprised predominantly of middle-aged women, which makes them poorly generalizable for studies in adolescents and young women.^{41,42} This gap in the literature highlights the value of the current study, as it introduces the baseline physical and psychosocial burdens of tuberous breast deformity in young women, which can spur further investigation of these outcomes to better characterize the objective impact of this condition when left untreated.

Due to concerns regarding physical and emotional maturity, as well as potential complications, healthcare professionals and parents may be apprehensive about providing surgical options for adolescents and young adults. Although no study has explored third-party payor coverage for tuberous corrective procedures, coverage rates for the treatment of breast asymmetry—of which tuberous breast deformity is a common comorbidity—are substantially lower than for other benign breast disorders.⁷ This likely serves as a barrier to treatment for many patients given cost considerations. However, the physical and psychosocial metrics explored in the current study provide the first objective evidence that young women with tuberous breasts experience health consequences compared with their unaffected peers. If additional research involving larger samples of tuberous breast patients results in similar findings, this would reaffirm that tuberous breast deformity should not simply be viewed as a cosmetic difference but a tangible condition warranting appropriate medical care and additional academic attention.

The current study is not without its limitations. Patients with tuberous breast deformity and controls featured differences in BMI. Therefore, we adjusted for BMI category in all regression models. Nevertheless, it must be acknowledged that there is considerable unexplained variability remaining in the model even after treating BMI as a covariate, and further research is needed to elucidate the other factors impacting scores. Our analysis allowed for up to 10% missing data, which may have impacted mean survey scores. The patients included represent a young population, and it remains unknown if their HRQoL deficits would persist over time or normalize without treatment as they age. All patients were recruited from an urban, pediatric tertiary care center, which may

affect the generalizability of our findings to populations with other geographic and medical facility characteristics. Additionally, control patients may have had undisclosed breast-related concerns, despite various opportunities to voice them in clinic. This would have subsequently underestimated the psychosocial effects of the tuberous breast condition. Lastly, the current study did not adjust for the different types or severity of tuberous breast reported. Future research is needed to determine if the severity of tuberous breast deformity impacts quality of life outcomes.

CONCLUSIONS

Patients with tuberous breast deformity have significantly lower baseline survey scores in general health, vitality, social functioning, mental health, and self-esteem compared with unaffected, healthy female controls. Objective measures of disordered eating thoughts and behaviors were significantly elevated in young women with tuberous breasts relative to their healthy peers. These findings remained significant even after adjusting for BMI category, which was higher in patients with tuberous breasts relative to controls. Healthcare providers should be aware of the potential physical and psychosocial impact of tuberous breast deformity. If further investigation with larger samples of tuberous breast patients yields similar results, clinicians may also consider regularly screening for disordered eating in affected patients. Moreover, early intervention with corrective procedures may serve as a countermeasure for these proposed health consequences, and further studies into the pre- to postoperative changes in HRQoL following surgical interventions are warranted.

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