

Intergender Anthropometric Comparison of the Nipple-Areola Complex

Comparação antropométrica intergêneros do complexo areolopapilar

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Abstract

Introduction The nipple-areola complex (NAC) plays a fundamental role in the esthetic and functional harmony of the thoracic region, with direct implications for procedures such as gender-affirming surgeries, postbariatric breast reconstructions, and gynecomastia treatments. Although the literature contains several reports on female parameters, data on male NAC remain scarce, hindering proper surgical planning.

Materials and Methods The present cross-sectional study included 440 male subjects aged 18 to 47 years with a body mass index (BMI) from 18 to 30 kg/m². The measurements included the internipple distance, the nipple-to-sternal notch distance, the NAC-to-inframammary fold (NAC-IMF) distance, and the horizontal and vertical dimensions of the NAC. We compared the data with the female parameters reported in the literature using descriptive and inferential statistics to assess significant differences.

Results The male NAC exhibited a greater internipple distance and a more inferior and lateralized positioning than the female NAC. The oblong shape of the male NAC contrasted with the circular pattern observed in females. The NAC-IMF distance was shorter in men than in women.

Conclusion The observed differences reinforce that female parameters are not suitable to guide male surgeries. The current study establishes specific guidelines for the male NAC, contributing to more precise and individualized outcomes in gender-affirming surgeries, breast reconstructions, and gynecomastia treatments, offering an innovative foundation for the clinical practice.

Keywords

- ▶ anthropometry
- ▶ gender dysphoria
- ▶ gynecomastia
- ▶ mammaplasty
- ▶ transsexualism

Study performed at the Department of Plastic and Reparative Surgery, Hospital Central do Exército, Rio de Janeiro, RJ, and at the Department of Surgery, Escola Paulista de Medicina, Universidade Federal de São Paulo (UNIFESP), São Paulo, SP, Brazil.

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Resumo

Introdução O complexo areolopapilar (CAP) desempenha papel fundamental na harmonia estética e funcional da região torácica, com implicações diretas em procedimentos como cirurgias de gênero, reconstruções mamárias pós-bariátricas e tratamentos de ginecomastia. Apesar de os parâmetros femininos estarem amplamente descritos na literatura, os dados masculinos permanecem escassos, o que dificulta o planejamento cirúrgico adequado.

Materiais e Métodos Foi realizado um estudo transversal com 440 indivíduos do sexo masculino, com idades entre 18 e 47 anos e índice de massa corporal (IMC) entre 18 e 30 kg/m². Foram coletadas medidas como distância entre os mamilos, distância mamilo-fúrcula, distância CAP-sulco inframamário (SIM) e dimensões horizontal e vertical do CAP. Os dados foram comparados com os parâmetros femininos descritos na literatura, e estatísticas descritivas e inferenciais foram utilizadas para avaliar diferenças significativas.

Resultados O CAP masculino apresentou maior distância entre os mamilos e um posicionamento mais inferior e lateralizado em relação ao feminino. O formato oblongo do CAP masculino contrastou com o padrão circunferencial feminino. A distância CAP-SIM foi menor nos homens comparada à das mulheres.

Conclusão As diferenças observadas reforçam que os parâmetros femininos não são adequados para orientar cirurgias masculinas. Este estudo estabelece diretrizes específicas para o CAP masculino, o que contribui para resultados mais precisos e individualizados em cirurgias de gênero, reconstruções mamárias e tratamentos de ginecomastia, e oferece uma base inovadora para a prática clínica.

Palavras-chave

- antropometria
- ginecomastia
- identidade de gênero
- mamoplastia
- transexualidade

Introduction

The analysis of the nipple-areola complex (NAC) is a plastic surgery mainstay, playing a significant role ranging from esthetic procedures to complex reconstructions. Although the anthropometric parameters of female NAC are widely documented and used as a reference in the clinical practice, data regarding male NAC remain limited and scattered in the literature. This disparity highlights the need for studies that clarify male morphological characteristics, contextualizing these measurements regarding the widely-established female values.

The anthropometric standards of the female NAC are fundamental guides in breast augmentation, reduction, and reconstruction surgeries,¹⁻³ and they have undergone validation in different populations. These studies have identified specific proportions, such as the ideal distances from the nipple to the sternal notch and to the inframammary fold (IMF), which are widely used in the surgical practice. In contrast, the male NAC presents unique challenges, requiring an approach considering the lack of breast volume and the need for harmony in a flat chest. Recent work^{4,5} suggests using predictive algorithms to optimize male NAC positioning and dimensions based on individual measurements.

The present study aims to fill a critical gap by comparing, for the first time, male anthropometric parameters and female standards established in the literature. Our methodology associates original data from a representative male

sample with the most cited female references, facilitating an intergender analysis with implications that extend beyond traditional surgical applications. In addition to contributing to the improvement of anatomical knowledge, the data provide support for advances in gender affirmation surgeries, postbariatric breast reconstructions, and gynecomastia correction.

The integration of comparative analyses between genders enables the formulation of updated guidelines for esthetic and restorative interventions, meeting the growing demand for evidence-based practices that consider individual and gender-specific needs. Thus, we propose a critical review and redefine metrics to support excellent practice in contemporary plastic surgery.

Objective

The current study aims to perform a comparative analysis of the anthropometric parameters of the male NAC obtained from original data and the references established in the literature on the female NAC.

Materials and Methods

Study Design

The present is an observational, descriptive, and cross-sectional study. The investigation included primary data collection among male subjects and a systematic literature review

to consolidate the female parameters widely used in the clinical practice.

Literature Review

We performed a systematic review in the PubMed, Scopus, and Web of Science databases with the descriptors *female nipple-areola complex anthropometry*, *breast measurements*, *reconstruction surgery*, and *mammoplasty*. We included studies from the last 20 years containing clear information on NAC distances to the sternal notch and IMF, areolar diameter, and intermammary distance. We excluded studies presenting non-quantitative data or non-representative samples.

Established Standards for the Female NAC

- Vandeput and Nelissen⁶ (2002) reported the distance from the nipple to the sternal notch as ranging from 19 to 21 cm and the internipple distance, from 18 to 22 cm.
- Tepper et al.² (2010) described the average diameter of the areola ranging from 4.2 to 4.5 cm.
- De la Torre and Davis⁷ (2015) reported the distance between the nipple and IMF ranging from 5 to 6 cm.

Male Data Collection

Inclusion Criteria

- Males aged 18 to 47 years.
- Body mass index (BMI) from 18 to 30 kg/m².
- Absence of previous thoracic surgeries, trauma, congenital deformities, or gynecomastia.

Exclusion Criteria

- Previous use of hormone therapies.
- Presence of chronic diseases or abnormalities potentially interfering with measurements.

Procedure

- The measurements were performed with the participants in an upright position with the arms relaxed.
- We used a high-precision flexible tape measure.
- A single trained evaluator performed all measurements, minimizing interobserver bias.

Location

- Measurements occur at the Brazilian Army Paratrooper Brigade in a controlled environment (24 °C) to prevent changes due to room temperature.

Collected Measurements

1. NAC measurements

- Vertical diameter of the areola (in centimeters).
- Horizontal diameter of the areola (in centimeters).

2. Body Proportions and Distances

- Internipple distance
- Distance from the nipple to the clavicle, sternal notch, and IMF (right and left sides)

- Humerus length (right and left sides)
- Distance from the sternal notch to the umbilicus
- Circumference of the chest, waist, neck, biceps, forearm, and wrist (right and left sides)
- Height and body weight.

Statistical Analysis

- We tabulated the data in Microsoft Excel (Microsoft Corp.) spreadsheets and analyzed it using the IBM SPSS Statistics for Windows (IBM Corp.) software.
- We calculated means, standard deviations, and 95% CIs for each variable.
- The comparison between the male data and the female data described in the literature used the Student's *t*-test for independent samples.
- The Mann-Whitney U test was used to compare non-parametric variables or those with asymmetric distribution.
- The significance level was set at $p < 0.05$.

Ethical Considerations

- All participants signed an informed consent form in accordance with the ethical guidelines for research involving human beings.
- The study was approved by the Central Army Hospital Study Center, which waived the need for review by a formal ethics committee due to the descriptive and non-interventionist nature of the study.

Results

Study Participants

The sample consisted of **440 male participants** aged 18 to 47 years and with a BMI ranging from 18 to 30 kg/m².

After excluding subjects with chest or nipple deformities, we included **401 participants** in the analysis.

Systemic Diseases

- **Number of participants with systemic diseases:** 11 (2.5%).
- **Reported conditions**
 - Rhinitis/Sinusitis/Bronchitis/Asthma: 7 cases.
 - Diabetes: 1 case.
 - Rheumatic fever: 1 case.
 - Leukemia: 1 case.
 - Systemic arterial hypertension: 1 case.

Physical Activity

- **Number of participants practicing regular physical activity:** 439 (99.8%).
- **Number of participants not practicing regular physical activity:** 1 (0.2%).

Smoking and Drinking Habits

- **Smokers:** 35 (8%).
- **Non-smokers:** 405 (92%).
- **Alcohol drinkers:** 169 (38.4%).

- **Non-alcohol drinkers:** 271 (61.6%).

Thoracic Deformities

- **Number of participants with thoracic deformities:** 29 (6.6%).
- **Reported deformities**
 - *Pectus excavatum*: 8 cases.
 - *Pectus carinatum*: 5 cases.
 - Asymmetry of the costal margin, more prominent on the right side: 3 cases.
 - Asymmetry of the right parasternal depression: 2 cases.
 - Other isolated types: 11 cases.

Other NAC Deformities

Number of participants with NAC deformities: 39 (8.9%).

Age Range

- 18 to 25 years: 416 participants (94.5%).
- 26 to 35 years: 20 participants (4.5%).
- 36 to 47 years: 1 participant (0.2%).

BMI Range

- Low body weight (< 18.5 kg/m²): 2 participants (0.5%).
- Regular body weight (18.5–24.9 kg/m²): 324 participants (73.6%).
- Overweight (25–29.9 kg/m²): 101 participants (23%).

Mean General Male NAC Data

The mean and standard deviation values of the data obtained after excluding subjects with chronic diseases or structural changes that compromise the analysis of anthropometric measurements are the following:

Internipple distance (►Fig. 1)

- **Mean:** 21.7 cm.
- **Standard deviation:** 1.6 cm.

Nipple-Sternal Notch Distance (►Fig. 1)

- **Mean:** 18.8 cm.
- **Standard deviation:** 1.3 cm.

NAC-IMF Distance (►Fig. 2)

- **Mean:** 4.1 cm.
- **Standard deviation:** 0.9 cm.

NAC Diameter (►Fig. 3)

- **Horizontal:**
 - **Mean:** 2.9 cm.
 - **Standard deviation:** 0.4 cm.
- **Vertical:**
 - **Mean:** 2.1 cm.
 - **Standard deviation:** 0.4 cm.

Clavicle-NAC Distance (►Fig. 2):

- **Mean:** 18.7 cm.
- **Standard deviation:** 1.5 cm.

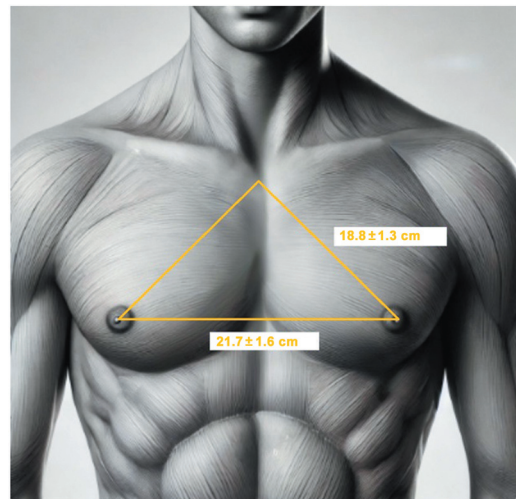


Fig. 1 Mean sternal notch-nipple-areola complex (NAC) and inter-NAC distances in male individuals.

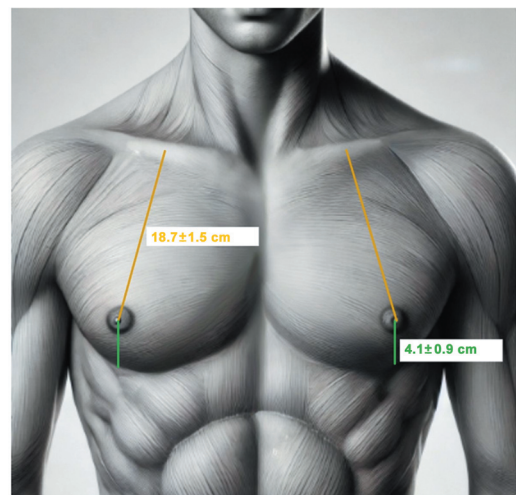


Fig. 2 Mean clavicle- NAC (in yellow) and NAC-inframammary fold (IMF) (in green) distances in male individuals.

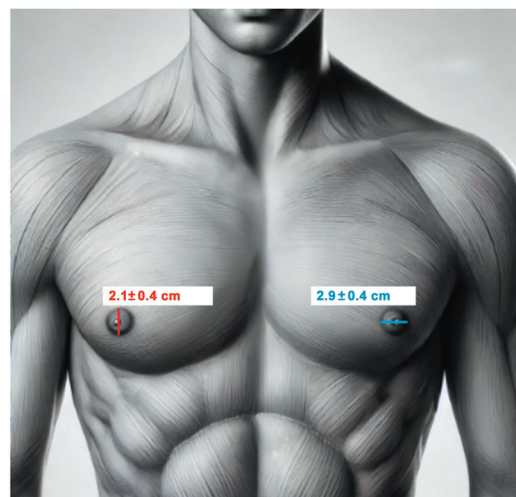


Fig. 3 Mean vertical (in red) and horizontal diameters (in blue) in male individuals.

Male Data Segmentation

1. NAC-related Patterns:

- **NAC Distances**
 - Internipple, nipple-sternal notch, and nipple-IMF distances are relatively consistent, with variations associated with BMI, height, or chest width (►Tables 1, 3).
 - Subjects with greater chest width tend to have greater internipple distances (►Table 3).

NAC (Horizontal and Vertical) Dimensions

- NAC dimensions remain stable across the different ranges of thoracic height and width, indicating the potential standardization of these measurements (►Tables 1–3).

2. Patterns per Group:

- **BMI**
 - Subjects with higher BMI often have greater internipple distance and larger chest circumference (►Table 2).
 - Differences in the nipple-sternal notch or nipple-IMF distances are smaller, suggesting that these measurements remain stable across BMIs.
- **Age Range**
 - Age groups did not present significant NAC measurement variations, indicating that age may not be a determining factor within the limits evaluated.

3. Measurement Correlations:

- **Height and BMI**
 - There were significant correlations involving height and internipple distance, chest width, and chest circumference (►Tables 1, 3).
 - These relationships suggest the potential adjustment of predictive models for NAC distances and dimensions based on these variables.

4. Applications:

Based on these patterns:

1. **Measurement standardization:** The stability in NAC dimensions across different subgroups suggests the feasibility of creating reference values.
2. **Predictive modeling:** It is possible to develop models based on variables such as height, BMI, and chest width to estimate NAC measurements.
3. **Clinical impact:** These standards can guide reconstructive or cosmetic surgeries, especially in cases of gynecomastia or gender-affirming procedures.

Discussion

The results of the current study highlight the need for an intergender anthropometric approach to the NAC, emphasizing fundamental differences between male and female standards and their implications for the surgical practice. Comparing the male data from the present study with the female parameters established in the literature,

Table 1 Correlation among height in meters and the measurements in centimeters of the clavicle-NAC, sternal notch-NAC, inter-NAC, NAC-IMF distances, and NAC diameters in male individuals

Height range	Clavicle-NAC distance (R): mean $\pm$ SD	Clavicle-NAC distance (L): mean $\pm$ SD	Sternal notch-NAC distance (R): mean $\pm$ SD	Sternal notch-NAC distance (L): mean $\pm$ SD	Sternal notch-NAC distance (L): mean $\pm$ SD	Vertical NAC diameter (R): mean $\pm$ SD	Vertical NAC diameter (L): mean $\pm$ SD	Horizontal NAC diameter (R): mean $\pm$ SD	Horizontal NAC diameter (L): mean $\pm$ SD	Inter-NAC distance: mean $\pm$ SD	NAC-IMF distance (R): mean $\pm$ SD	NAC-IMF distance (L): mean $\pm$ SD
< 1.67	17.8 $\pm$ 1.4	17.9 $\pm$ 1.3	17.8 $\pm$ 1.1	17.9 $\pm$ 1.2	17.9 $\pm$ 1.2	2 $\pm$ 0.3	2 $\pm$ 0.3	2.8 $\pm$ 0.5	2.8 $\pm$ 0.5	20.7 $\pm$ 1.5	3.4 $\pm$ 0.6	3.6 $\pm$ 0.6
1.67–1.76	18.3 $\pm$ 1.5	18.5 $\pm$ 1.4	18.4 $\pm$ 1.3	18.5 $\pm$ 1.3	18.5 $\pm$ 1.3	2 $\pm$ 0.4	2 $\pm$ 0.4	2.9 $\pm$ 0.4	2.9 $\pm$ 0.4	21.5 $\pm$ 1.5	4 $\pm$ 0.8	4 $\pm$ 0.9
1.77–1.87	19.1 $\pm$ 1.6	19.4 $\pm$ 1.5	19.2 $\pm$ 1.4	19.4 $\pm$ 1.4	19.4 $\pm$ 1.4	2.1 $\pm$ 0.4	2.1 $\pm$ 0.4	3 $\pm$ 0.4	3 $\pm$ 0.4	22.1 $\pm$ 1.7	4.3 $\pm$ 1	4.3 $\pm$ 0.9
> 1.87	19 $\pm$ 1.5	19.1 $\pm$ 1.5	19.2 $\pm$ 1.5	19.3 $\pm$ 1.7	19.3 $\pm$ 1.7	2.1 $\pm$ 0.2	2 $\pm$ 0.3	2.9 $\pm$ 0.3	2.8 $\pm$ 0.3	23.4 $\pm$ 3.2	4.5 $\pm$ 0.7	4.5 $\pm$ 0.9

Abbreviations: IMF; inframammary fold; L, left side; NAC, nipple-areola complex; R, right side; SD, standard deviation.

Table 2 Correlation among thorax circumference and the clavicle-NAC, sternal notch-NAC, inter-NAC, NAC-IMF distances, and NAC diameters in centimeters in male individuals

Thorax circumference	Clavicle-NAC distance (R): mean $\pm$ SD	Clavicle-NAC distance (L): mean $\pm$ SD	Sternal notch-NAC distance (R): mean $\pm$ SD	Sternal notch-NAC distance (L): mean $\pm$ SD	Inter-NAC distance: mean $\pm$ SD	NAC-IMF distance (R): mean $\pm$ SD	NAC-IMF distance (L): mean $\pm$ SD	Vertical NAC diameter (R): mean $\pm$ SD	Vertical NAC diameter (L): mean $\pm$ SD	Horizontal NAC diameter (R): mean $\pm$ SD	Horizontal NAC diameter (L): mean $\pm$ SD
< 83	16.7 $\pm$ 1	16.9 $\pm$ 0.9	17.1 $\pm$ 0.8	17.2 $\pm$ 0.9	19.5 $\pm$ 1.2	3.5 $\pm$ 0.6	3.5 $\pm$ 0.6	2 $\pm$ 0.2	2 $\pm$ 0.3	2.7 $\pm$ 0.4	2.8 $\pm$ 0.4
83–90	18 $\pm$ 1.2	18.2 $\pm$ 1.1	18.4 $\pm$ 1.2	18.2 $\pm$ 1.1	21 $\pm$ 1.3	4.1 $\pm$ 0.9	4.1 $\pm$ 0.9	2 $\pm$ 0.4	2 $\pm$ 0.4	2.8 $\pm$ 0.4	2.8 $\pm$ 0.4
91–100	19.2 $\pm$ 1.4	19.3 $\pm$ 1.2	19.3 $\pm$ 1.2	19.3 $\pm$ 1.2	22.3 $\pm$ 1.5	4.1 $\pm$ 0.9	4.1 $\pm$ 0.9	2.1 $\pm$ 0.4	2.1 $\pm$ 0.4	3 $\pm$ 0.4	3 $\pm$ 0.4
> 100	20 $\pm$ 1.2	20.2 $\pm$ 1.2	20.1 $\pm$ 1.1	20.2 $\pm$ 1.2	24 $\pm$ 1.5	4.5 $\pm$ 0.8	4.5 $\pm$ 1	2.3 $\pm$ 0.4	2.3 $\pm$ 0.4	3.2 $\pm$ 0.5	3.2 $\pm$ 0.5

Abbreviations: IMF; inframammary fold; L, left side; NAC, nipple-areola complex; R, right side; SD, standard deviation.

Table 3 Correlation among thorax width and the clavicle-NAC, sternal notch-NAC, inter-NAC, NAC-IMF distances, and NAC diameters in centimeters in male individuals

Thorax width	Clavicle-NAC distance (R): mean $\pm$ SD	Clavicle-NAC distance (L): mean $\pm$ SD	Sternal notch-NAC distance (R): mean $\pm$ SD	Sternal notch-NAC distance (L): mean $\pm$ SD	Inter-NAC distance: mean $\pm$ SD	NAC-IMF distance (R): mean $\pm$ SD	NAC-IMF distance (L): mean $\pm$ SD	Vertical NAC diameter (R): mean $\pm$ SD	Vertical NAC diameter (L): mean $\pm$ SD	Horizontal NAC diameter (R): mean $\pm$ SD	Horizontal NAC diameter (L): mean $\pm$ SD
< 27	16.2 $\pm$ 0.3	16.3 $\pm$ 0.6	16.8 $\pm$ 0.3	16.8 $\pm$ 0.8	20.8 $\pm$ 0.8	4.5 $\pm$ 0.3	4.3 $\pm$ 0.3	2.1 $\pm$ 0.4	2 $\pm$ 0.3	2.8 $\pm$ 0.3	2.8 $\pm$ 0.3
27–31	17.9 $\pm$ 1.3	18.1 $\pm$ 1.3	18.1 $\pm$ 1.1	18.2 $\pm$ 1.1	20.9 $\pm$ 1.3	3.9 $\pm$ 0.9	3.9 $\pm$ 0.9	2 $\pm$ 0.4	2 $\pm$ 0.4	2.8 $\pm$ 0.4	2.8 $\pm$ 0.4
32–37	19 $\pm$ 1.4	19.1 $\pm$ 1.3	19 $\pm$ 1.3	19.1 $\pm$ 1.3	22.1 $\pm$ 1.7	4.2 $\pm$ 0.9	4.2 $\pm$ 0.9	2.1 $\pm$ 0.4	2.1 $\pm$ 0.4	2.9 $\pm$ 0.4	2.9 $\pm$ 0.4
> 37	20.1 $\pm$ 1.4	20.3 $\pm$ 1.4	20.1 $\pm$ 1.3	20.4 $\pm$ 1.2	24.2 $\pm$ 1.3	4.3 $\pm$ 1	4.4 $\pm$ 1	2.2 $\pm$ 0.3	2.1 $\pm$ 0.4	3.2 $\pm$ 0.5	3.2 $\pm$ 0.4

Abbreviations: IMF; inframammary fold; L, left side; NAC, nipple-areola complex; R, right side; SD, standard deviation.

it is evident that the morphology of the male NAC requires specific guidelines for esthetic and reconstructive interventions.^{1-3,8}

The comparative analysis revealed statistically significant differences between genders in terms of several variables. The mean internipple distance was greater in males (21.7 ± 1.6 cm) (►Fig. 1) than in females (18 – 22 cm) (►Fig. 4).^{1,2} The mean nipple-sternal notch distance was shorter in men (18.8 ± 1.3 cm) (►Fig. 1) than in women (19,1 – 21,1 cm) (►Fig. 4),⁷ with $p < 0.001$. The mean NAC-IMF distance was also significantly shorter in the male group (4.1 ± 0.9 cm) (►Fig. 2) than in women (5–6 cm) (►Fig. 5).⁷ The mean NAC diameter showed lower values in men, with a mean horizontal diameter of 2.9 ± 0.4 cm and a mean vertical diameter of 2.1 ± 0.4 cm (►Fig. 3), compared with the mean female measurements of 4,2 cm and 4,5 cm respectively (►Fig. 6).^{1,2} Furthermore, the mean clavicle-NAC distance was shorter in men (18.7 ± 1.5 cm) (►Fig. 2) than in women (19 – 21 cm) (►Fig. 5).^{1,7}

In addition to the distance measurements, the shape of the male NAC was predominantly oblong, contrasting with the circumferential pattern observed in women.^{9,10} This difference is crucial, as male surgeries often use instruments and techniques based on female standards, potentially leading to unsatisfactory outcomes, such as asymmetries and disproportions.

Studies in women often indicate NACs centered on the breast, while the data herein presented show that the male NAC positioning tends to be more inferior and lateralized.^{11,12} This discrepancy reinforces the inadequacy of adopting female standards as a reference for male interventions and highlights the significance of establishing specific and validated male parameters.

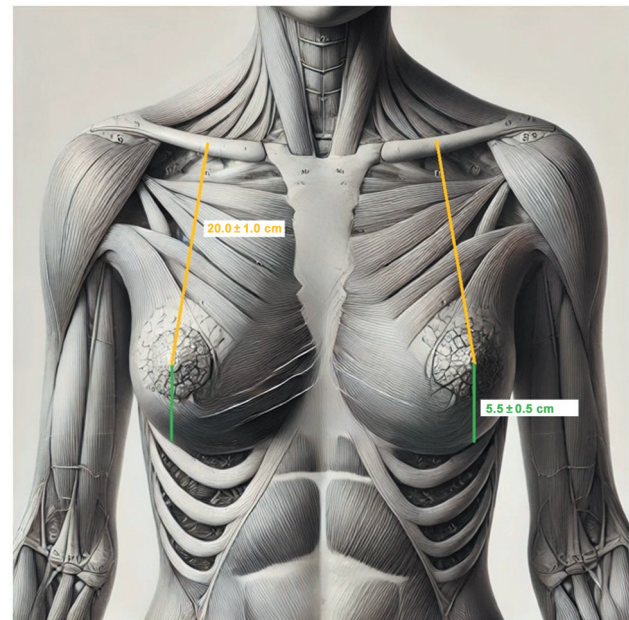


Fig. 5 Mean clavicle-NAC (in yellow) and NAC-IMF (in green) distances in female individuals.

The choice of a sample composed of healthy, mixed-race Brazilian subjects with no thoracic deformities provided the study with methodological robustness and clinical relevance, enabling the identification of consistent patterns with potential international applicability. Additionally, we observed the influence of variables such as height and BMI on NAC positioning and dimensions, indicating the need for personalized surgical procedures.

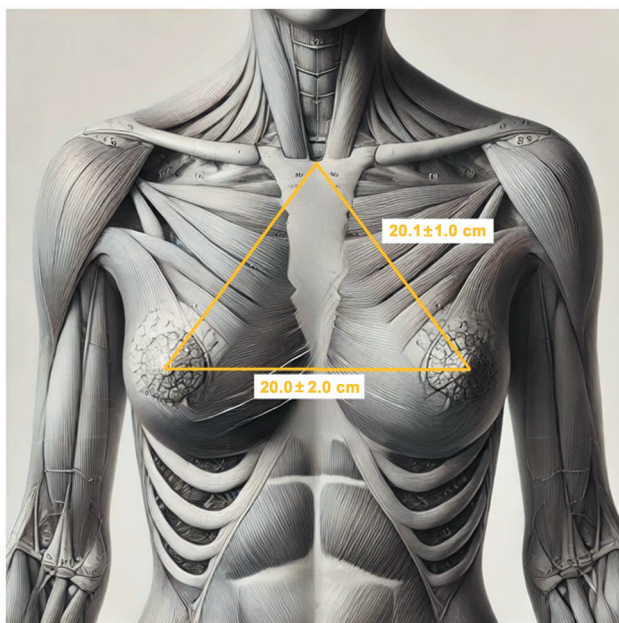


Fig. 4 Mean sternal notch-NAC and inter-NAC distances in female individuals.

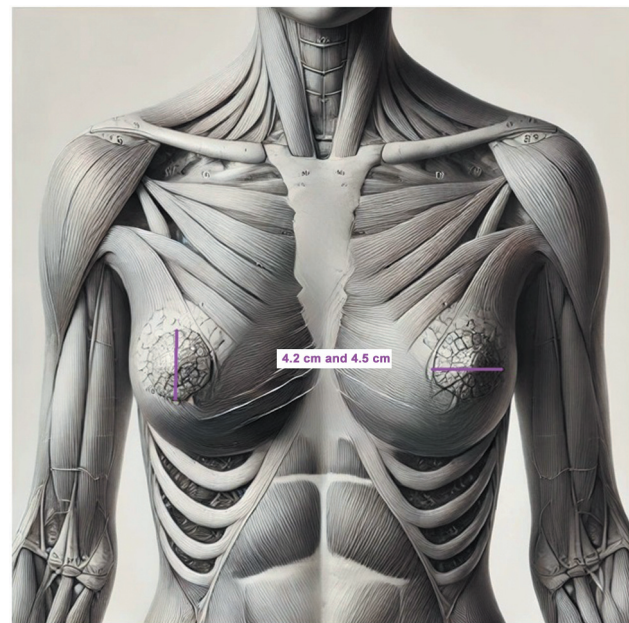


Fig. 6 Vertical and horizontal diameters (in lavenders) in female individuals.

The findings contribute significantly to improving approaches in gender surgery, postbariatric reconstructions, and gynecomastia treatments, highlighting the importance of individualized planning based on male anthropometric evidence. Future studies are recommended to expand sampling and explore ethnic and morphological variations to refine clinical guidelines applicable to the contemporary surgical practice.

Conclusion

The present comparative study of the anthropometric parameters of the male NAC and the female references established in the literature revealed essential differences and similarities applicable to the surgical practice. While both genders share general proportions that ensure thoracic harmony, they present significant differences regarding NAC distances, shapes, and positioning.

The male NAC had a greater internipple distance and a more inferior and lateralized positioning than the female NAC. Additionally, the oblong shape of the male NAC contrasted with the circumferential female pattern, emphasizing the inadequacy of applying female measurements as a direct reference in male surgeries. These findings reinforce the need for specific guidelines for the male NAC respecting its unique anatomical characteristics.

By exploring the implications of these differences, the current study contributes significantly to the improvement in surgical practices in contexts such as gender surgery, postbariatric breast reconstruction, and gynecomastia treatments. The adoption of evidence-based male anthropometric parameters can improve esthetic and functional outcomes, promoting greater accuracy and patient satisfaction.

Therefore, the present study not only fills a gap in the literature by presenting a robust comparative model but also provides an innovative foundation for advances in the clinical practice, highlighting the importance of tailored and evidence-based approaches for excellence in plastic surgery.

Clinical Trials

None.

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Conflict of Interests

The authors have no conflict of interests to declare.

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