

Patient-reported outcomes in masculinizing gender-affirming chest surgery: validation of the GENDER-Q Chest scales

Caleb Haley ^{1†}, Shane D. Morrison^{2†}, Manraj N. Kaur³, Charlene Rae ⁴, Megan Lane¹, Danny A. Young-Afat^{5,6}, Tim C. van de Grift ⁵, Nicola R. Dean ⁷, Kathleen A. Armstrong⁸, Devin Coon⁹, Zac A. Cannell¹⁰, Christian X. Lava¹¹, Sylvie D. Cornacchi⁴, Alexis Laungani¹², Margriet G. Mullender ⁵, Jens A. Sørensen¹³, Lotte Poulsen ¹³, Jack G. Graesser¹³, Thomas Satterwhite⁶, Allison C. Hu⁶, Gerhard S. Mundinger¹⁴, Hilliard T. Brydges², Jessica J. Hsu¹, Blair R. Peters¹⁵, Jens U. Berli¹⁵, Christodoulos Kaoutzanis¹⁶, Nargis Kalia¹⁷, Rachel Bluebond-Langner¹⁸, Oren Ganor¹⁹, Alireza Hamidian Jahromi²⁰, Bashar A. Hassan²¹, Fan Liang²¹, John H. Pang⁶, Edward C. Ray²², Gabriel A. Del Corral²³, Kenneth L. Fan¹¹, Lily R. Mundy²¹, Andrea L. Pusic⁹ and Anne F. Klassen ^{4*}

¹Section of Plastic Surgery, Department of Surgery, University of Michigan, Ann Arbor, Michigan, USA

²Division of Plastic Surgery, Department of Surgery, University of Washington Medical Center, Seattle, Washington, USA

³Patient-Reported Outcomes, Value, & Experience Center (PROVE), Mass General Brigham, Harvard Medical School, Boston, Massachusetts, USA

⁴Department of Pediatrics, McMaster University, Hamilton, Ontario, Canada

⁵Department of Plastic, Reconstructive, and Hand Surgery, Amsterdam University Medical Centre, Amsterdam, The Netherlands

⁶Align Surgical Associates Inc., San Francisco, California, USA

⁷College of Medicine and Public Health, Flinders University, Bedford Park, South Australia, Australia

⁸Department of Surgery, Women's College Hospital, Toronto, Ontario, Canada

⁹Division of Plastic and Reconstructive Surgery, Department of Surgery, Brigham and Women's Hospital, Mass General Brigham, Boston, Massachusetts, USA

¹⁰Trans Health South Australia, Flinders Medical Centre, Bedford Park, South Australia, Australia

¹¹Department of Plastic and Reconstructive Surgery, MedStar Georgetown University Hospital, Washington DC, USA

¹²Plastic Surgery Division, GrS Montréal, Montreal, Quebec, Canada

¹³Research Unit for Plastic Surgery, University of Southern Denmark, Odense, Denmark

¹⁴Crane Center for Transgender Surgery, Austin, Texas, USA

¹⁵Division of Plastic and Reconstructive Surgery, Department of Surgery, Oregon Health and Science University, Portland, Oregon, USA

¹⁶Division of Plastic and Reconstructive Surgery, Department of Surgery, University of Colorado, Anschutz Medical Campus, Aurora, Colorado, USA

¹⁷Department of Surgery, University of Colorado, Anschutz Medical Campus, Aurora, Colorado, USA

¹⁸Hansjörg Wyss Department of Plastic Surgery, NYU Grossman School of Medicine, New York, New York, USA

¹⁹Department of Plastic and Oral Surgery, Boston Children's Hospital, Boston, Massachusetts, USA

²⁰Department of Plastic and Reconstructive Surgery, Lewis Katz School of Medicine at Temple University, Philadelphia, Pennsylvania, USA

²¹Department of Plastic and Reconstructive Surgery, Johns Hopkins Medicine, Baltimore, Maryland, USA

²²Department of Surgery, Cedars-Sinai Medical Center, Los Angeles, California, USA

²³Department of Plastic and Reconstructive Surgery, MedStar Franklin Square Medical Center, Baltimore, Maryland, USA

*Correspondence to: Anne F. Klassen, Department of Pediatrics, McMaster University, 1280 Main Street West, Hamilton, Ontario, L8N 3Z5, Canada (e-mail: aklass@mcmaster.ca)

†. Joint first authors (contributed to the work equally)

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Abstract

Background Masculinizing gender-affirming chest surgery is the most frequently accessed type of gender-affirming procedure. The GENDER-Q Chest scales were developed to better assess patient-reported outcomes in masculinizing gender-affirming chest surgery, yet previous psychometric assessment of these scales is limited. The aim of this study was to assess the construct validity of the GENDER-Q Chest scales (Chest, Nipples & Areolas, and Scars).

Methods An international, cross-sectional study was performed to develop the GENDER-Q between February 2022 and March 2024. Individuals were included in this analysis if they had sought or received masculinizing gender-affirming chest surgery and completed the GENDER-Q Chest scale. Construct validity was assessed for each scale by testing a priori hypotheses. According to Consensus-based Standards for the Selection of Health Measurement Instruments guidelines, at least 75% acceptance of hypotheses indicates sufficient evidence of construct validity.

Results A total of 2846 participants completed the GENDER-Q Chest scale. For the GENDER-Q Chest, Nipples & Areolas, and Scars scales, 95% (21 of 22), 79% (15 of 19), and 100% (12 of 12) of hypotheses were accepted for each scale respectively. Patients who had undergone surgery and did not need revisions at survey completion reported the highest satisfaction, while patients who had not yet undergone surgery reported the lowest satisfaction.

Conclusion The GENDER-Q Chest scales evidenced construct validity to measure appearance of chest, nipples and areolas, and scars for individuals seeking or undergoing masculinizing gender-affirming chest surgery. The GENDER-Q Chest scales provide a robust, validated approach for assessing outcomes in this context and are well suited for generating high-quality evidence on patient-reported outcomes.

Lay summary

Masculinizing gender-affirming chest surgery is a common gender-affirming procedure for transgender and gender-diverse people who want their chest to better match their gender identity. The GENDER-Q Chest scales are questionnaires that measure satisfaction with chest appearance, nipples, and scars. Before questionnaires like these can be used widely, they need to be tested to ensure they accurately measure what they intend to measure. This form of testing is called construct validation. In a study of 2846 participants from multiple countries, the GENDER-Q Chest scales showed strong construct validity. This means that the GENDER-Q provides trustworthy tools that can produce high-quality evidence that can be used to improve surgical care for transgender and gender-diverse people undergoing these procedures.

Introduction

Gender-affirming care is essential for the estimated 1–3% of individuals worldwide who identify as transgender or gender-diverse (TGD)¹. Over the past 15 years, gender-affirming surgical procedures have increased substantially, with masculinizing gender-affirming chest surgery being the most common². There is growing interest in understanding the outcomes from these procedures, including calls for higher-quality research from patients, providers, and policymakers alike^{3–5}. Patient-reported outcome measures (PROMs) are increasingly used to evaluate outcomes that matter most to patients⁶. These tools are valuable because conventional surgical metrics, such as complication rates, length of stay, and reoperation rates, often fail to measure outcomes related to individual patient goals and therefore may not capture the true impact of these procedures on patients' lives⁷.

Previous PROM studies of masculinizing gender-affirming chest surgery report far-reaching benefits, including improved satisfaction with appearance, body image, quality of life, and psychosocial outcomes, with low rates of regret^{8–15}. Despite these positive results, systematic reviews examining how patient-reported outcomes (PROs) are measured in gender-affirming surgery have demonstrated that the current literature relies on a range of instruments, most of which were not designed or validated for use in TGD populations undergoing gender-affirming surgery^{16–18}. Using PROMs not specifically designed for the population of interest, and PROMs that lack psychometric evidence, weakens the credibility of findings, complicates clinical application, and hinders care

guideline development¹⁹. The lack of standardized PROMs also limits data comparison across studies. In response, the GENDER-Q was created to provide a comprehensive and globally applicable instrument to measure PROs across the spectrum of gender-affirming care^{6,20–22}. Prior work demonstrated strong psychometric evidence for the GENDER-Q Chest scales, including content validity, internal consistency, and test-retest reliability (*Table S1*)²². However, comprehensive evaluation of construct validity had not been completed, which is crucial for confirming a PROM's clinical value. Construct validity refers to how accurately an instrument measures its intended theoretical concept^{23,24}.

The aim of this study was to provide evidence for the construct validity of the three GENDER-Q Chest scales that measure appearance of the chest, nipples and areolas, and scars. Hypothesized relationships of these three scales with clinical variables and other GENDER-Q scales were evaluated to establish their validity for assessing chest satisfaction in masculinizing gender-affirming chest surgery.

Methods

Data source

A cross-sectional study was conducted to develop and validate the GENDER-Q through an international field test²². Ethical approval was obtained from the Hamilton Integrated Research Ethics Board (#13171) and from collaborating sites.

Table 1 GENDER-Q scales used

GENDER-Q domain	GENDER-Q scale	PROM construct	Number of questions	Response options
Chest	Chest	Current satisfaction with appearance of chest	10	6 (extremely dissatisfied to extremely satisfied)
	Nipples & Areolas	Current satisfaction with appearance of nipples and areolas	8	6 (extremely dissatisfied to extremely satisfied)
	Scars	Current bother with scar appearance	12	4 (very much to not at all)
Body	Body	Current satisfaction with body appearance	10	6 (extremely dissatisfied to extremely satisfied)
Sexual	Sexual Well-being	Frequency of feeling positive towards sexual activity generally	12	5 (never to always)
Health-Related Quality of Life (HRQL)	Body Image	Frequency of feeling satisfied with appearance over the past week	8	5 (never to always)
	Gender Dysphoria	Frequency gender dysphoria interfering with daily life over the past week	14	5 (never to always)
	Social Acceptance	Frequency of impact of gender identity on social well-being over the past week	9	5 (never to always)
	Psychological Distress	Frequency of experiencing gender-related distress over the past week	10	5 (never to always)
	Psychological Well-being	Frequency of feeling positive emotions related to gender identity over the past week	10	5 (never to always)

All scales are scored from 0 (worst possible score) to 100 (best possible score). PROM, patient-reported outcome measure.

Participant recruitment

Detailed data collection methods are available in Kaur *et al.*²² (published in 2025). TGD individuals were recruited from clinical sites and community groups to participate in the GENDER-Q international field test between February 2022 and March 2024. Individuals were eligible to take part in the study if they were aged ≥ 18 years and had sought or received gender-affirming care within the past 5 years. Participants completed an online survey in REDCap (Research Electronic Data Capture, Vanderbilt University, Nashville, TN, USA)^{25,26}. The survey contained demographics, clinical questions, GENDER-Q scales, and psychometric validation items. Branching logic was used to ensure participants were asked only relevant, required questions, while all other questions were optional. The GENDER-Q Chest scales were only shown to participants who wanted or had previously undergone masculinizing gender-affirming chest surgery. For data analysis, participants were included if they completed the Chest scale. Completion of each scale was optional; consequently, some participants may not have completed the Nipples & Areolas scale or the Scars scale.

Outcomes

Demographic and clinical data

Participants answered questions regarding demographics, chest appearance preference (masculinizing, feminizing, other), testosterone use (yes, no; duration), and chest surgery status (want, had, had and currently need revisions). Participants who underwent surgery answered clinical questions regarding surgical

technique, time since surgery, complications, revisions, perceived nipple position, and number of nipples.

GENDER-Q Chest scales

The GENDER-Q comprises 54 independently functioning scales and two checklists^{21,22}; this study focuses on the Chest, Nipples & Areolas, and Scars scales ([Table 1](#)). The Chest scale measures current satisfaction with chest appearance. The Nipples & Areolas scale measures current satisfaction with nipple and areola appearance. The Scars scale assesses how bothered individuals are with the appearance of their chest scars. The content for the Scars scale is from the SCAR-Q, which was previously developed by Klassen *et al.*²⁷ The Chest and Nipples & Areolas scales can be used before surgery and after surgery, while the Scars scale is only relevant after surgery. To score each scale, each items' associated response value is summed to generate a raw score. The raw score is then transformed using Rasch-transformed values that range from 0 (worst) to 100 (best). Missing data are imputed via within-person mean imputation if $\geq 50\%$ of the scale's items are complete. Other GENDER-Q scales utilized in this study included the Body scale, the Sexual Well-being scale, and five Health-Related Quality of Life (HRQL) scales (Body Image, Gender Dysphoria, Social Acceptance, Psychological Distress, and Psychological Well-being) ([Table 1](#)).

Statistical analysis

Analyses were conducted in SPSS (IBM, Armonk, NY, USA; version 30). Descriptive statistics were calculated for the GENDER-Q

Chest scales. Statistical significance was set at $\alpha = 0.050$. Kurtosis (absolute >7) and skewness (absolute >2) were used to assess substantial non-normality²⁸. Psychometric analyses were guided by the Consensus-based Standards for the Selection of Health Measurement Instruments (COSMIN) guidelines^{29–31}. Construct validity was determined for each scale by testing a priori hypotheses. According to COSMIN guidelines, acceptance of at least 75% of these hypotheses is considered sufficient evidence of construct validity. Hypotheses were formulated based on available evidence, clinical reasoning, and participant feedback during qualitative interviews. Hypotheses reflected expected group-level differences and correlations between GENDER-Q Chest scales and other GENDER-Q scales. Group-level differences were assessed using an independent-sample *t* test or ANOVA or the equivalent non-parametric test for data not normally distributed. If the hypothesis stated directionality, a one-sided *t* test was applied; all other tests were two-sided. Correlations between scales were assessed using the Pearson correlation coefficient, with values of <0.3 indicating unrelated constructs, values of 0.3 to <0.5 indicating related but dissimilar constructs, and values of ≥ 0.5 indicating similar constructs³².

Results

In total, 2846 participants completed the Chest scale, 2523 participants completed the Nipples & Areolas scale, and 1921 participants completed the Scars scale (Fig. S1). The mean(s.d.) age of the sample was 29.3(9.6) years, with a range of 18–74 years. Most identified as male (61.6%) or non-binary (32.0%), were White (75.5%), and lived in the USA (47.5%) or Canada (32.2%). Most (78.9%) completed the scale after surgery and 86.6% of those who underwent surgery had a double incision mastectomy. Full demographic and clinical details are shown in Table 2.

Construct validation

GENDER-Q Chest

Of the 22 hypotheses assessed for the GENDER-Q Chest scale, 1 was rejected, resulting in an acceptance rate of 95% (Table 3).

Group-level differences for the Chest scale are shown in Table S2. As hypothesized, Chest scale scores varied by surgical status. Preoperative participants reported the lowest scores (23.0(14.6)), followed by participants who had undergone surgery and needed revisions at survey completion (59.0(19.0), $P < 0.001$), and those who had undergone surgery and did not need revisions at survey completion reported the highest scores (79.5(17.2), $P < 0.001$) (Fig. 1a). Regarding complications and revisions, as hypothesized: participants with postoperative complications scored lower than those who did not report any complications ($P \leq 0.002$); and participants who reported not needing revisions scored higher than those who had completed or needed future revisions ($P < 0.001$). As expected, participants with two nipples had higher scores compared with those with one nipple ($P = 0.028$) and participants who thought that their nipples were appropriately positioned had higher scores compared with those who thought they were malpositioned ($P < 0.001$). Contrary to the hypothesis, participants who were ≤ 6 months postoperative had statistically higher scores compared with participants who were >6 months postoperative

Table 2 Self-reported demographic and clinical characteristics of the study sample for the GENDER-Q chest scales ($n = 2846$)

	Values
Age at survey completion (years)	
18–24	1068 (37.5)
25–29	725 (25.5)
30–39	690 (24.2)
40–49	216 (7.6)
≥ 50	147 (5.2)
Gender identity	
Man	1738 (61.1)
Non-binary	912 (32.0)
Indigenous or other cultural gender minority identity (for example two-spirit)	25 (0.9)
Other	171 (6.0)
Sex assigned at birth	
Female	2846 (100.0)
Country of residence	
Australia	155 (5.4)
Canada	917 (32.2)
Denmark	88 (3.1)
Netherlands	55 (1.9)
UK	126 (4.4)
USA	1353 (47.5)
Other	149 (5.2)
Prefer not to answer	3 (0.1)
Race	
Black	108 (3.8)
East Asian	48 (1.7)
Indigenous	24 (0.8)
Latin American	82 (2.9)
Middle Eastern	26 (0.9)
South Asian	18 (0.6)
Southeast Asian	31 (1.1)
White	2148 (75.5)
Other	8 (0.3)
Multiple races	327 (11.5)
Prefer not to answer	21 (0.7)
Missing	5 (0.2)
Education level	
Some high school	104 (3.7)
Completed high school	377 (13.2)
Some college or trade school or university	787 (27.7)
Completed college or trade school or university	1019 (35.8)
Some masters or doctoral degree	166 (5.8)
Completed masters or doctoral degree	386 (13.6)
Prefer not to answer	7 (0.2)
Chest surgery status	
'I want this'	601 (21.1)
'I had this'	2012 (70.7)
'I had this and need more'	233 (8.2)
Type of chest surgery	
Double incision	1944 (86.6)
T-anchor	62 (2.8)

(continued)

Table 2 Continued

	Values
Circumareolar	63 (2.8)
Periareolar	148 (6.6)
Other chest surgery	24 (1.1)
I am not sure	4 (0.2)
Time since surgery	
≤6 months	309 (13.8)
7 to <12 months	332 (14.8)
1 to <2 years	335 (14.9)
2 to <3 years	352 (15.7)
3 to <4 years	219 (9.8)
4 to <5 years	177 (7.9)
≥5 years	520 (23.2)
Missing	1 (0.0)
Complications	
Haematoma	198 (8.8)
Seroma	287 (12.8)
Surgical-site infection	157 (7.0)
Revisions	
Lateral standing cutaneous deformity revision	
Do not need	1387 (61.8)
Need	471 (21.0)
Completed	142 (6.3)
Not sure	242 (10.8)
Missing	3 (0.1)
Chest contour revision	
Do not need	1350 (60.1)
Need	310 (13.8)
Completed	287 (12.8)
Not sure	289 (12.9)
Missing	9 (0.4)
Excess tissue removal	
Do not need	1719 (76.6)
Need	144 (6.4)
Completed	178 (7.9)
Not sure	189 (8.4)
Missing	15 (0.7)
Hypopigmentation correction	
Do not need	1849 (82.4)
Need	134 (6.0)
Completed	13 (0.6)
Not sure	228 (10.2)
Missing	21 (0.9)
Nipple revision	
Do not need	1728 (77.0)
Need	216 (9.6)
Completed	53 (2.4)
Not sure	239 (10.6)
Missing	9 (0.4)
Scar revision	
Do not need	1605 (71.5)
Need	254 (11.3)
Completed	73 (3.3)
Not sure	294 (13.1)
Missing	19 (0.8)

(continued)

Table 2 Continued

	Values
Number of nipples	
Two	1923 (85.7)
One—assumed postoperative complication	55 (2.4)
Zero—assumed postoperative complication	64 (2.9)
Zero—nipples removed during surgery per patient preference	189 (8.4)
Prefer not to answer	5 (0.2)
Missing	9 (0.4)
Perceived nipple position of participants with two nipples	
Appropriately positioned	1686 (87.7)
Malpositioned	229 (11.9)
Prefer not to answer	8 (0.4)

Values are *n* (%).

(79.5(17.5) versus 77.0(18.6), $P=0.013$), although this difference may not be clinically significant.

Correlations between the Chest scale and other GENDER-Q scales are shown in Table S3. The Scars scale, Sexual Well-being scale, and most HRQL scales demonstrated related but dissimilar constructs to the Chest scale, as expected ($r=0.3$ to <0.5 , $P<0.001$). The Nipples & Areolas, Body, and Body Image scales demonstrated similar constructs to the Chest scale, as expected ($r\geq 0.5$, $P<0.001$).

GENDER-Q Nipples & Areolas

Of the 19 hypotheses assessed for the GENDER-Q Nipples & Areolas scale, 4 were rejected, resulting in an acceptance rate of 79% (Table 3).

Group-level differences for the Nipples & Areolas scale are shown in Table S2. As hypothesized, Nipples & Areolas scale scores varied by surgical status. Preoperative participants reported the lowest scores (43.0(17.4)), followed by participants who had undergone surgery and needed revisions at survey completion (48.8(14.8), $P<0.001$), and those who had undergone surgery and did not need revisions at survey completion reported the highest scores (69.6(19.2), $P<0.001$) (Fig. 1b). Participants without complications ($P\leq 0.011$) and who did not need revisions ($P<0.001$) scored higher on the Nipples & Areolas scale, as expected. Additionally, as hypothesized: those who only had one nipple had lower scores compared with those who had both nipples ($P<0.001$); and participants who reported that their nipples were appropriately positioned had higher scores compared with those who thought they were malpositioned ($P<0.001$). Contrary to the hypothesis, participants who were ≤ 6 months postoperative had higher scores compared with participants who were >6 months postoperative (67.3(20.1) versus 64.7(20.3), $P=0.037$), although this difference may not be clinically significant. Another hypothesis that was rejected was the expectation that participants who underwent periareolar mastectomies would report higher satisfaction compared with participants who underwent double incision mastectomy with free nipple grafting. This difference was not observed (66.4(18.7) versus 65.7(20.2), $P=0.339$).

Correlations between the Nipples & Areolas scale and other GENDER-Q scales are shown in Table S3. The Scars and HRQL

Table 3 Summary of hypotheses tested for construct validity of the GENDER-Q chest scales

Construct validity hypotheses	GENDER-Q Chest scales		
	Chest	Nipples & Areolas	Scars
Group-level difference hypotheses			
1. Participants who had surgery without needing revisions will score higher on scales than those who had surgery and needed revisions or those who want surgery*	Y	Y	NA
2. Participants who are ≤6 months postoperative will score lower on scales than those who are >6 months postoperative, given that patients' chests often take 4–6 months to fully heal after masculinizing gender-affirming chest surgery†	N	N	NA
3. Participants who report having specific complications will score lower on scales than those who did not have those specific complications‡§			
a. Haematoma	Y	Y	NA
b. Seroma	Y	Y	NA
c. Surgical-site infection	Y	Y	NA
4. Participants who report needing specific revisions will score lower on scales than those who did not need those specific revisions*			
a. Lateral standing cutaneous deformity revision	Y	NA	NA
b. Chest contour revision	Y	NA	NA
c. Excess tissue removal	Y	NA	NA
d. Hypopigmentation correction	Y	Y	Y
e. Nipple revision	Y	Y	NA
f. Scar revision	Y	NA	Y
5. Participants who report that their nipples are located in the right place for them will score higher on scales than those who report the nipples are located in the wrong place¶#	Y	Y	NA
6. Participants who report having two nipples will score higher on scales than those who have one‡¶	Y	Y	NA
7. Participants who underwent periareolar procedures will score higher on scales than those who underwent double incision procedures, given that double incision procedures produce more scarring, discoloration, and wound healing complications associated with nipple grafts**	NA	N	Y
Correlation hypotheses			
1. Chest (≥0.5 Nipples & Areolas; 0.3 to <0.5 Scars)†	NA	Y	Y
2. Nipples & Areolas (≥0.5 Chest; 0.3 to <0.5 Scars)†	Y	NA	Y
3. Scars (0.3 to <0.5 Chest, Nipples & Areolas)†	Y	Y	NA
4. Body (≥0.5 Chest; 0.3 to <0.5 Nipples & Areolas; <0.3 Scars)†	Y	N	Y
5. Sexual Well-being (0.3 to <0.5 Chest, Nipples & Areolas; <0.3 Scars)†	Y	N	Y
6. Body Image (≥0.5 Chest; 0.3 to <0.5 Nipples & Areolas; <0.3 Scars)†	Y	Y	Y
7. Gender Dysphoria (0.3 to <0.5 Chest, Nipples & Areolas; <0.3 Scars)†	Y	Y	Y
8. Social Acceptance (0.3 to <0.5 Chest, Nipples & Areolas; <0.3 Scars)†	Y	Y	Y
9. Psychological Distress (0.3 to <0.5 Chest, Nipples & Areolas; <0.3 Scars)†	Y	Y	Y
10. Psychological Well-being (0.3 to <0.5 Chest, Nipples & Areolas; <0.3 Scars)†	Y	Y	Y
Number of hypotheses tested	22	19	12
Number of hypotheses accepted	21	15	12
Number of hypotheses rejected	1	4	0
Percentage of hypotheses accepted	95%	79%	100%

*van de Grift TC, Elfering L, Greijdanus M, Smit JM, Bouman M-B, Klassen AF *et al.* Subcutaneous mastectomy improves satisfaction with body and psychosocial function in trans men: findings of a cross-sectional study using the BODY-Q chest module. *Plast Reconstr Surg* 2018;**142**:1125–1132. †Expert opinion. ‡Berkowitz R, Vu J, Brummett C, Waljee J, Englesbe M, Howard R. The impact of complications and pain on patient satisfaction. *Ann Surg* 2021;**273**:1127–1134. §Archer S, Pinto A, Vuik S, Bicknell C, Faiz O, Byrne B *et al.* Surgery, complications, and quality of life: a longitudinal cohort study exploring the role of psychosocial factors. *Ann Surg* 2019;**270**:95–101. ¶Black CK, Fan KL, Economides JM, Camden RC, Del Corral GA. Analysis of chest masculinization surgery results in female-to-male transgender patients: demonstrating high satisfaction beyond aesthetic outcomes using advanced linguistic analyzer technology and social media. *Plast Reconstr Surg Glob Open* 2020;**8**:e2356. #Ayyala HS, Mukherjee TJ, Le TM, Cohen WA, Luthringer M, Keith JD. A three-step technique for optimal nipple position in transgender chest masculinization. *Aesthet Surg J* 2020;**40**:NP619–NP625. **Rifkin WJ, Robinson IS, Kloer C, Cripps CN, Boyd CJ, Blasdel G *et al.* Gender-affirming mastectomy: comparison of periareolar and double incision patterns. *Plast Reconstr Surg Glob Open* 2022;**10**:e4356. N, no—hypothesis rejected; NA, hypothesis not tested; Y, yes—hypothesis accepted.

scales were considered related but dissimilar constructs to the Nipples & Areolas scale, as expected ($r=0.3$ to <0.5 , $P<0.001$). The Chest scale was considered a similar construct to the

Nipples & Areolas scale, as hypothesized ($r=0.6$, $P<0.001$). The Sexual Well-being scale was considered an unrelated construct to the Nipples & Areolas scale, showing a weaker

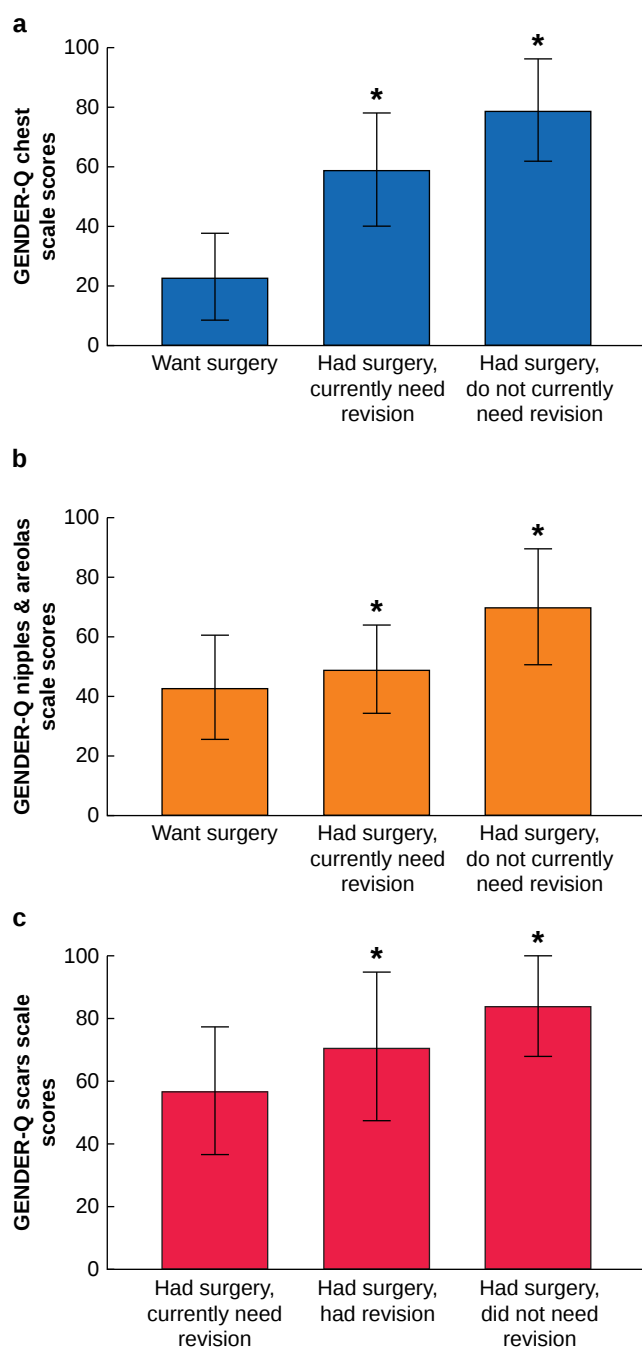


Figure 1 GENDER-Q Chest scale scores according to surgical status (Chest and Nipples & Areolas) or revision status (Scars)

a Mean GENDER-Q Chest scale scores according to surgical status. **b** Mean GENDER-Q Nipples & Areolas scale scores according to surgical status. **c** Mean GENDER-Q Scars scale scores according to revision status (GENDER-Q Scars scale can only be completed after surgery). *Significant ($P < 0.050$), with the value for the first bar as the reference.

correlation than hypothesized ($r = 0.2$, $P < 0.001$). The Body scale was considered a similar construct to the Nipples & Areolas scale, a stronger correlation than expected ($r = 0.5$, $P < 0.001$).

GENDER-Q Scars

Of the 12 hypotheses assessed for the GENDER-Q Scars scale, none were rejected, resulting in an acceptance rate of 100% (Table 3).

Group-level differences for the Scars scale are shown in Table S2. As hypothesized, Scars scale scores varied by revision status. Participants who had undergone surgery and needed revisions at survey completion reported the lowest scores (56.6(20.3)), followed by those who had undergone surgery and underwent revisions (71.1(23.5), $P < 0.001$), and those who had undergone surgery and did not need revisions reported the highest scores (84.0(15.9), $P < 0.001$) (Fig. 1c). The hypothesis was confirmed that participants who underwent periareolar mastectomies had higher satisfaction with scars compared with participants who underwent double incision mastectomies ($P < 0.001$). Regarding complications and revisions, participants who needed future revisions for hypopigmentation or scars scored lower than those who had a revision or did not need revisions, as hypothesized ($P < 0.001$).

Correlations between the Scars scale and other GENDER-Q scales are shown in Table S3. All scales correlated as hypothesized. The Chest and Nipples & Areolas scales were considered related but dissimilar constructs to the Scars scale ($r = 0.3$ to < 0.5 , $P < 0.001$) and all other correlations were considered dissimilar constructs to the Scars scale ($r < 0.3$, $P < 0.001$).

Discussion

The GENDER-Q is a comprehensive PROM developed by an international team of experts in collaboration with TGD individuals to rigorously measure PROs across the spectrum of gender-affirming care, including surgery^{6,20–22}. The GENDER-Q Chest, Nipples & Areolas, and Scars scales were specifically designed to measure chest appearance in masculinizing gender-affirming chest surgery. In this psychometric analysis guided by COSMIN^{29–31}, the GENDER-Q Chest scales demonstrated construct validity for assessing the appearance of the chest, nipples and areolas, and scars. Participants who had undergone surgery reported higher satisfaction compared with those who wanted to but had not yet undergone surgery. These findings show that the GENDER-Q Chest scales can generate high-quality, patient-centred data regarding the impact of masculinizing gender-affirming chest surgery. Collecting this evidence is crucial given the current heightened interest in understanding outcomes of gender-affirming care, as such information can inform clinical care, quality improvement, and policy decisions.

Through confirmation of most a priori hypotheses, the present study provides evidence of construct validity for the GENDER-Q Chest scales, which were specifically developed for TGD individuals undergoing masculinizing gender-affirming chest surgery. Establishing construct validity is essential to ensuring that an instrument accurately measures its intended concept, thereby strengthening its clinical utility^{23,24}. This work builds on the previously reported psychometric properties for the GENDER-Q Chest scales (Table S1)²². Structural validity of all three scales was supported by Rasch Measurement Theory (RMT) analysis, which demonstrated overall model fit, one-dimensionality, and acceptable item performance. The Person Separation Index (PSI) values ranged from 0.81 to 0.95, indicating adequate to excellent measurement precision. Reliability was further supported by Cronbach α coefficients (0.92–0.99) and intraclass correlation coefficients (0.93–0.96), demonstrating strong internal consistency and test-retest reliability. No differential item functioning

by age was detected for any scale, indicating stable performance across age groups. The smallest detectable change ranged from 1.0 to 1.1 points across the scales.

Furthermore, by involving TGD communities throughout the development of these scales, the GENDER-Q not only accurately measures relevant constructs but also uses TGD-inclusive language and reflects patient priorities³³, making it a meaningful tool for research in this field. This participatory approach improves data accuracy, strengthens trust between participants and researchers, and enhances the credibility of data generated by these instruments^{34,35}.

In this study, participants who had undergone surgery and did not need revisions at survey completion reported the highest satisfaction on the GENDER-Q Chest and Nipples & Areolas scales, followed by those who had undergone surgery and needed revisions at survey completion, while participants who wanted to undergo surgery but had not yet undergone surgery reported the lowest satisfaction. These findings suggest that masculinizing gender-affirming chest surgery is efficacious in improving chest appearance satisfaction for individuals who desire these procedures, consistent with previous research demonstrating the far-reaching benefits of masculinizing gender-affirming chest surgery⁸⁻¹⁵. Prior studies have used instruments such as the Transgender Congruence Scale (TCS), Gender Congruence and Life Satisfaction (GCLS) scale, Chest Dysphoria Scale (CDS), Body Image Quality of Life Index (BIQLI), BREAST-Q, and BODY-Q Chest and Nipples scales (Table S4)^{8-12,15}. The TCS, GCLS, and CDS are the only instruments that were developed exclusively among TGD individuals; however, the TCS and GCLS assess appearance generally, rather than surgical outcomes, and the CDS lacks robust development and psychometric validation^{10,36,37}. The BIQLI and BREAST-Q were developed for cisfemales and may lack content validity for TGD individuals^{38,39}. While previous studies using the BREAST-Q have shown significant benefits after masculinizing gender-affirming chest surgery⁹, it was not developed for TGD individuals undergoing chest masculinization and many questions are not applicable to TGD individuals (for example questions about wearing a bra). Therefore, these measures may not accurately reflect the aspects of satisfaction and quality of life most important to TGD individuals, so the results should be interpreted with caution. The BODY-Q Chest and Nipples scales were developed and validated in TGD individuals undergoing masculinizing gender-affirming chest surgery^{40,41} and have been widely used to measure chest appearance satisfaction in this population^{11,12,15,42,43}. Even so, because these scales were also designed for cisgender individuals undergoing body contouring and gynaecomastia procedures, they lack questions that were added to the GENDER-Q to maximize content validity in masculinizing gender-affirming chest surgery^{40,41}. Furthermore, the GENDER-Q Chest and Nipples & Areolas scales use six response options per item, compared with four in the BODY-Q Chest and Nipple scales, allowing for greater precision and discrimination of nuanced patient experiences. Given these advantages, the GENDER-Q Chest and Nipples & Areolas scales are recommended over the BODY-Q Chest and Nipple scales for assessing PROs in masculinizing gender-affirming chest surgery.

This study has limitations. Given the various recruitment techniques that were used, including the use of community outreach and social media platforms, the total number of individuals reached is

unable to be determined and thus the participation rate cannot be estimated. Reliance on self-reported, online data collection may exclude individuals with limited technology access or those living in unsafe environments. The survey length could also result in decreased participation due to time constraints or fatigue. Accordingly, selection and non-response bias are possible. For example, people who previously experienced discrimination when seeking gender-affirming care may have been less likely to participate, whereas those with strong opinions or greater technological proficiency may have been more motivated to complete the survey. As such, these dynamics could bias estimates in either direction. The predominantly White sample from mostly North America and Europe limits the generalizability to individuals of differing racial or ethnic backgrounds and geographical regions. Cultural differences may influence how individuals engage with PROMs, including how questions are understood, which outcomes are prioritized, comfort with sensitive topics, and the response burden of completing multiple instruments⁴⁴. Further validation in geographically, racially, and ethnically diverse samples would broaden applicability and support cross-cultural adaptation of the GENDER-Q scales. Nonetheless, the large, international sample of greater than 2800 participants strengthens the credibility of these findings and enhances the statistical power of the analyses. Lastly, recall bias may affect responses about surgical history, such as type of surgery or complications; however, this does not impact GENDER-Q Chest scales' scores, as these scales assess the participants' current perception of their appearance.

These findings have several important implications for advancing the study of masculinizing gender-affirming chest surgery. The GENDER-Q Chest scales now enable researchers to generate high-quality, longitudinal evidence regarding outcomes most important to patients. Collecting this data can empower patients to make evidence-informed decisions and allow clinicians to adapt their practices accordingly based on the long-term outcomes after this surgery. For policymakers, data generated from the GENDER-Q Chest scales can also inform decisions regarding policy, reimbursement models, and advocacy efforts regarding masculinizing gender-affirming chest surgery. Determining the GENDER-Q Chest scales' responsiveness, minimally important differences, and normative values would be valuable future work to enhance the interpretability of data generated from these scales⁴⁵⁻⁴⁷.

Evaluating the outcomes in masculinizing gender-affirming chest surgery is critical given the growing demand for high-quality research in this field. The GENDER-Q was rigorously developed to address the lack of validated PROMs in gender-affirming surgery. This study extends the psychometric assessment of the GENDER-Q Chest, Nipples & Areolas, and Scars scales and provides additional support for their construct validity. The findings demonstrate that the GENDER-Q Chest scales are effective measures of chest, nipple, and scar appearance in masculinizing gender-affirming chest surgery and can be used to generate high-quality evidence on the impact of these procedures on patients' lives.

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Author contributions

Caleb Haley (Formal analysis, Investigation, Visualization, Writing—original draft, Writing—review & editing), Shane D. Morrison (Conceptualization, Formal analysis, Investigation, Methodology, Writing—original draft, Writing—review & editing), Manraj N. Kaur (Conceptualization, Formal analysis, Investigation, Methodology, Writing—review & editing), Charlene Rae (Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Writing—original draft, Writing—review & editing), Megan Lane (Investigation, Writing—review & editing), Danny A Young-Afat (Investigation, Writing—review & editing), Tim C. van de Grift (Investigation, Writing—review & editing), Nicola R. Dean (Investigation, Writing—review & editing), Kathleen A. Armstrong (Investigation, Writing—review & editing), Devin Coon (Investigation, Writing—review & editing), Zac A. Cannell (Investigation, Writing—review & editing), Christian X. Lava (Investigation, Writing—review & editing), Sylvie D. Cornacchi (Conceptualization, Data curation, Investigation, Project administration, Resources, Writing—review & editing), Alexis Laungani (Investigation, Writing—review & editing), Margriet G Mullender (Investigation, Writing—review & editing), Jens A. Sørensen (Investigation, Writing—review & editing), Lotte Poulsen (Investigation, Writing—review & editing), Jack G. Graesser (Investigation, Writing—review & editing), Thomas Satterwhite (Investigation, Writing—review & editing), Allison C. Hu (Investigation, Writing—review & editing), Gerhard S. Mundinger (Investigation, Writing—review & editing), Hilliard T. Brydges (Investigation, Writing—review & editing), Jessica J. Hsu (Investigation, Writing—review & editing), Blair R. Peters (Investigation, Writing—review & editing), Jens U. Berli (Investigation, Writing—review & editing), Christodoulos Kaoutzanis (Investigation, Writing—review & editing), Nargis Kalia (Investigation, Writing—review & editing), Rachel Bluebond-Langner (Investigation, Writing—review & editing), Oren Ganor (Investigation, Writing—review & editing), Alireza Hamidian Jahromi (Investigation, Writing—review & editing), Bashar A. Hassan (Investigation, Writing—review & editing), Fan Liang (Investigation, Writing—review & editing), John H. Pang (Investigation, Writing—review & editing), Edward C. Ray (Investigation, Writing—review & editing), Gabriel A. Del Corral (Investigation, Writing—review & editing), Kenneth L. Fan (Investigation, Writing—review & editing), Lily R. Mundy (Investigation, Writing—review & editing), Andrea L. Pusic (Conceptualization, Investigation, Methodology, Supervision, Writing—review & editing), and Anne F. Klassen

(Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Supervision, Writing—review & editing)

Disclosure

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Supplementary material

Supplementary material is available at *BJS* online.

Data availability

Given the personal nature of the data, data will not be publicly available to protect the study participants from the potential risk of identification. Individuals may request access to the data or the analysis code by contacting the corresponding author. Decisions will be made on a case-by-case basis based on the reason for the request.

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**Measuring Patient-Reported Outcomes in Masculinizing Gender-Affirming Chest Surgery:
Validation of the GENDER-Q Chest Scales in 2,846 Individuals**

Authors:

1. Caleb Haley MD, MSc*, Section of Plastic Surgery, University of Michigan, 1500 E Medical Center Drive, Ann Arbor, MI, United States, 48109, Calebah@med.umich.edu
2. Shane D. Morrison MD, MS*, University of Washington Medical Center, 1959 NE Pacific Street, Mailstop #356410, Seattle, Washington, United States, 98195, shanemd@uw.edu
3. Manraj N. Kaur PhD, Patient-Reported Outcomes and Values, & Experience Center (PROVE), Mass General Brigham, Harvard Medical School; 75 Francis Street, Boston, MA, United States, 02115, mkaur17@bwh.harvard.edu
4. Charlene Rae PhD, Department of Pediatrics, McMaster University, 1280 Main Street W, Hamilton, ON, Canada, L8N 3Z5, crae@mcmaster.ca
5. Megan Lane MD, MS, Section of Plastic Surgery, University of Michigan, 1500 E Medical Center Drive, Ann Arbor, MI, United States, 48109, megalane@med.umich.edu
6. Danny A. Young-Afat MD PhD, Department of Plastic, Reconstructive and Hand Surgery, Amsterdam University Medical Center, PO Box 7057, 1007 MB, Amsterdam, The Netherlands, d.youngafat@amsterdamumc.nl, Align Surgical Associates Inc., 2299 Post St. Suite 207, San Francisco, CA, United States, 94115
7. Tim C. van de Grift MD PhD, Department of Plastic Reconstructive and Hand Surgery, Amsterdam University Medical Center, De Boelelaan 1117, 1081 HV Amsterdam, The Netherlands, t.vandegrift@amsterdamumc.nl
8. Nicola R. Dean MBChB, PhD, College of Medicine and Public Health, Flinders University, Flinders Drive, Bedford Park, South Australia 5042, Australia, nicola.dean@sa.gov.au
9. Kathleen A. Armstrong MD, MSc, Department of Surgery, Women's College Hospital, 76 Grenville St, 8th Floor Toronto, ON, Canada, M5S 1B2, Kathleen.armstrong@wchospital.ca
10. Devin Coon MD, MS, Brigham and Women's Hospital, Harvard Medical School; 75 Francis Street, Boston, MA, United States, 02116, dcoon@bwh.harvard.edu
11. Zac A. Cannell BSocWk, MMHP, Trans Health South Australia, Level 5, Flinders Medical Centre, Flinders Drive, Bedford Park, South Australia 5042, Australia, zac.cannell@yahoo.com.au
12. Christian X. Lava MS, Department of Plastic and Reconstructive Surgery, MedStar Georgetown University Hospital, 3800 Reservoir Rd NW, Washington, DC, United States, 20007, cl1449@georgetown.edu
13. Sylvie D. Cornacchi MSc, Department of Pediatrics, McMaster University, 1280 Main Street W, Hamilton, ON, Canada, L8N 3Z5, cornacs@mcmaster.ca
14. Alexis Laungani MD, Plastic Surgery Division, GrS Montréal, 999 rue de Salaberry Montreal, QC, Canada, H3L 1L2, alaungani@grsmontreal.com
15. Margriet G. Mullender PhD MBA, Department of Plastic Reconstructive and Hand Surgery, Amsterdam University Medical Center, De Boelelaan 1117, 1081 HV Amsterdam, The Netherlands, m.mullender@amsterdamumc.nl
16. Jens Ahm Sørensen MD, PhD, Research Unit for Plastic Surgery, University of Southern Denmark, J. B. Winsloews Vej 4 DK - 5000 Odense C, Denmark, jens.sorensen@rsyd.dk
17. Lotte Poulsen MD, PhD, Research Unit for Plastic Surgery, University of Southern Denmark, J. B. Winsloews Vej 4 DK - 5000 Odense C, Denmark, lotte_poulsen@hotmail.com

18. Jack G. Graesser BA Medicine, Research Unit for Plastic Surgery, University of Southern Denmark, J. B. Winsloews Vej 4 DK - 5000 Odense C, Denmark, jackggraesser@gmail.com
19. Thomas Satterwhite MD, Align Surgical Associates Inc., 2299 Post St. Suite 207, San Francisco, CA, United States, 94115, tsatterwhite@alignsurgical.com
20. Allison C. Hu MD, Align Surgical Associates Inc., 2299 Post St. Suite 207, San Francisco, CA, United States, 94115, allisonhu@stanford.edu
21. Gerhard S. Mundinger MD, MBA, Crane Center for Transgender Surgery, 4407 Bee Cave Rd, Suite 612 Austin, TX, United States, 78746, sol@cranects.com
22. Hilliard T. Brydges MD, University of Washington Medical Center, 1959 NE Pacific Street, Mailstop #356410, Seattle, Washington, United States, 98195, hillbry@uw.edu
23. Jessica J. Hsu MD, PhD, Section of Plastic Surgery, University of Michigan, 1500 E Medical Center Drive, Ann Arbor, MI, United States, 48109, jehsu@med.umich.edu
24. Blair R. Peters MD, Department of Surgery - Division of Plastic and Reconstructive Surgery, 3303 SW Bond Ave, Portland, OR, United States, 97239, petersbl@ohsu.edu
25. Jens U. Berli MD, MBA, Department of Surgery - Division of Plastic and Reconstructive Surgery, 325 Sam Jackson Park Rd, Portland, OR, United States, 97239, berli@ohsu.edu
26. Christodoulos Kaoutzannis MD, Department of Surgery, Division of Plastic and Reconstructive Surgery, University of Colorado, Anschutz Medical Campus, 12631 E 17th Avenue, C309, Aurora, CO, United States, 80045, Christodoulos.Kaoutzannis@cuanschutz.edu
27. Nargis Kalia MPH, Department of Surgery, University of Colorado, Anschutz Medical Campus, 12631 E 17th Avenue, C309, Aurora, CO, United States, 80045, Nargis.kalia@cuanschutz.edu
28. Rachel Bluebond-Langner MD, Hansjörg Wyss Department of Plastic Surgery, NYU Grossman School of Medicine, 222 East 41st Street, 7th Floor, New York, NY, United States, 10017, Rachel.Bluebond-Langner@nyulangone.org
29. Oren Ganor MD, Department of Plastic and Oral Surgery, Boston Children's Hospital, Boston Children's Hospital, 300 Longwood Ave, Boston, MA, United States, 02115, oren.ganor@childrens.harvard.edu
30. Alireza Hamidian Jahromi MD, Department of Plastic and Reconstructive Surgery, Lewis Katz School of Medicine at Temple University, 3509 N Broad Street, Philadelphia, PA, United States, 19140, alireza.hamidianjahromi@tuhs.temple.edu
31. Bashar A. Hassan MD MPH, Plastic Surgery, Johns Hopkins, 600 N Wolfe St, Baltimore, MD, United States, 21287, bhassan2@jh.edu
32. Fan Liang MD, Plastic Surgery, Johns Hopkins, 600 N Wolfe St, Baltimore, MD, United States, 21287, fliang6@jh.edu
33. John H. Pang MD, Align Surgical Associates Inc., 2299 Post St. Suite 207, San Francisco, CA, United States, 94115, johnhenry@alignsurgical.com
34. Edward C. Ray MD, Department of Surgery, Cedars-Sinai Medical Center, 8635 West 3rd Street, Suite 770W, Los Angeles, CA, United States, 90048, edward.ray@cshs.org
35. Gabriel A. Del Corral MD, Department of Plastic and Reconstructive Surgery, MedStar Franklin Square Medical Center, 9000 Franklin Square Dr, Baltimore, MD, United States, 21237, Gabriel.A.DelCorral@medstar.net
36. Kenneth L. Fan MD, Department of Plastic and Reconstructive Surgery, MedStar Georgetown University Hospital, 3800 Reservoir Rd NW, Washington, DC, United States, 20007, Kenneth.L.Fan@medstar.net
37. Lily R. Mundy MD, Plastic Surgery, Johns Hopkins, 600 N Wolfe St, Baltimore, MD, United States, 21287, lmundy3@jhu.edu

38. Andrea L. Pusic MD MSc, Division of Plastic and Reconstructive Surgery, Mass General Brigham, 75 Francis S, Boston, MA, United States, 02116, apusic@bwh.harvard.edu
39. Anne F Klassen DPhil, Department of Pediatrics, McMaster University, 1280 Main Street W, Hamilton, ON, Canada, L8N 3Z5, aklass@mcmaster.ca

*Drs. Caleb Haley and Shane Morrison contributed to the work equally and are co-first authors.

Corresponding Author:

Anne F Klassen, DPhil
Department of Pediatrics
McMaster University
1280 Main Street W
Hamilton, ON, Canada, L8N 3Z5
aklass@mcmaster.ca

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GENDER-Q CHEST VALIDATION

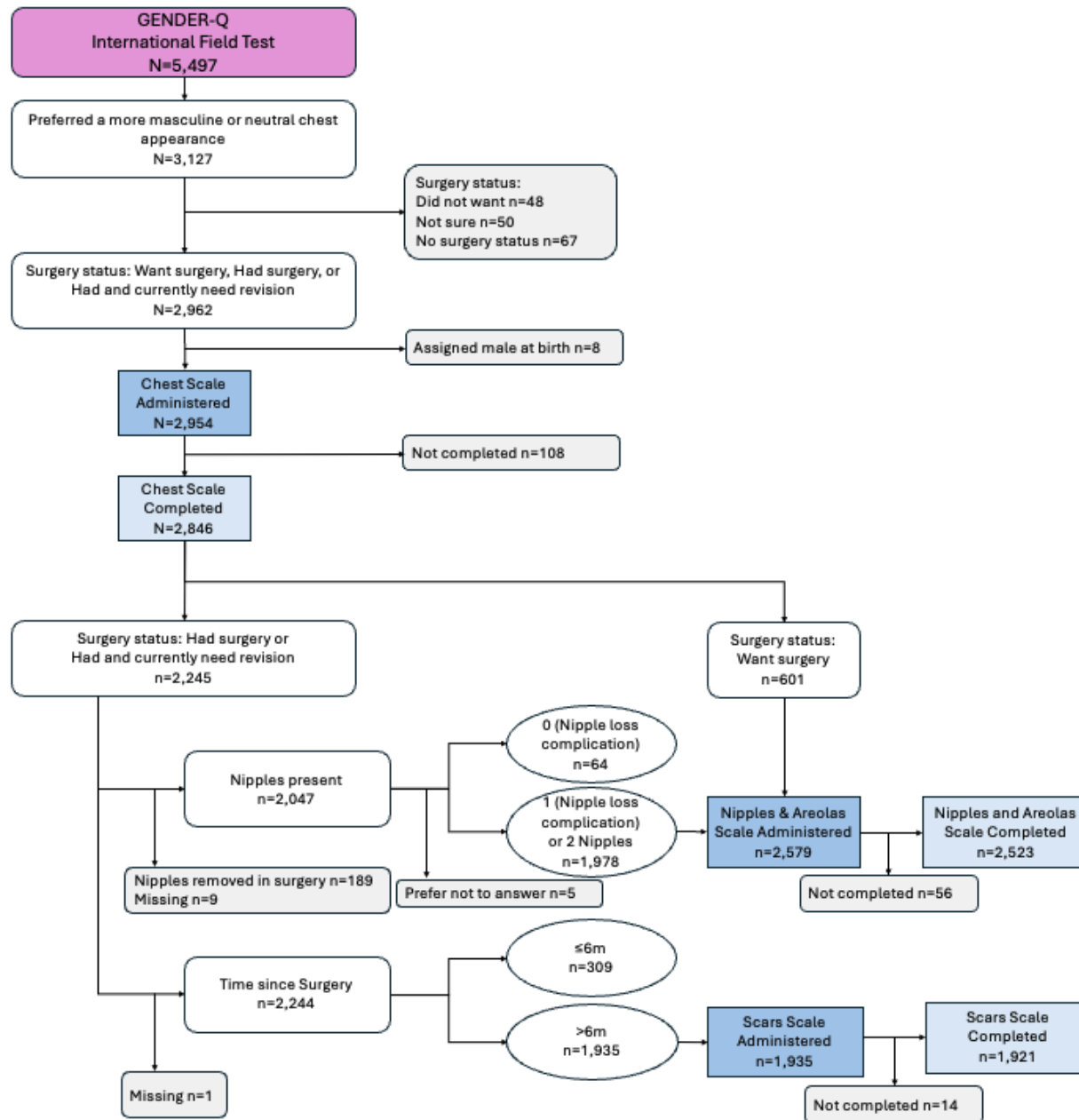
Supplementary Figures and Tables

eTable S1 Rasch Measurement Theory Results for GENDER-Q Chest Scales

GENDER-Q Scale	Items, No.	Completed (n)	Included in RMT (n)	% of sample to score on scale	c2	DF	p-value	PSI +extr	PSI -extr	α +extr	α -extr	DIF Age	DIF Masc/Fem	ICC Average (n)	SDC group
Chest	10	2857	2186	76.5	95.45	90	0.33	0.94	0.95	0.99	0.98	0	NA	0.96 (208)	1.1
Nipples & Areolas	12	2535	2200	86.9	71.4	72	0.50	0.92	0.91	0.95	0.93	0	NA	0.93 (209)	1.0
Scars	8	1927	1340	69.8	113.51	108	0.34	0.81	0.85	0.95	0.92	0	NA	0.95 (97)	1.1
c2 = Chi-square; DF = degrees of freedom; PSI = Person Separation Index; +extr = with extremes; -extr = without extremes; α = Cronbach alpha; DIF = differential item functioning; r = Pearson correlation coefficient, ICC = Intraclass correlation co-efficient; SDC = smallest detectable change															

GENDER-Q CHEST VALIDATION

eFigure S1 Flow Diagram Showing the Branching Logic for Scale Administration and the Number of Patients Who Completed Each Scale



GENDER-Q CHEST VALIDATION

eTable S2 Group-Level Differences of GENDER-Q Chest, Nipples & Areolas, and Scars Scales for Construct Validity

GENDER-Q Scale	Hypothesis	N	Mean	SD	95% CI		p-value	Hypothesis Accepted or Rejected
					LB	UB		
Participants who had surgery without needing revisions will score higher on scales than those who had surgery and needed revisions or those who want surgery								
Chest	Wants surgery	601	23.0	14.6	21.8	24.2	<0.001	Accepted
	Had surgery, needed revisions	233	59.0	19.0	56.6	61.5	<0.001	
	Had surgery, did not need revisions	2012	79.5	17.2	78.7	80.2	--	
Nipples & Areolas	Wants surgery	588	43.0	17.4	41.6	44.4	<0.001	Accepted
	Had surgery, needed revisions	421	48.8	14.8	47.4	50.2	<0.001	
	Had surgery, did not need revisions	1507	69.6	19.2	68.6	70.6	--	
Participants less than or equal to 6-months postoperative will score lower on scales than those who are greater than those greater than 6-months postoperative, given that patients' chests often take 4-6 months to fully heal following masculinizing gender-affirming chest surgery								
Chest	<=6m postoperative	309	79.5	17.5	77.6	81.5	0.013	Rejected
	>6m postoperative	1935	77.0	18.6	76.2	77.9		
Nipples & Areolas	<=6m postoperative	252	67.3	20.1	64.8	69.8	0.037	Rejected
	>6m postoperative	1684	64.7	20.3	63.8	65.7		
Participants who report having specific complications will score lower on scales than those who did not have those specific complications								
HEMATOMA								
Chest	No, I did NOT have this	2004	77.9	18.4	77.1	78.7	0.002	Accepted
	Yes, I HAD this and it is fixed	191	73.8	18.9	71.1	76.5		
Nipples & Areolas	No, I did NOT have this	1735	65.5	20.2	64.6	66.5	0.011	Accepted
	Yes, I HAD this and it is fixed	165	61.8	20.3	58.6	64.9		
INFECTION								

GENDER-Q CHEST VALIDATION

Chest	No, I did NOT have this	2064	77.9	18.3	77.1	78.7	<0.001	Accepted
	Yes, I HAD this and it is fixed	154	71.3	19.3	68.2	74.3		
Nipples & Areolas	No, I did NOT have this	1784	65.6	20.0	64.7	66.5	<0.001	Accepted
	Yes, I HAD this and it is fixed	127	58.4	21.5	54.6	62.2		
SEROMA								
Chest	No, I did NOT have this	1881	78.1	18.3	77.3	78.9	0.004	Accepted
	Yes, I HAD this and it is fixed	255	74.9	19.3	72.5	77.2		
Nipples & Areolas	No, I did NOT have this	1636	65.8	19.9	64.8	66.7	0.006	Accepted
	Yes, I HAD this and it is fixed	209	62.0	21.5	59.1	64.9		
Participants who report needing specific revisions will score lower on scales than those who did not need those specific revisions								
LATERAL STANDING CUTANEOUS DEFORMITY REVISION								
Chest	Had surgery, did not need revisions	1387	81.6	17.3	80.7	82.5	<0.001	Accepted
	Had surgery, had revisions	142	75.2	16.7	72.4	77.9		
	Had surgery, needs revisions	471	66.7	18.4	65.0	68.4		
CHEST CONTOUR REVISION								
Chest	Had surgery, did not need revisions	1350	82.7	16.5	81.9	83.6	<0.001	Accepted
	Had surgery, had revisions	287	78.9	17.4	76.9	80.9		
	Had surgery, needs revisions	310	58.0	15.2	56.3	59.7		
EXCESS TISSUE REMOVAL								
Chest	Had surgery, did not need revisions	1719	80.3	17.3	79.5	81.2	<0.001	Accepted
	Had surgery, had revisions	178	74.5	19.0	71.6	77.3		
	Had surgery, needs revisions	144	57.3	17.6	54.4	60.2		
HYPOPIGMENTATION CORRECTION								
Chest	Don't Need	1849	78.4	18.3	77.6	79.2	<0.001	Accepted

GENDER-Q CHEST VALIDATION

	Need	134	70.7	19.6	67.4	74.0		
Nipples & Areolas	Don't Need	1591	66.6	20.3	65.6	67.6	<0.001	Accepted
	Need	119	55.8	20.4	52.1	59.5		
Scars	Don't Need	1608	80.5	18.6	79.6	81.4	<0.001	Accepted
	Need	121	62.7	23.0	58.5	66.8		
NIPPLE REVISION								
Chest	Had surgery, did not need revisions	1728	79.5	17.9	78.7	80.4	<0.001	Accepted
	Had surgery, had revisions	53	78.2	15.2	74.0	82.4		
	Had surgery, needs revisions	216	64.1	19.4	61.5	66.7		
Nipples & Areolas	Had surgery, did not need revisions	1461	69.9	19.2	68.9	70.9	<0.001	Accepted
	Had surgery, had revisions	46	59.6	16.4	54.7	64.4		
	Had surgery, needs revisions	197	44.0	15.9	41.7	46.2		
SCAR REVISION								
Chest	Had surgery, did not need revisions	1605	80.0	17.7	79.1	80.8	<0.001	Accepted
	Had surgery, had revisions	73	75.7	15.4	72.1	79.3		
	Had surgery, needs revisions	254	67.9	20.9	65.3	70.5		
Scars	Had surgery, did not need revisions	1393	84.0	15.9	83.2	84.8	--	Accepted
	Had surgery, had revisions	70	71.1	23.5	65.5	76.7	<0.001	
	Had surgery, needs revisions	237	56.6	20.3	54.0	59.2	<0.001	
Participants who report that their nipples are located in the right place for them will score higher on scales than those who report the nipples are located in the wrong place								
Chest	Nipples are not appropriately positioned	229	66.9	17.5	64.6	69.2	<0.001	Accepted
	Nipples are appropriately positioned	1686	79.1	17.9	78.3	80.0		

GENDER-Q CHEST VALIDATION

Nipples & Areolas	Nipples are not appropriately positioned	221	50.4	15.7	48.3	52.5	<0.001	Accepted
	Nipples are appropriately positioned	1653	67.7	19.6	66.7	68.6		
Participants who report having two nipples will score higher on scales than those who have one								
Chest	I have both of my nipples	1923	77.6	18.3	76.8	78.4	0.028	Accepted
	I have one nipple and the other is gone	55	71.8	21.7	66.0	77.7		
Nipples & Areolas	I have both of my nipples	1881	65.6	20.0	64.7	66.5	<0.001	Accepted
	I have one nipple and the other is gone	55	48.0	21.6	42.1	53.8		
Participants who underwent periareolar procedures will score higher on scales than those who underwent double incision procedures, given that double incision procedures produce more scarring, discoloration, and would healing complications associated with nipple grafts								
Nipples & Areolas	Double incision, have both nipples	1610	65.7	20.2	64.7	66.7	0.339	Rejected
	Periareolar	139	66.4	18.7	63.2	69.5		
Scars	Double incision	1658	77.1	19.6	76.1	78.0	<0.001	Accepted
	Periareolar	130	91.5	13.5	89.2	93.9		

GENDER-Q CHEST VALIDATION

eTable S3 Correlations between GENDER-Q Chest, Nipples & Areolas, and Scars Scales for Construct Validity

GENDER-Q Domain	GENDER-Q Scale		GENDER-Q Chest	GENDER-Q Nipples & Areolas	GENDER-Q Scars
Chest	Chest	r	--	--	--
		n	--	--	--
	Nipples and Areolas	r	0.6	--	--
		n	2523	--	--
	Scar	r	0.3	0.3	--
		n	1921	1688	--
Body	Body	r	0.6	0.5*	0.2
		n	2698	2439	1820
Sexual	Sexual Well-being	r	0.3	0.2*	0.2
		n	2197	1998	1494
Health-Related Quality of Life (HRQL)	Body Image	r	0.5	0.4	0.2
		n	2466	2235	1660
	Gender Dysphoria	r	0.4	0.3	0.2
		n	2443	2214	1638
	Social Acceptance	r	0.4	0.3	0.1
		n	2507	2270	1686
	Psychological Distress	r	0.4	0.3	0.2
		n	2425	2196	1626
	Psychological Well-being	r	0.4	0.3	0.2
		n	2477	2243	1664
Pearson correlation coefficients are as follows: <0.3 indicates the scales measure unrelated constructs, 0.3 to <0.5 measure related but dissimilar constructs, and ≥0.5 measure similar constructs. r = Pearson correlation coefficient n = Sample size *Hypothesis rejected; all others accepted					

eTable S4 Previously Used Patient-Reported Outcome Measures Evaluating Outcomes after Gender-Affirming Chest Surgery

Patient-Reported Outcome Measure	Constructs	Number of Items	Response Options	Scoring Range	Target Population	Potential Weaknesses Compared to GENDER-Q Chest Scales	Development References
Transgender Congruence Scale (TCS)	Appearance congruence & gender identity acceptance	12	5 (Strongly disagree to Strongly Agree)	1 to 5 (Higher scores indicate higher congruency)	Transgender and gender-diverse individuals	Assesses appearance generally rather than specific surgical outcomes. Scale is scored from 1 to 5 limiting the interpretability of the scales.	Kozee, H. B., Tylka, T. L., & Bauerband, L. A. (2012). Measuring Transgender Individuals' Comfort with Gender Identity and Appearance: Development and Validation of the Transgender Congruence Scale. <i>Psychology of Women Quarterly</i> , 36(2), 179-196. doi.org/10.1177/0361684312442161
Gender Congruence and Life Satisfaction (GCLS) Scale	Gender congruence and life satisfaction as it relates to the following domains: Genitalia Chest Other secondary sex characteristics Social gender role recognition Physical and emotional intimacy Psychological functioning Life satisfaction	38	5 (Never to Always)	1 to 5 (Higher scores indicate greater congruence, well-being, and life satisfaction)	Transgender and gender-diverse individuals	Assesses appearance generally rather than specific surgical outcomes. Scales are scored from 1 to 5 limiting the interpretability of the scales.	Jones BA, Bouman WP, Haycraft E, Arcelus J. The Gender Congruence and Life Satisfaction Scale (GCLS): Development and validation of a scale to measure outcomes from transgender health services. <i>Int J Transgend</i> . 2018;20(1):63-80. Published 2018 Apr 26. doi:10.1080/15532739.2018.1453425
Chest Dysphoria Scale (CDS)	The discomfort and subsequent consequences of chest dysphoria	17	4 (Never to All the Time)	0 to 51 (Higher scores indicate higher distress)	Transmasculine adolescents and young adults	Assesses chest appearance generally rather than specific surgical outcomes. Lacks robust development and psychometric validation.	Olson-Kennedy J, Warus J, Okonta V, Belzer M, Clark LF. Chest Reconstruction and Chest Dysphoria in Transmasculine Minors and Young Adults: Comparisons of Nonsurgical and Postsurgical Cohorts. <i>JAMA Pediatr</i> . May 1 2018;172(5):431-436. doi:10.1001/jamapediatrics.2017.5440

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Body Image Quality of Life Inventory (BIQLI)	The impact of body image on various aspects of life.	19	7 (Very Negative Effect to Very Positive Effect)	-3 to +3 (Higher scores indicate better body image quality of life)	General population but was developed in university females	Assesses body image and quality of life generally rather than specific surgical outcomes. Not developed specifically in TGD individuals undergoing chest masculinization procedures. May not reflect TGD priorities in masculinizing gender-affirming chest surgery May lack content validity for TGD individuals Scale is scored from -3 to +3 limiting the interpretability of the scales.	Cash, T.F. and Fleming, E.C. (2002), The impact of body image experiences: Development of the body image quality of life inventory. <i>Int. J. Eat. Disord.</i> , 31: 455-460. doi.org/10.1002/eat.10033
BREAST-Q	Satisfaction and quality of life related to the breast in the following procedure types: Augmentation Reduction/Mastopexy Breast Cancer	Depends on scale selection	Depends on scale selection	0 to 100 (Higher scores indicate higher satisfaction)	Cisfemales undergoing reconstructive and cosmetic breast surgery	Not developed specifically in TGD individuals undergoing chest masculinization procedures Many items not applicable (e.g., bra-related questions) May not reflect TGD priorities in masculinizing gender-affirming chest surgery May lack content validity for TGD individuals	Pusic AL, Klassen AF, Scott AM, Klok JA, Cordeiro PG, Cano SJ. Development of a new patient-reported outcome measure for breast surgery: the BREAST-Q. <i>Plast Reconstr Surg.</i> 2009;124(2):345-353. doi:10.1097/PRS.0b013e3181aee807
BODY-Q Chest and Nipples	Satisfaction with chest and nipples appearance	Chest - 10 Nipples - 5	4 (Very Dissatisfied to Satisfied)	0 to 100 (Higher scores indicate higher satisfaction)	Patients undergoing body contouring, gynecomastia, or gender-affirming chest surgeries	Not developed specifically in TGD individuals undergoing chest masculinization procedures May not reflect TGD priorities in masculinizing gender-affirming chest surgery May lack content validity for TGD individuals	Dalaei F, de Vries CEE, Cano SJ, et al. BODY-Q Normative Scores: Psychometric Validation of the BODY-Q in the General Population in Europe and North America. <i>Plast Reconstr Surg Glob Open.</i> 2023;11(11):e5401. Published 2023 Nov 16. doi:10.1097/GOX.0000000000005401

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