

# Body Contouring Surgery After Bariatric Surgery Improves Long-Term Health-Related Quality of Life and Satisfaction With Appearance

## An International Longitudinal Cohort Study Using the BODY-Q

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**Objective:** To examine health-related quality of life (HRQL) and satisfaction with appearance in patients who have undergone bariatric surgery (BS) with or without subsequent body contouring surgery (BCS) in relation to the general population normative for the BODY-Q.

**Background:** The long-term impact of BS with or without BCS has not been established using rigorously developed and validated patient-reported outcome measures. The BODY-Q is a patient-reported outcome measure developed to measure changes in HRQL and satisfaction with appearance in patients with BS and BCS.

**Methods:** Prospective BODY-Q data were collected from 6 European countries (Denmark, the Netherlands, Finland, Germany, Italy, and Poland) from June 2015 to February 2022 in a cohort of patients who

underwent BS. Mixed-effects regression models were used to analyze changes in HRQL and appearance over time between patients who did and did not receive BCS and to examine the impact of patient-level covariates on outcomes.

**Results:** This study included 24,604 assessments from 5620 patients. BS initially led to improved HRQL and appearance scores throughout the first postbariatric year, followed by a gradual decrease. Patients who underwent subsequent BCS after BS experienced a sustained improvement in HRQL and appearance or remained relatively stable for up to 10 years postoperatively.

**Conclusions:** Patients who underwent BCS maintained an improvement in HRQL and satisfaction with appearance in contrast to patients who

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only underwent BS, who reported a decline in scores 1 to 2 years postoperatively. Our results emphasize the pivotal role that BCS plays in the completion of the weight loss trajectory.

**Keywords:** bariatric surgery, body contouring surgery, health-related quality of life, massive weight loss, patient-reported outcomes, patient-reported outcome measures, postbariatric surgery, weight loss surgery

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Since 1975, the prevalence of obesity has more than tripled and reached epidemic proportions.<sup>1</sup> By 2030, the prevalence is estimated to reach 20% of people worldwide, and the cost of obesity-related care represents over 20% of all health care expenses.<sup>2,3</sup> Obesity is associated with a range of negative outcomes including increased comorbidities, reduced life expectancy, increased economic burden due to increased medical treatments, and productivity loss.<sup>4</sup> In addition, people living with morbid obesity experience lower health-related quality of life (HRQL) than people who do not experience obesity.<sup>5,6</sup>

Bariatric surgery (BS) is the most effective weight loss treatment, resulting in sustained weight loss, remission of obesity-related medical problems, and improvement of HRQL in the short term.<sup>7</sup> However, the massive weight loss (MWL) that can be achieved with BS leaves 70% to 90 percent of patients with varying degrees of excess skin, which may decrease HRQL and satisfaction with appearance in an otherwise successful weight loss trajectory.<sup>8,9</sup> Excess skin is associated with infections, ulcerations, pain, impairments in physical activities, social isolation, and concerns regarding the patient's body image.<sup>10</sup> Therefore, MWL after BS has led to a new population of patients seeking body contouring surgery (BCS) in the United States and Europe.<sup>11,12</sup> Figure 1 shows the change in appearance after BCS. In the short term (< 5 years of follow-up), BCS has been shown to positively impact HRQL.<sup>13–15</sup> However, the long-term effects of BS with and without BCS on postoperative patient outcomes are unknown.<sup>15</sup>

HRQL and patients' satisfaction with outcomes after surgery are best measured using patient-reported outcome measures (PROMs).<sup>16</sup> Prior research has indicated that the BODY-Q emerged as the PROM, meeting the highest number of criteria for psychometric rigor, particularly suitable for patients undergoing BS and BCS.<sup>10,17</sup> The BODY-Q has been increasingly used in cross-sectional and short-term prospective studies.<sup>13–15</sup> However, the weight loss trajectory from pre-BS to post BCS has not been established longitudinally, nor has comparisons been made with the general population normative scores of the BODY-Q.<sup>18</sup> This represents a current gap in the existing literature, as no previous studies have employed population norms for the BODY-Q as a reference point for comparison with the patient's level of satisfaction with appearance and HRQL. Long-term studies evaluating patient-reported outcomes (PROs) of BS alone and BS followed by BCS are urgently needed to understand the impact of these treatments on patients' HRQL and satisfaction with appearance. The PRO data could be employed to establish realistic patient expectations post BS and post BCS and for preoperative patient counseling, resulting in enhanced shared decision-making.<sup>19</sup> This study aimed to explore the long-term changes in HRQL and appearance throughout the weight loss trajectory from pre-BS to post BCS in a large European sample of patients. In addition, we aimed to compare BODY-Q scores for patients with normative values in the general population.

## METHODS

### Study Design

Figure 2 shows the data collection time points. This study was designed as a multicenter, international cohort study to assess HRQL and satisfaction with appearance through the weight loss trajectory from pre-BS to post BCS. Data were collected from patients aged 18 years or older. Patients who were unable to communicate in the language of data collection or with cognitive impairments were excluded. The study was registered at ClinicalTrials.gov (NCT05272215), and reported according to the STROBE Guidelines.<sup>20</sup>

### Patient Characteristics

The following patient characteristics were collected: age, current weight, preoperative weight, height, marital status, education level, obesity-related comorbidities (ie, diabetes, hypertension, hyperlipidemia, obstructive sleep apnea, osteoarthritic disease, and cardiovascular/coagulation disease), BS type, BS date, previous BCS, area of BCS, and BCS dates. In Denmark and the Netherlands, patient characteristics were captured throughout the follow-up period, while only baseline characteristics were collected in the remaining countries.

### Data Collection and BODY-Q Administration

#### Bariatric Surgery

Patients seeking BS treatment from the following hospital units were invited to participate in the study: Denmark: Odense University Hospital, Odense, and Hospital of Southwest Jutland, Esbjerg. The Netherlands: OLVG West Hospital, Amsterdam, and St. Antonius Hospital, Nieuwegein. Participants from Denmark were recruited between June 2015 and November 2021, and participants from the Netherlands were recruited between February 2019 and November 2021. The BODY-Q was administered at the following time points: before BS and after BS (<6-, 6–12-, 24-, 36-, 48-, and 60 months postoperatively).

#### Body Contouring Surgery

Patients seeking BCS treatment from the following hospital units were invited to this study: Denmark: Odense University Hospital, Odense; Hospital of Southwest Jutland, Esbjerg; Herlev and Gentofte Hospital, Herlev; and Printzlau Private Hospital, Virum (from June 2015 to November 2021), the Netherlands: OLVG West Hospital, Amsterdam; Catharina Hospital, Eindhoven; and St. Antonius Hospital, Nieuwegein (from December 2017 to November 2021), Finland: Tampere University Hospital, Tampere (from February 2019 to November 2021), Germany: Johanniter-Krankenhaus und Waldkrankenhaus, Bonn (from June 2018 to May 2021), Italy: Università Campus Bio-Medico Hospital, Rome (from February 2019 to November 2021), and Poland: Marciniak Specialized Hospital, Wrocław (from February 2019 to November 2021). The BODY-Q was administered at 6 time points: before BCS and after BCS (<6-, 6–12-, 24-, 36-, 48 months postoperatively). In Germany, the BODY-Q was administered at 2 time points before BCS and 1 year after BCS.

#### Data Administration

Participants from Denmark received a direct link to complete the study survey in the Research Electronic Data Capture (REDCap) hosted by the Open Patient data Explorative Network (OPEN), University of Southern Denmark. The participants were contacted using a secure electronic mailbox.



**FIGURE 1.** Clinical pictures from 2 patients before and after body contouring surgery. The figure shows 2 patients before (the 2 left pictures) and after body contouring surgery (the 2 right pictures).

Patients who did not respond were sent up to 3 weekly reminders. The option to complete the survey at the point of care using an iPad was also provided. Participants from the Netherlands, Finland, Italy, and Poland were invited to participate via an e-mail invitation and were recruited via a URL link directly in Castor EDC (Amsterdam, the Netherlands). A weekly reminder was sent up to 2 times to nonresponders. In Germany, patients were invited to participate and complete the survey at the point of care. Data were entered manually into Microsoft Excel (2018).

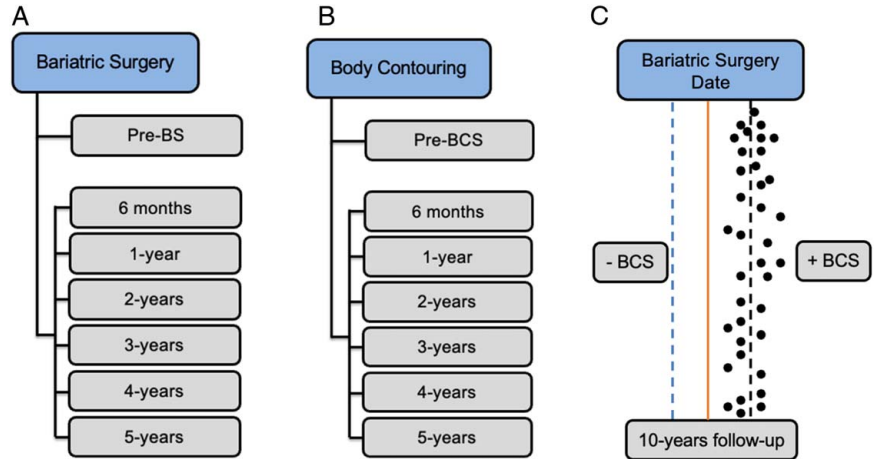
### Outcome Measures

The BODY-Q is a comprehensive PROM designed to measure HRQL, appearance, eating-related concerns, and experience of care in patients undergoing weight loss and/or BCS after MWL.<sup>21</sup> It consists of 32 independently functioning scales

that assess 4 key domains: appearance, HRQL, eating concerns, and experience of care. Supplemental 1, Supplemental Digital Content 1, <http://links.lww.com/SLA/F21> presents the BODY-Q framework, illustrating how these scales align with the overarching domains. The variety of scales provides the flexibility to select the subset of scales most appropriate for measuring the desired outcomes in research or clinical settings.<sup>21–24</sup>

The BODY-Q was rigorously developed to measure changes over the entire weight loss trajectory. The psychometric validation of the BODY-Q, the translation, and linguistic validation in the used languages have been published elsewhere.<sup>22,23,25–28</sup> In this study, the following BODY-Q HRQL (ie, body image, physical function, psychologic, sexual, and social) and appearance (ie, abdomen and body) scales were included. Each of the BODY-Q scales has between 4 and 10 items scored on a Likert scale from 1 (ie, very dissatisfied) to 4

**FIGURE 2.** Data collection time points. (A) Prospective BODY-Q administration for patients undergoing bariatric surgery (BS), (B) prospective BODY-Q administration for patients undergoing body contouring (BCS), and (C) study design, using the BS date to compute a 10-year follow-up period since the BS date, representing 3 groups: BS without BCS (blue line), BS with BCS (black line), and the general normative population (orange line). Patient characteristics were captured throughout the follow-up period in Denmark and the Netherlands, and at baseline in Germany, Italy, Finland, and Poland.



(ie, very satisfied). The summed raw scores of all items in a scale were transformed using Rasch Conversion Tables for each scale to generate a score between 0 (worst) and 100 (best).

**Normative BODY-Q Scores**

General population normative BODY-Q scores were established as a reference value for the general population BODY-Q scores using an international sample of 4051 participants from 12 countries in North America and Europe. The participants were recruited through the crowdsourcing platforms Prolific Academic and Amazon Mechanical Turk. The normative values presented as means of the total population, continent-specific, and country-specific,<sup>18</sup> as well as the psychometric properties of the normative values and evidence to support the use of a common scoring algorithm, have been published elsewhere.<sup>29</sup>

**Missing Data**

To reduce the percentage of missing data in the questionnaires, e-mail reminders were sent to all patients. In Castor EDC, patients are required to complete all items on a scale, whereas the REDCap survey permitted missing values. If at least 50% of the scale’s items were completed, the mean of the completed item was used to score the scale in compliance with the BODY-Q User Guide.

**Statistical Analysis**

Statistical analyses were performed using Stata Version 17. Descriptive statistics including mean, SD, and 95% CI were computed for continuous variables, and percentages were computed for categorical variables. The BODY-Q was administered prospectively both preoperatively and at intervals up to 4 to 5 years postoperatively. To analyze the impact of BCS after BS, we used the date of the BS to compute “time elapsed after BS.” This approach established multiple time points for a 10-year follow-up period (see Table 1 for specific time points). Figure 2 provides an overview of these follow-up periods and the overall study design. To examine the longitudinal data with repeated measures over time and to evaluate the impact of relevant covariates, we employed a mixed-effects linear regression model. The covariates included were age, gender, Body Mass Index (BMI), comorbidities, educational level, marital status, and country of origin. This model simulates individual-specific changes in responses, handles missing data and time-varying covariates, and accounts for the correlation among repeated measures by including a random intercept for each patient.

**RESULTS**

**Baseline Characteristics**

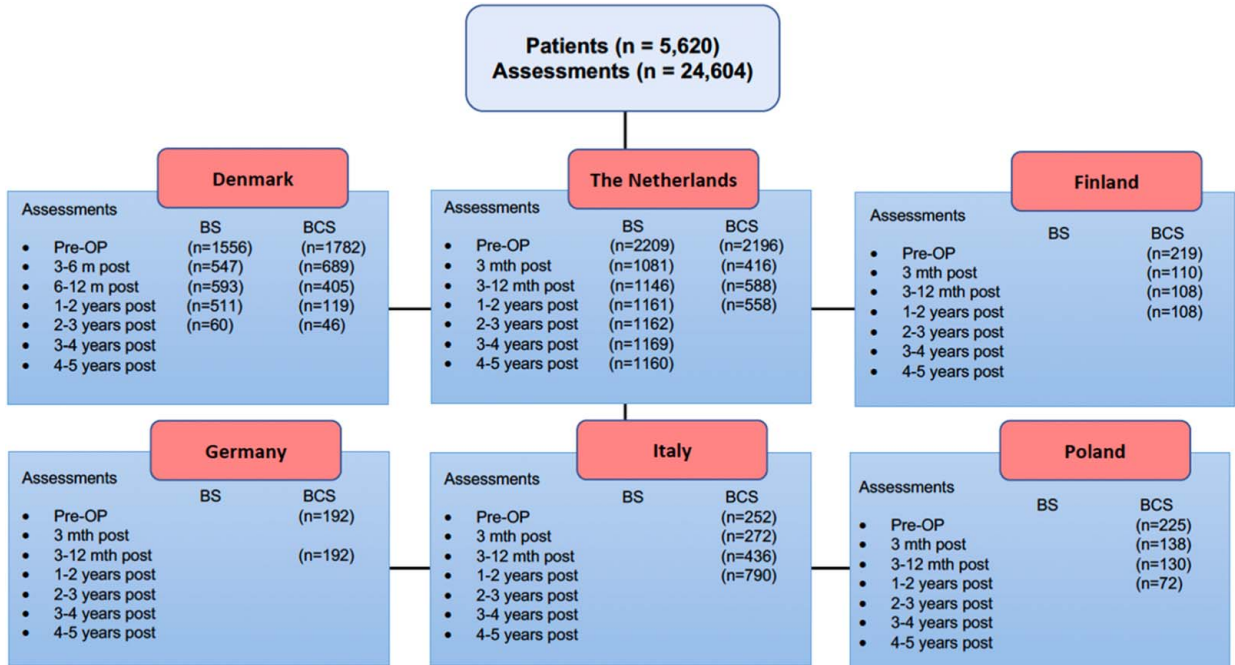
The sample consisted of 24,604 assessments from 5620 patients: 3451 patients from Denmark, 1426 from the Netherlands, 63 from Finland, 192 from Germany, 420 from Italy, and

**TABLE 1.** Number of Assessments at Each Time Point After Bariatric Surgery Date

Time Point	Denmark (n)	Netherlands (n)	Finland (n)	Germany (n)	Italy (n)	Poland (n)
Pre-BS	1556	2209	—	—	—	—
6 mo post BS	334	3806	—	—	—	—
1 yr post BS	575	1404	—	192	6	—
2 yr post BS	929	2028	62	—	15	43
3 yr post BS	816	781	63	—	21	142
4 yr post BS	370	535	68	—	12	125
5 yr post BS	238	284	—	—	18	102
6 yr post BS	182	144	21	—	—	25
7 yr post BS	145	117	9	—	9	14
8 yr post BS	108	60	14	—	—	—
9 yr post BS	95	61	6	—	—	7
10 yr post BS	295	105	9	—	30	9

n indicates number; Post BS, after bariatric surgery; Pre-BS, before bariatric surgery.

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**FIGURE 3.** Flowchart of countries and number of assessments from each time point. The figure shows the total number of assessments and patients in the cohort as well as the respective number of assessments prospectively collected from each country.

68 from Poland. Figure 3 presents the number of assessments from each country, Table 1 presents the number of assessments at each time point after the BS date, Supplemental 2, Supplemental Digital Content 2, <http://links.lww.com/SLA/F22> presents the participant characteristics, and Table 2 presents the mean BMI. The cohort consisted of 82.3% females and 17.7% males, with a mean age of 43 years and a baseline BMI of  $45.2 \pm 7.5$  kg/m<sup>2</sup> before BS and  $28.7 \pm 4.7$  kg/m<sup>2</sup> before BCS. Table 2 shows the mean BMI of the Danish and Dutch patients from baseline to 5 years postoperatively. Only baseline BMI data

were available in Poland, Finland, Germany, and Italy. The mean follow-up was 37 months in total with a mean follow-up of 30.6 months in Denmark, 16.7 months in the Netherlands, 49.0 months in Finland, 12 months in Germany, 64.9 months in Italy, and 49.4 months in Poland.

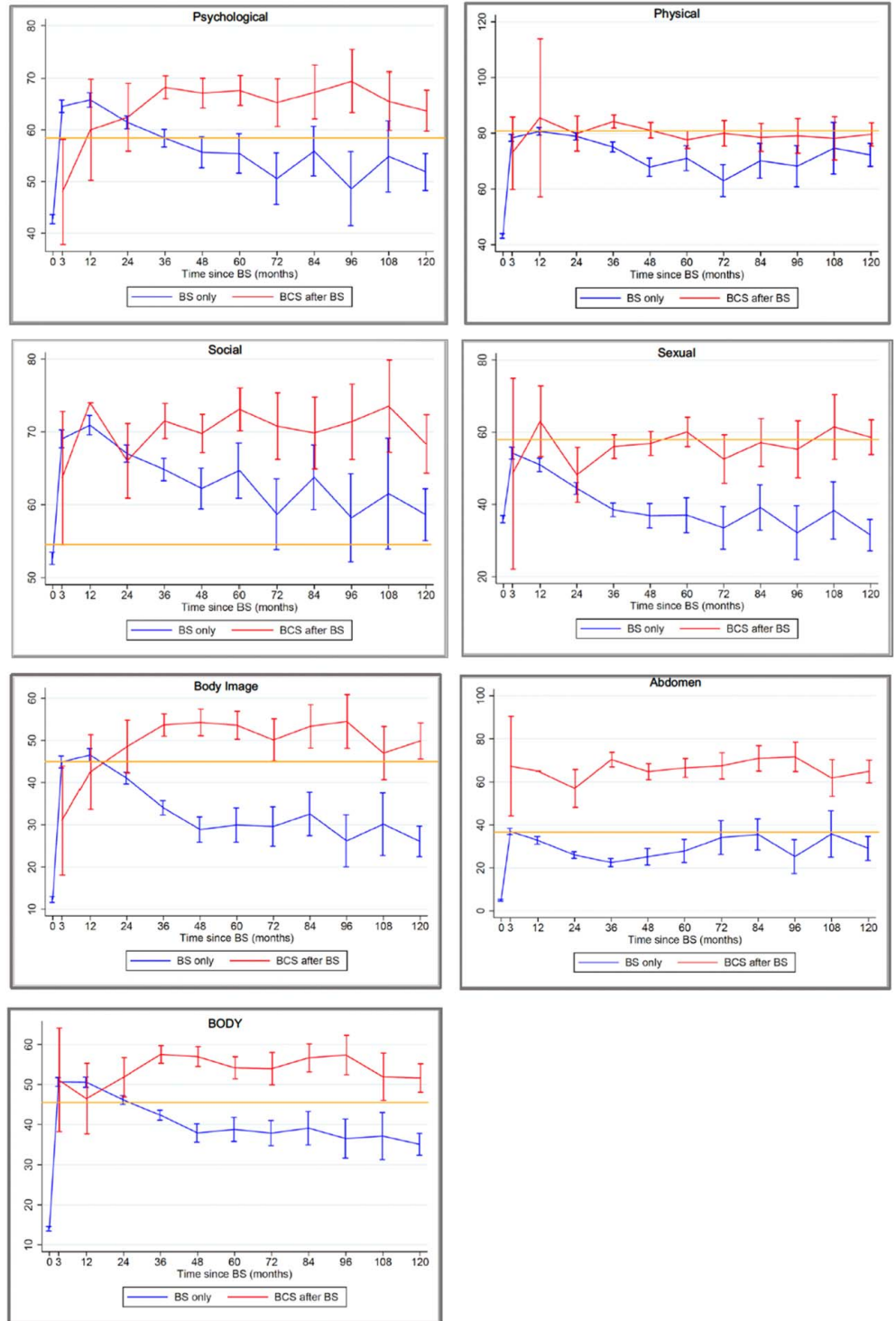
**The Impact of Body Contouring After BS**

Figure 4 shows the change in HRQL and appearance scales across the 10-year follow-up of patients who only underwent BS compared to patients who underwent BCS post BS.

**TABLE 2.** Mean BMI (kg/m<sup>2</sup>) From Baseline to 5 Years Postoperatively

BMI	BS	Total			DK			The Netherlands		
		N	Mean	SD	N	Mean	SD	N	Mean	SD
<b>BMI BS</b>										
	Baseline	2075	45.17	7.49	1492	46.44	7.07	583	43.90	7.91
	6 mo	966	33.69	5.47	547	33.95	6.36	419	33.43	4.57
	1 yr	964	29.67	5.07	593	31.00	5.58	371	28.33	4.55
	2 yr	879	29.53	5.52	511	30.94	6.28	368	28.11	4.75
	3 yr	717	30.37	7.59	435	32.18	9.64	282	28.55	5.53
	4 yr	466	31.33	7.93	253	33.29	10.32	213	29.37	5.54
	5 yr	105	32.53	7.29	60	34.24	9.88	45	30.82	4.70
<b>BMI BCS</b>										
	Baseline	3257	28.57	5.17	1782	27.54	3.68	1475	29.59	6.66
	6 mo	1003	27.34	4.10	689	26.23	3.39	314	28.45	4.80
	1 yr	811	27.61	4.44	405	26.81	4.09	406	28.40	4.78
	2 yr	781	27.74	4.09	408	27.03	3.31	373	28.44	4.87
	3 yr	518	27.58	4.26	389	26.99	2.99	129	28.16	5.53
	4 yr	246	26.79	3.04	246	26.79	3.04	—	—	—
	5 yr	75	26.95	3.42	75	26.95	3.42	—	—	—

N indicates number of patients.  
 Time points: 6 mo = 6 months postoperatively, 1 yr = 1 year postoperatively, 2 yr = 2 years postoperatively, 3 yr = 3 years postoperatively, 4 yr = 4 years postoperatively, 5 yr = 5 years postoperatively.  
 Baseline BCS = all included countries. Country-specific baseline BMI for BCS, Italy: 25.6 (2.81) kg/m<sup>2</sup>, Germany: 32.6 (7.50) kg/m<sup>2</sup>, Poland: 27.6 (4.11) kg/m<sup>2</sup>, and Finland: 29.0 (3.72) kg/m<sup>2</sup>.



**FIGURE 4.** Change in BODY-Q scores over the weight loss trajectory. Change in health-related quality of life and appearance over the course of 10 years for each scale and the normative values (orange line). The figure shows the Rasch-converted BODY-Q scores (y axis) and time since BS (x axis) for all included patients. The blue line shows the scores of patients who only had BS ( $\pm$  SD), and the red line shows the scores of patients who had BS and subsequent BCS ( $\pm$  SD) \*. \*The following covariates were included in the mixed-effects linear regression model: age, gender, BMI, comorbidities, educational level, marital status, and country of origin.

Table 3 shows the impact of BCS on BS scores. Initial improvements were seen in all scales post BS, with psychologic, physical, social, body image, and body scales peaking at 12 months, whereas sexual and abdomen scores peaked at 3 months. A decline in all the BODY-Q scores was noted in patients with BS only with no rebound, notably with the 10-year

sexual score dropping below preoperative levels. Participants treated with BCS after BS demonstrated significantly higher scores ( $P < 0.001$ ) at 2 years post BCS, sustaining or improving scores over the follow-up period in all scales, with a minor decline observed in psychologic, social, body image, abdomen, and body scales 8 to 10 years post BCS. However, a statistically

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**TABLE 3.** The Impact of Body Contouring Surgery on Bariatric Surgery

BODY-Q	Psychologic				Social				Sexual				Physical				
	BS vs BCS	n	Coef.	95% CI	P	n	Coef.	95% CI	P	n	Coef.	95% CI	P	n	Coef.	95% CI	P
Baseline	2038	0	—	—	2030	0	—	—	1984	0	—	—	2034	0	—	—	—
Time point 6 M	1064	-13.4	-31.5; 4.72	NS	1054	-2.48	-19.7; 14.8	NS	865	-4.80	-26.3; 16.7	NS	1073	-3.21	-21.6; 15.2	NS	NS
Time point 1 Y	882	-6.74	-32.9; 19.5	NS	873	-1.41	-25.4; 22.6	NS	757	12.3	-18.2; 42.8	NS	889	13.7	-13.7; 41.2	NS	NS
Time point 2 Y	1157	6.78	2.05; 11.5	0.005	1155	6.41	2.16; 10.7	0.003	1068	10.5	4.93; 16.1	<0.001	1156	4.01	-1.06; 9.08	NS	NS
Time point 3 Y	947	10.3	7.92; 12.7	<0.001	941	7.89	5.72; 10.0	<0.001	941	18.4	15.7; 21.2	<0.001	949	8.48	5.90; 11.0	<0.001	<0.001
Time point 4 Y	451	9.76	6.63; 12.9	<0.001	449	7.65	4.84; 10.5	<0.001	446	19.6	16.0; 23.3	<0.001	450	11.4	8.07; 14.8	<0.001	<0.001
Time point 5 Y	290	12.1	8.12; 16.1	<0.001	287	8.74	5.15; 12.3	<0.001	285	20.7	16.1; 25.3	<0.001	286	8.58	4.33; 12.8	<0.001	<0.001
Time point 6 Y	162	13.1	7.71; 18.4	<0.001	162	7.94	3.08; 12.8	0.001	160	16.7	10.4; 22.9	<0.001	160	12.0	6.20; 17.8	<0.001	<0.001
Time point 7 Y	152	11.1	5.51; 16.6	<0.001	151	3.52	-1.54; 8.58	NS	151	18.9	12.5; 25.4	<0.001	152	8.16	2.26; 14.1	0.007	0.007
Time point 8 Y	93	16.3	8.87; 23.7	<0.001	93	10.5	3.73; 17.2	0.002	92	19.5	10.8; 28.2	<0.001	91	7.71	-0.27; 15.7	NS	NS
Time point 9 Y	85	6.74	-1.00; 14.5	<0.001	84	8.74	1.69; 15.8	0.02	82	20.6	11.5; 29.8	<0.001	83	5.03	-3.22; 13.3	NS	NS
Time point 10 Y	244	12.5	8.16; 16.9	<0.001	244	10.6	6.64; 14.5	<0.001	240	26.3	21.2; 31.4	<0.001	240	6.30	1.55; 11.1	0.009	0.009
BODY-Q																	
BS vs BCS	n	Coef.	95% CI	P	n	Coef.	95% CI	P	n	Coef.	95% CI	P	n	Coef.	95% CI	P	P
Baseline	2033	0	—	—	2090	0	—	—	2065	0	—	—	2065	0	—	—	—
Time point 6 M	1080	-11.4	-29.4; 6.57	NS	1183	33.9	14.3; 53.4	<0.001	1120	0.68	-12.8; 14.2	NS	1120	0.68	-12.8; 14.2	NS	NS
Time point 1 Y	893	-1.37	-28.7; 26.0	NS	748	35.9	5.19; 66.7	0.02	741	-0.38	-21.7; 21.0	NS	741	-0.38	-21.7; 21.0	NS	NS
Time point 2 Y	1161	9.52	4.48; 14.6	<0.001	1094	34.0	28.0; 40.1	<0.001	1075	8.30	4.03; 12.6	<0.001	1075	8.30	4.03; 12.6	<0.001	<0.001
Time point 3 Y	956	20.2	17.6; 22.8	<0.001	994	48.2	45.2; 51.2	<0.001	980	15.4	13.3; 17.4	<0.001	980	15.4	13.3; 17.4	<0.001	<0.001
Time point 4 Y	455	24.1	20.7; 27.4	<0.001	473	37.9	34.0; 41.8	<0.001	464	17.5	14.8; 20.2	<0.001	464	17.5	14.8; 20.2	<0.001	<0.001
Time point 5 Y	290	24.4	20.1; 28.6	<0.001	307	37.7	32.8; 42.6	<0.001	300	16.4	13.0; 19.8	<0.001	300	16.4	13.0; 19.8	<0.001	<0.001
Time point 6 Y	165	19.5	13.8; 25.1	<0.001	166	32.7	26.1; 39.3	<0.001	164	15.3	10.7; 19.9	<0.001	164	15.3	10.7; 19.9	<0.001	<0.001
Time point 7 Y	153	21.2	15.3; 27.1	<0.001	158	34.4	27.6; 41.2	<0.001	159	15.9	11.2; 20.6	<0.001	159	15.9	11.2; 20.6	<0.001	<0.001
Time point 8 Y	94	28.8	21.0; 36.6	<0.001	95	47.8	38.8; 56.8	<0.001	95	19.4	13.1; 25.6	<0.001	95	19.4	13.1; 25.6	<0.001	<0.001
Time point 9 Y	85	16.8	8.63; 25.0	<0.001	89	27.0	17.7; 36.2	<0.001	87	14.5	8.02; 21.0	<0.001	87	14.5	8.02; 21.0	<0.001	<0.001
Time point 10 Y	246	24.4	19.8; 29.1	<0.001	248	36.3	30.8; 41.7	<0.001	248	16.6	12.9; 20.4	<0.001	248	16.6	12.9; 20.4	<0.001	<0.001

The table shows the difference between patients undergoing bariatric surgery (BS) with and without body contouring surgery (BCS) in each BODY-Q scale. 6 M indicates 6 months postoperatively; Coef., coefficient; n, number of patients; NS, nonsignificant. (The following covariates were included in the mixed-effects linear regression model: age, gender, BMI, comorbidities, educational level, marital status, and country of origin.)

significant improvement was observed. The largest improvement was found in the abdomen scale after 3 years, showing a 48.2-point difference between BS only and subsequent BCS ( $P < 0.001$ ).

### Changes in HRQL Scores and Normative Values

Figure 4 shows the general population normative BODY-Q scores (orange line) for all scales to compare the scores of patients with the general population. In the following scales: psychologic, physical, sexual, body image, abdomen, and body, BCS was associated with scores at either the level of the normative values or above the general population scores. Patients who underwent only BS, without subsequent BCS, scored lower than the general population across all scales. The exception was the social scale, where patients who had only BS scored higher than the normative social scores, without subsequent BCS.

### Patient-level Covariates

Supplemental 3, Supplemental Digital Content 3, <http://links.lww.com/SLA/F23> shows the individual coefficients for each variable in the mixed-effect linear model for all BODY-Q scales. For all scales, age groups 40 to 49 and 50 to 59 years were associated with higher scores ( $P < 0.001$ ), and BMI  $> 40$  kg/m<sup>2</sup> was positively associated with scale scores ( $P < 0.05$ ).

Male participants scored significantly lower than female participants in psychologic ( $P < 0.01$ ), physical ( $P < 0.001$ ), abdomen ( $P < 0.001$ ), and body ( $P < 0.04$ ), and significantly higher in sexual ( $P < 0.001$ ). Comorbidities (especially diabetes, hypertension, hyperlipidemia, and psychiatric disorders) were negatively associated with BODY-Q scores for all scales. Being single was negatively associated with all scales ( $P < 0.001$ ).

## DISCUSSION

We explored changes in HRQL and satisfaction with appearance throughout the weight loss trajectory up to 10 years after the BS date and compared the patients' BODY-Q scores with the normative scores of the general population. Patients who only had BS experienced a significant improvement in HRQL and satisfaction with appearance from baseline to 3 to 12 months after surgery; however, their scores gradually declined over time. In contrast, patients who underwent BCS after BS reported sustained or even continuous improvement in BODY-Q scores 10 years after they had BS. Our findings confirm that while BS initially has a major impact on short-term improvements in HRQL and appearance, subsequent BCS can potentially lead to improved or sustained long-term improvements in HRQL and satisfaction with appearance.

After the first postbariatric year, patients who underwent BCS scored significantly higher than patients who underwent BS alone 10 years after surgery. This finding is crucial for clinicians, patients, and health care providers to understand the potential effect of BCS on weight loss trajectory. Currently, BCS is not an integrated procedure in the weight loss trajectory post BS.<sup>30</sup> In many countries, it is classified as cosmetic surgery; hence, it is not routinely reimbursed by health care insurance.<sup>31</sup> Our findings advocate the integration of BCS after BS into the weight loss trajectory. Currently, there is a substantial discrepancy between the number of patients desiring BCS and the uptake of BCS post BS.<sup>32,33</sup> In a retrospective follow-up of 37,806 patients, Altieri et al<sup>34</sup> demonstrated that only 6% of patients who underwent BS subsequently underwent BCS. Factors such as insurance coverage and income can influence the decision to undergo BCS post BS, especially in countries where BCS is not

publicly funded. Another barrier to BCS uptake is the ambiguous evidence regarding the complication rate post BS. While some studies attest to BCS as a safe and effective reconstruction solution to remove excess skin following MWL,<sup>35</sup> others have reported high complication rates.<sup>36</sup> In the included countries, BS and BCS are either available through public health systems within specified criteria (Denmark and Finland),<sup>25,37</sup> via health insurance companies (the Netherlands, Germany, and Italy),<sup>11,38</sup> and National Healthcare Insurer (Poland).<sup>39</sup> Currently, only a few American studies have investigated the impact of socioeconomic factors on the reimbursement of BCS following BS. Cost and insurance coverage are major barriers for patients undergoing BCS in the United States.<sup>40,41</sup> However, this study only included European countries, which means the socioeconomic evaluations from the United States are not directly applicable.<sup>42</sup> This study primarily involved Danish (61.4%) and Dutch (25.4%) patients. In our context, BCS after BS is not considered cosmetic surgery within specified criteria, and these procedures are either fully publicly funded (in Denmark and Finland) or covered by national health insurance companies (in the Netherlands, Belgium, Italy, and Poland).<sup>30,37,38</sup> Therefore, we do not encounter the same socioeconomic disparities as observed in the United States,<sup>43</sup> making this a minor concern in our analysis. To the best of our knowledge, no studies have yet explored the impact of socioeconomic factors on BODY-Q scores.

Overall, the findings of this study raise questions about whether health care providers, insurance companies, clinicians, and politicians should rethink the current referral pathway worldwide. In addition, it is suggested that national BCS guidelines regarding reimbursements should be standardized to minimize potential socioeconomic disparities.<sup>33,44</sup> Should BCS be more accessible to postbariatric patients? Is the current insurance coverage and national health system reimbursement sufficient, or should it be modified with PRO incorporation? To answer these questions, health economic cost-utility studies are urgently needed. These studies should assess the benefits of BS and BCS compared to the costs and harms of both treatments in each country, respecting the differences such as those between North America and Europe regarding the reimbursement of BCS.

Sociodemographic factors may influence patients undergoing BCS after BS. Factors such as being female, younger age, the amount of weight loss, and changes in BMI have previously been shown to influence the desire for BCS.<sup>45</sup> Overall, patients with higher pre-BS BMI and post-BS BMI are more likely to undergo procedures covered by insurance, as they tend to lose more weight and develop a larger number of excess folds or pannus, making them eligible for insurance coverage.<sup>40</sup> Among surgeons, there is a perception that younger age is associated with a lower risk of excess skin following BS, due to greater skin elasticity and better skin retraction in younger patients. Conversely, Gusenoff et al<sup>40</sup> found that age was not a predictor of the need for BCS after gastric bypass; instead, the time elapsed since the gastric bypass, rather than the patient's age, was a significant factor. In this study, patients under 40 years of age were more dissatisfied with their appearance and had lower HRQL, scoring lower on the BODY-Q scales. Divorced patients showed a trend toward a significantly higher amount of BCS,<sup>40</sup> aligning with our findings that being single negatively impacts all BODY-Q scales and, hence, may increase the desire for BCS.

Altieri et al<sup>34</sup> suggested that BCS typically occurs within 2 years after BS, which corresponds with our observation that HRQL and satisfaction with appearance scores begin to decline



1 to 2 years post BS without subsequent BCS. Based on these findings, the timeframe may be crucial for patients considering BCS. Clinicians and health care providers should be aware of this critical point in the trajectory of weight loss. In addition, understanding patients' expectations of BS and BCS is pivotal for effective preoperative informed consent and establishing realistic expectations.<sup>46</sup>

Weight regain after BS could also be an important factor that requires further exploration. The prevalence of weight regain has been reported to be between 5.7% and 76% at 2 to 6 years after BS.<sup>47</sup> Our study showed slight weight regain 3 to 5 years post BS. However, the patients who underwent BCS sustained a significantly lower BMI (Table 2). Longer follow-up on the patient's weight is needed to assess the potential concern with weight regain in the BS-alone population compared to BS followed by BCS.

Prior research has primarily focused on the short-term effects of BS and BCS in cross-sectional or short-term prospective studies.<sup>14,15,35,48</sup> Our BS findings align with Kvaalem et al,<sup>49</sup> where over 90% of participants were satisfied with the results 1-year post surgery, while only 69% were satisfied and felt that their expectations of BS were met 5 years post surgery. Similarly, other studies using the BODY-Q showed that HRQL for patients undergoing BS improved most significantly within the first year after surgery and then gradually declined.<sup>14,15</sup>

In contrast to our BCS findings, a small sample of 33 Dutch patients undergoing BCS after BS showed improved HRQL post BCS using the Obesity Psychosocial State Questionnaire. However, after a 7-year follow-up, only 55% of patients were satisfied with their BCS results.<sup>50</sup> Our team previously showed improvement in BODY-Q HRQL and satisfaction with appearance scores in a Danish cohort of BS and BCS patients that included 1414 people surveyed cross-sectionally and 66 people surveyed longitudinally. This study had a larger and longer follow-up period than our previous study. In contrast to this study, we previously did not observe significant differences between BS patients who later underwent BCS and those who only underwent BS until 3 to 4 years post surgery.<sup>48</sup>

This indicates the importance of larger sample sizes and longer follow-ups to draw conclusions on the evidence of BCS. To the best of our knowledge, this study is the largest up to 10-year longitudinal study to describe the changes in HRQL and satisfaction with appearance throughout the entire weight loss trajectory. With a European sample of over 24,600 assessments and up to 10 years after BS date, our findings have broad applicability. Although only 448 patients were included at the 10-year point after BS survey, the use of a robust, psychometrically validated, condition-specific PROM further strengthens the reliability of our results. Our results provide valuable insights into patient experiences pre-surgery and post surgery, serving as a guide for clinicians to counsel patients and for patients to set realistic expectations for BS and BCS outcomes.

This study has several limitations. First, the sample sizes varied across countries, with the majority of participants from Denmark (61.4%) and the Netherlands (25.4%). Germany, Italy, Finland, and Poland only provided baseline characteristics and lacked follow-up data regarding patient characteristics such as BMI and comorbidities post surgery. The generalizability of the results may be affected by nonparticipation, potentially leading to nonresponse and selection bias. Finally, due to the complexity of measuring the entire weight loss trajectory, several parameters, such as the number of previous BCS, complications following BS and BCS, and longer follow-up regarding weight regain after BS and BCS, were not measured. Future research is

needed and should be focused on extended and more extensive follow-ups, incorporating PRO data with clinical data and clinical information. This approach is essential for accurate consideration of variables such as specific BCS surgical technique, weight regain, comorbidities, and treatment complications. In addition, there is a need for cost-utility evaluations.

## CONCLUSIONS

Our results provide evidence of the positive impact of BS and BCS on patients' lives and emphasize the consideration of BCS as part of the treatment pathway in patients' weight loss trajectory given the role it plays in improving HRQL and satisfaction with appearance. Patients undergoing only BS reported a gradual decline in BODY-Q HRQL and satisfaction with appearance scores over time, whereas those who underwent BCS after BS maintained improved scores across all scales over time. This study provides prospective comparative data over a 10-year period after the time of BS, aiding in the advocacy of including BCS in the weight loss trajectory.

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