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The Impact of Psychiatric Diagnoses on Patient-Reported Satisfaction and Quality-of-Life in Post-Mastectomy Breast Reconstruction

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Abstract

Objective: The purpose of this study was to determine the prevalence of psychiatric diagnoses among a sample of breast reconstruction patients and measure the association between these diagnoses and reconstruction-related, patient-reported outcomes.

Summary of Background Data: The impact of psychiatric disorders in conjunction with breast cancer diagnosis, treatment, and reconstruction have the potential to cause significant patient distress but remains not well understood.

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All authors listed above meet the following criteria:

1. Authors make substantial contributions to conception and design, and/or acquisition of data, and/or analysis and interpretation of data;
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Methods: A retrospective review of post-mastectomy breast reconstruction patients from 2007–2018 at Memorial Sloan Kettering Cancer Center was conducted. Patient demographics, comorbidities, cancer characteristics, psychiatric diagnoses, and BREAST-Q Reconstruction Module scores (measuring satisfaction with breast, well-being of the chest, psychosocial, and sexual well-being) at postoperative years 1–3 were examined. Mixed effects models and cross-sectional linear regressions were conducted to measure the effect of psychiatric diagnostic class type and number on scores.

Results: Of 7414 total patients, 50.1% had at least one psychiatric diagnosis. Patients with any psychiatric diagnoses prior to reconstruction had significantly lower BREAST-Q scores for all domains at all time points. Anxiety (50%) and depression (27.6%) disorders were the most prevalent and had the greatest impact on BREAST-Q scores. Patients with a greater number of psychiatric diagnostic classes had significantly worse patient-reported outcomes compared to patients with no psychiatric diagnosis. Psychosocial (β: −7.29; 95% CI: −8.67, −5.91) and sexual well-being (β: −7.99; 95% CI: −9.57, −6.40) were most sensitive to the impact of psychiatric diagnoses.

Conclusions: Mental health status is associated with psychosocial and sexual well-being after breast reconstruction surgery as measured with the BREAST-Q. Future research will need to determine what interventions (e.g screening, early referral) can help improve outcomes for breast cancer patients with psychiatric disorders undergoing breast reconstruction.

MINI ABSTRACT

Question: What is the impact of comorbid psychiatric diagnoses on breast reconstruction patient-reported satisfaction and quality of life outcomes comparing women with a history of psychiatric diagnosis prior to reconstructive surgery versus women without a history?

Findings: Having any psychiatric diagnosis led to significantly lower patient-reported outcomes. As a patient increased the number of psychiatric diagnosis categories, patient-reported satisfaction and quality of life significantly decreased.

INTRODUCTION

Women with breast cancer can experience significant distress regarding their diagnosis and subsequent treatment, and are at high risk for developing psychiatric disorders during the course of their cancer treatment and into survivorship.[1,2] Psychiatric comorbidities, such as depression and anxiety, have a significant impact on breast cancer clinical outcomes. Studies have demonstrated an increased risk of postoperative complications, prolonged hospitalization, non-adherence with cancer treatment, and mortality due to psychiatric comorbidities.[3–7] Furthermore, psychiatric disorders can negatively impact patient quality-of-life, sometimes resulting in lasting emotional and social dysfunctions.[8,9]

Little research has focused specifically on the impact of mental health on breast cancer patients who undergo breast reconstruction.[10,11] Given the increasing incidence of breast cancer and rates of survivorship[12], it is imperative that clinicians understand the impact of pre-existing psychiatric conditions with breast cancer and reconstruction treatment on quality-of-life outcomes in this growing population.

A recently published study from our group examining patient-reported outcomes from 3,268 postmastectomy reconstruction patients over eight years identified that patients with any psychiatric diagnosis (i.e., ICD-9 or 10 code) were significantly more likely to have lower BREAST-Q satisfaction with breast and physical well-being of chest scores at all examined time points.[10] Similarly, a smaller cross-sectional study with 471 patients has found that psychosocial and sexual well-being scores were lower in patients with a psychiatric diagnosis.[11] While these studies identified an association between a psychiatric diagnosis and a decrease in BREAST-Q scores, larger, longitudinal studies with more specific categorization of psychiatric class are needed to obtain a deeper understanding.

In this study, we sought to further characterize the impact of mental health on patient-reported outcomes for post-mastectomy reconstruction patients. Our first objective was to quantify the effect of specific classes of psychiatric diagnoses and determine whether particular classes of psychiatric diagnoses have greater effects on BREAST-Q scores by comparing women with a history of psychiatric diagnosis prior to reconstruction versus women with no history of psychiatric diagnosis prior to reconstruction. Our second objective was to determine the impact of a greater number of psychiatric diagnostic classes, on BREAST-Q scores. We hypothesized that over a three-year period, patients with a history of any psychiatric disorder would have lower BREAST-Q scores for all domains, that different psychiatric classes (such as anxiety or depressive disorders) have different effects on scores, and that increasing number of diagnostic classes would be related to BREAST-Q scores decrease.

METHODS:

Data Source and Study Population

An IRB approved study (18–202) was performed to evaluate patient-reported outcomes in post-mastectomy reconstruction patients (a component of routine clinical care). All women who underwent breast reconstruction (immediate or delayed) with implant or autologous tissues between January 2007 and March 2018 at Memorial Sloan Kettering Cancer Center, an academic, National Cancer Institute designated cancer center, were eligible for inclusion. For implant patients, both one- and two-stage reconstructions were included. Autologous flap reconstructions included free transverse rectus abdominis myocutaneous (TRAM), muscle-sparing free TRAM, deep inferior epigastric perforator, and superficial inferior epigastric artery perforator flaps. Patients undergoing therapeutic oncologic and/or prophylactic mastectomy as well as patients having undergone prophylactic mastectomy due to genetic indications were included. All patients were female. The primary exclusion criterion was related to the timing of psychiatric diagnosis. Patients with no history of a psychiatric diagnosis before reconstruction who were later diagnosed with a psychiatric disorder following reconstruction were excluded. Patients with a history of a psychiatric diagnosis and who received an additional new diagnosis following reconstruction were included.

Data Collection and Patient Variables

Demographic data, treatment method, and postoperative outcomes were recorded secondarily and included: age, body mass index (BMI), history of smoking, diabetes, hypertension, history of bariatric surgery, marital status, and insurance type. These data were obtained through chart review of intake notes from the time of a patient's breast reconstruction consultation. Cancer and surgical-related variables included: malignancy history (none, localized tumor, metastatic), radiation therapy timing (preoperative, postoperative, none), chemotherapy timing (neoadjuvant, adjuvant, none), reconstructive timing (immediate, immediate/delayed, or delayed), and laterality (unilateral or bilateral) plus lymphedema and hormone therapy status.

Classification of Psychiatric Diagnosis

Data was collected and extracted for each patient where psychiatric diagnosis was defined ICD-9: diagnosis codes between '290' and '319.99' or as ICD-10: diagnosis codes such as 'F#' and were recorded in patient medical records through clinical evaluation. Diagnosis codes were categorized into classes: anxiety, depressive, substance related, stress and adjustment, schizophrenia and psychotic, bipolar, personality, and other disorders (see Supplementary Table 1). A patient could have multiple diagnoses, some within the same class (e.g., multiple types of depressive diagnoses such as major depressive and depressive episodes) or among different classes (e.g., a depressive and substance-related disorders). The sum of different classes per patient were calculated and classified as number of psychiatric classes. Throughout the paper we will refer to a single ICD-9 or 10 code as "diagnosis" and a group of psychiatric disorders (i.e., depressive, anxiety) as "class".

Questionnaire

Patient-reported outcomes were assessed via the reconstruction module of the BREAST-Q, which measures (1) satisfaction with breast, (2) psychosocial well-being, (3) physical well-being of the chest and upper body, (4) physical well-being of the abdomen, (5) sexual well-being, and (6) satisfaction with outcome. The BREAST-Q is a validated measure, first developed at our institution in 2007. Memorial Sloan Kettering Cancer Center implementation of the BREAST-Q began in 2009. The BREAST-Q reconstruction module was designed to be completed by patients who undergo either therapeutic or prophylactic mastectomy followed by reconstruction. Values for subscales were converted to summary scores ranging from 0 to 100 via Q-Score software. Higher scores represented superior outcomes, with a difference of 4 points on the Q-Score considered to be clinically significant.[13] Satisfaction with breast, physical well-being of the chest, psychosocial well-being, and sexual well-being were included as the primary domains of interest. BREAST-Q data for the current study was classified as preoperative (prior to reconstruction) and postoperative (1–3 years). Patients were included in the patient-reported outcome analysis if they completed a BREAST-Q domain at any of the timepoints of interest.

Statistical Analysis

Baseline demographics, surgical, and cancer characteristics were compared between psychiatric diagnosis cohort and no psychiatric diagnosis cohort with a Student t-test

(continuous variables) or Pearson Chi-Square test (categorical variables). Patients were classified as having a psychiatric disorder by the total number of different diagnosed, psychiatric classes per patient, and by class type. Sum of diagnosed classes was defined as number of patients multiplied by the number of diagnosis classes per/patient). Unadjusted and adjusted mixed effects regression models were created to analyze the impact of having any psychiatric diagnosis prior to reconstruction on BREAST-Q domain scores. Per domain, patients with any or all yearly BREAST-Q scores during the postoperative period (1–3 years) were included in the mixed effects models. A subgroup analysis of all patients who completed both a preoperative and 1-year postoperative BREAST-Q was performed to understand the change in score from baseline to one year, examining patients with and without psychiatric diagnoses. Mixed effects modeling was then performed, adjusting for timing of BREAST-Q completion.

Yearly cross-sectional unadjusted and adjusted linear regression models were used to analyze the influence of having a prevalent psychiatric disorder class on postoperative BREAST-Q domain scores. Specifically, these adjusted models accounted for patients with multiple psychiatric classes. Yearly cross-sectional unadjusted and adjusted linear regression models assessed increasing psychiatric classes (one, two, or three and more classes) on postoperative BREAST-Q domain scores. Given that most patients had an anxiety or anxiety and depressive disorder(s), a sensitivity analysis was conducted to analyze the influence of increasing number of diagnostic classes (one, two, and three or more classes) with class type (anxiety, anxiety and depressive, and anxiety, depressive, and other class). All adjusted models included confounders in the relationship between psychiatric diagnosis to BREAST-Q scores such as: age, BMI, smoking status, race/ethnicity, radiation, and reconstruction modality[10]. Timing of BREAST-Q responses were adjusted for as part of the mixed-effects analysis. Confounders were selected using a causal inference approach, specifically using directed acyclic graphs (DAGs) to model our causal pathways. The use of DAGs is an established approach for understanding the relationship between exposure and outcome, identifying appropriate variables for modeling, and, conversely, preventing overadjustment with variables that may actually increase bias in the model.[14–18] Institutional experience and a review of the literature informed our choice of confounders.[10] Our DAG has been included as Supplemental Figure 1. All analyses were conducted using R Statistical Software (R version 4.0.2, packages: tidyverse, ggplot2, nlme). All tests were two sided and an alpha level of 0.05 was considered significant.

RESULTS

A total of 8,515 breast reconstruction patients underwent breast reconstruction during the study period; 7,414 patients were included for final analysis while 1,101 patients did not have a diagnosis prior to reconstruction but were diagnosed at some point following reconstruction were excluded. Of the 7,414 patients, 3,711 (50.1%) patients had at least one psychiatric diagnosis prior to reconstruction (exposure group) and 3,703 (49.9%) patients had no diagnosed psychiatric disorder prior to reconstruction (control group). A flowchart of patients included in the study is shown in Supplemental Figure 2.

Demographics, Surgical, and Cancer-Related Characteristics

Patients with a history of psychiatric diagnosis were on average younger, more likely to be White, more likely to be a former or current smoker, and have hypertension (Table 1a). These patients also had significantly greater BMIs than the no psychiatric diagnosis cohort. Patients with a psychiatric diagnosis were more likely to have a localized tumor or metastatic cancer, require neo- or adjuvant chemotherapy, pre- or postoperative radiation, and hormone therapy. These patients were also more likely to experience lymphedema (Table 1b).

Number and Distribution of Classes

A total of 8,618 psychiatric diagnosis classes (ICD-9 and 10 codes; defined as number of patients multiplied by the number of diagnosis classes per/patient) were grouped into eight different psychiatric classes for the exposed cohort (Table 2). While most of the psychiatric diagnosis patients had only one class (n=1,696, [45.7%]), a large proportion of patients had two different psychiatric classes (30.6%) or three or more different classes (15.8%). No patient had all eight classes. Anxiety disorders were the most common class (n = 3,710 [99.97%]) followed by depressive disorders (n = 2,043 [55.1%]), substance related disorders (n = 1,224 [33%]), and stress and adjustment disorders (n = 1,054 [28.4%]). Supplemental Table 2 demonstrates that, while all patients with psychiatric diagnoses had at least one class present prior to reconstruction, additional/new diagnoses were made in the cohort post reconstruction. Nicotine and tobacco use was the most common substance-related disorder.

Mixed Effects Models: The Impact of Psychiatric Diagnosis

During the three-year postoperative period, adjusted models showed significantly lower scores in all four BREAST-Q domains when comparing patients with a diagnosed psychiatric disorder prior to post-mastectomy reconstruction to those who have no psychiatric diagnosis (Table 3). The greatest clinical and significant differences occurred within the psychosocial (β: −7.29; 95% CI: −8.67, −5.91) and sexual well-being (β: −7.99; 95% CI: −9.57, −6.40) domains.

Subgroup examination of unadjusted, average score changes from the preoperative to one-year postoperative time period revealed that BREAST-Q scores changes trended similarly for patients who had psychiatric diagnoses and those who did not. (Supplemental Table 3) The mixed effects model (that adjusted for timing of survey response) of the preoperative to one-year postoperative time period, similarly revealed that patients with psychiatric diagnoses had significantly lower scores in all four BREAST-Q domains. (Supplemental Table 4)

Cross-Sectional Linear Regressions: The Most Prevalent Classes

Trends in the adjusted cross-sectional regressions demonstrated that anxiety and depressive classes were the more impactful psychiatric classes over time, amongst all four domains of the BREAST-Q, even after accounting for patients with multiple psychiatric classes (Figure 1, Table 4). Differences in adjusted estimates between patients with anxiety disorders versus no psychiatric disorders, over the three time points, ranged from: satisfaction with breast: −3.25 to −1.94 physical well-being of the chest: −3.95 to −1.43, psychosocial well-being:

−4.36 to −3.50, and sexual well-being: −5.37 to −3.84. Adjusted differences comparing patients with depressive disorders versus no psychiatric disorders ranged from: satisfaction with breast: −3.54 to −2.86, physical well-being of the chest: −4.75 to −3.02, psychosocial well-being: −6.76 to −6.51, sexual well-being: −8.19 to −6.80.

Cross-Sectional Linear Regressions: Increasing Number of Diagnostic Classes

Trends in the adjusted cross-sectional regressions demonstrated that as the number of psychiatric diagnostic classes increased, patient BREAST-Q scores for all domains decreased when compared to patients with no psychiatric disorder (Figure 2, Table 5). The most sensitive domains, psychosocial and sexual well-being, demonstrated three-year postoperative differences ranging from: one class: −5.40 to −2.91, two classes: −9.10 to −7.05, three or more classes: −15.73 to −14.22, and one class : −5.86 to −3.20, two classes: −12.34 to −7.95, three or more classes: −15.68 to −14.56, respectively.

Sensitivity Analysis: Number of Classes and Most Prevalent Classes

Sensitivity analysis (Supplementary Table 5) showed similar results to the overall cross-sectional regressions with decreasing BREAST-Q scores for all domains as the number of diagnostic classes increased from only one class (of anxiety disorders), two classes (of anxiety and depressive disorders), to three or more classes (anxiety, depressive, and additional disorders).

DISCUSSION

Both the prevalence and impact of psychiatric disorders on patient-reported outcomes in breast cancer patients who undergo breast reconstruction remains poorly understood. In our study, we found that one in two patients had at least one diagnosed psychiatric disorder prior to reconstruction, and over half of patients with psychiatric disorder diagnoses had at least two different classes of disorders prior to reconstruction. Previous studies examining mental health outcomes in breast reconstruction patients focused primarily on the role of surgical reconstruction on mental health post mastectomy. However, these studies fail to consider the trajectory of a patient's mental health possibly impacted by diagnosis, cancer treatment, and future sequelae of treatment by focusing on one component of the breast cancer treatment process, breast reconstruction. Overall, the high prevalence of psychiatric disorders identified in our study and the impact that such diagnoses have on outcomes supports the importance of screening, early referral, and concurrent mental health treatment in an effort to better serve the needs of our breast cancer patients.

We found that nearly all patients with psychiatric diagnoses history had some type of anxiety disorder and more than half had some type of depressive disorder. This finding is similar to other studies that have examined the prevalence of psychiatric diagnoses in breast cancer patients.[19–24] Recent meta-analyses have found that the prevalence of anxiety disorder to be 42% and the prevalence of depression to be 32.2% among breast cancer patients. For every domain and timepoint evaluated, anxiety and depressive disorders had the largest impact on BREAST-Q scores compared to the other classes of psychiatric diagnoses examined. Furthermore, the number of classes of psychiatric diagnoses was inversely related

with BREAST-Q score; patients affected by an increasing number of psychiatric classes demonstrated decreasing patient satisfaction and quality-of-life. Previous studies have shown that breast reconstruction patients with psychiatric disorders are more likely to experience decision regret regarding their reconstruction[25] and undergo more breast reconstruction revision surgeries.[26] Thus, mental health appears to impact both reconstruction-related outcomes (i.e., BREAST-Q scores) and may have more downstream effects years throughout survivorship.[9,27]

Patient satisfaction and well-being are the measures by which plastic surgeons judge the success of breast reconstruction. In clinical research, these measures have commonly been assessed using BREAST-Q satisfaction with breast and physical well-being domains given the perceived sensitivity of these domains to outcomes. In contrast, psychosocial and sexual well-being domains have not been routinely assessed nor has the potential impact or interaction of one BREAST-Q domain on another been evaluated. For example, quality-of-life factors as measured by the psychosocial well-being domain may explain some percent of satisfaction with breast scores. In our cohort, satisfaction with breast and physical well-being scores were dramatically lower among those with a psychiatric diagnosis compared to those without, suggesting that clinical research and statistical analyses examining BREAST-Q scores must account for a patient's mental health status. If not, surgeons may draw inaccurate conclusions from patient-reported outcomes research regarding the impact of certain breast reconstruction interventions. More importantly, these results suggest a key opportunity for clinical intervention to improve patient outcomes throughout the cancer treatment process. In other areas of breast cancer care, psychological distress impacts patient decision-making, decision quality, and adherence regarding aspects of their cancer treatment, including chemotherapy, endocrine therapy, and breast surgery.[28–33] Our results can serve as additional impetus for improving longitudinal access to psychiatric care. Ideally, concurrent psychiatric care should become routine clinical practice for breast cancer and reconstruction patients given the prevalence of psychiatric disorders in our cohort in addition to psychological distress being termed the "sixth vital sign" in cancer care.[34]

Through routine BREAST-Q utilization, physicians can better assess and address mental health needs by collaborating with other professionals and referring patients to appropriate mental and sexual health treatment and services. In this study, we found that, while all BREAST-Q domains were affected by psychiatric diagnoses, the psychosocial and sexual well-being domains were the most sensitive to the impact of psychiatric diagnoses. Unlike many other patient-reported outcome measures, the BREAST-Q Reconstruction module was designed specifically for breast reconstruction patients and underwent rigorous psychometric testing to ensure its validity and reliability[35,36]. At our institution, we routinely administer the BREAST-Q to identify patients who may need additional revision procedures or referrals to physical therapy by trending patient scores over time. Psychosocial and sexual well-being scores can similarly be trended by both plastic surgeons, psychiatrists, and other clinicians involved in the longitudinal treatment of breast cancer patients. Overall, the combination of all BREAST-Q domains provides a comprehensive view of the patient's quality-of-life where each domain may serve to provide context when interpreting a patient's other BREAT-Q domain scores.

Breast cancer patients often have multiple contributors to psychological distress, including fear of cancer progression,[37] cancer-related intrusive thoughts,[37] sleep disturbances,[38,39] fatigue,[40,41] treatment-related symptoms and side effects (lymphedema, menopausal symptoms),[42–45] body image concerns,[46,47] and fertility concerns.[28,48] Therefore, it is crucial for providers of breast cancer patients to identify those who are affected by psychiatric symptoms, offering evidence-based interventions, pharmacological or non-pharmacological/complementary therapies. Examples of pharmacotherapy interventions, such as SSRIs, anti-psychotics, and anxiolytics, have shown to be effective for treating psychiatric symptoms in breast cancer survivors.[49] In addition, non-pharmacological therapies, including cognitive behavioral therapy and other psychotherapies, support groups, and mind body practices (i.e. exercise, meditation) have all had demonstrated efficacy in managing stress and symptoms specific to breast cancer survivors.[50–56] Providers who evaluate breast reconstruction patients can use metrics like the BREAST-Q psychosocial and sexual well-being subscales to identify at-risk patients, discuss possible sources of psychological distress, and proactively refer patients to the appropriate treatment pathways.

The current study has both strengths and weaknesses. A key strength is the large cohort size analyzed, which allowed us to conduct robust longitudinal modeling. For the study, an a priori sample size of 394 patients per arm (788 total) was estimated to provide 80% power to measure a four-point clinical difference in BREAST-Q scores with a standard deviation of 20. Therefore, our analyses are adequately powered to detect this difference.

Some limitations include half of patients not completing the BREAST-Q for each domain, possibly resulting in non-response bias. Our cross-sectional regressions may result in underreporting of the true impact of psychiatric disorders on BREAST-Q scores since healthier patients may be more likely to respond. We may have overestimated the number of patients with active psychiatric disorders when using ICD-9 and ICD-10 codes to identify patients with psychiatric disorders. It is possible that these codes could have been entered into the electronic health record without confirmation of the diagnosis by a psychiatrist or the patient may not have had active disease at the time of BREAST-Q assessment. Patients with anxiety and adjustment disorders, especially, share symptoms and may be classified as having one or the other at different timepoints. Non-psychiatrists may also use these two categories interchangeably. Also, there is no information about functioning (axis 5) which could provide more information about the impact of the psychiatric diagnoses. Future research can further parse out the impact of active psychiatric illness on patient-reported outcomes, ideally with the use of a screening tool (e.g. State-Trait Anxiety Inventory[57] for anxiety or the Patient Health Questionnaire[58] for depressive symptoms). This dataset and analysis included only women who underwent mastectomy with reconstruction. Future research should also examine the impact of psychiatric diagnoses on women with lumpectomy or mastectomy only. Lastly, this is a single urban institution analysis with a population centered mainly in the northeastern United States and with access to a comprehensive cancer center. The exact numbers and prevalence may lack generalizability though this study can serve as a concept applicable to other geographic areas or populations with less access to comprehensive centers (i.e. uninsured or underinsured patients).

CONCLUSIONS

Psychiatric disorders are common in post mastectomy breast reconstruction patients, with more than half of the patients in our cohort having at least one psychiatric diagnosis. Such diagnoses impacted BREAST-Q scores for every domain and timepoint evaluated. Psychosocial and sexual well-being were most sensitive to the effects of psychiatric disorders. Physicians should recognize that mental health is an important determinant of patient satisfaction and quality-of-life after breast reconstruction, and should routinely utilize all domains of the BREAST-Q in clinical practice to screen and identify patients who may need additional mental health care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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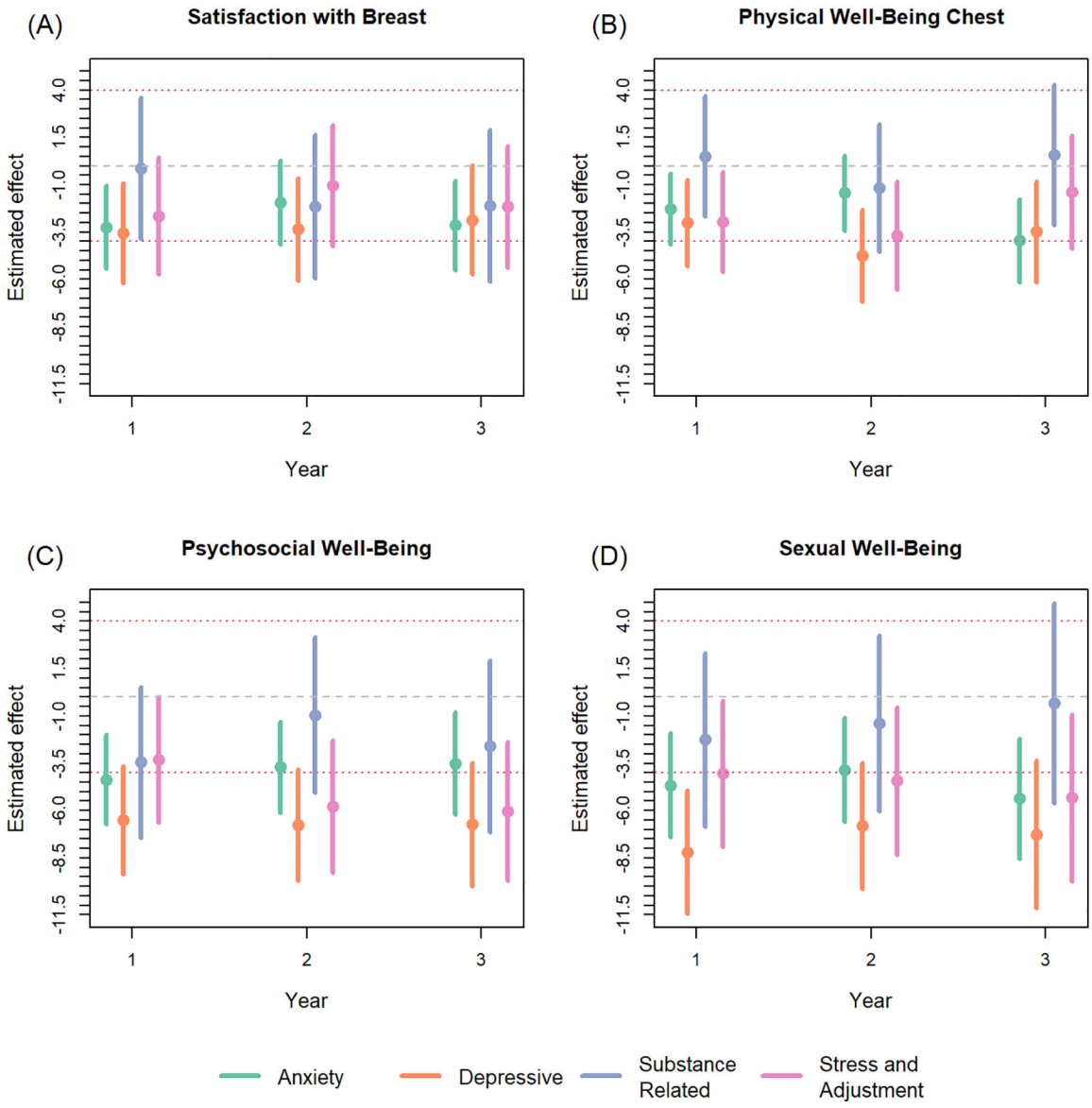

Figure 1:

Adjusted cross-sectional regressions examining the impact of psychiatric diagnosis class on BREAST-Q scores per domain for postoperative years 1–3. Dashed lines indicate the range for a 4-point, minimally important clinical difference from 0. Models were adjusted for: age, BMI, smoking status, race/ethnicity, radiation, and reconstruction modality. In addition, models were adjusted for other prevalent psychiatric diagnosis classes.

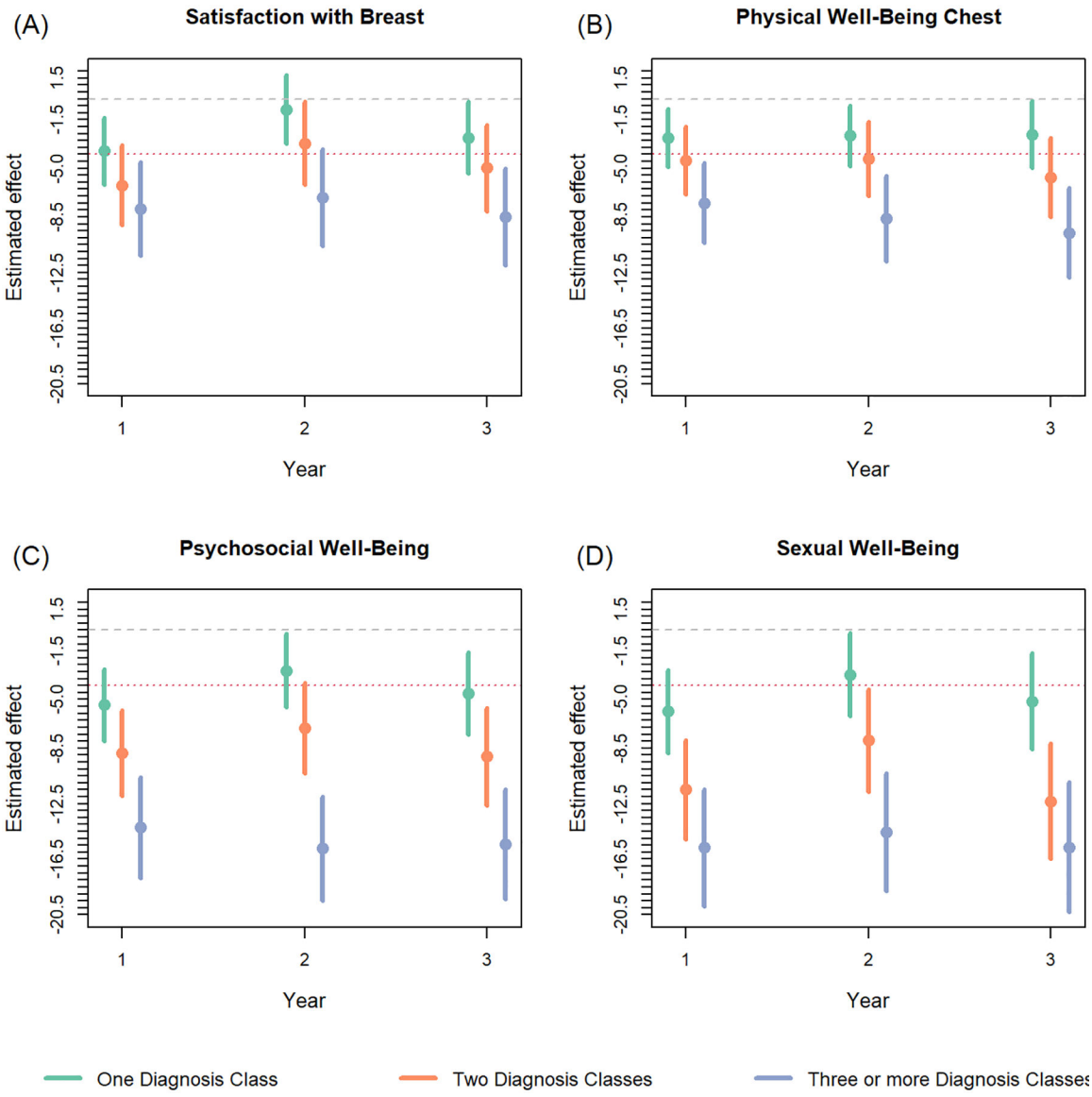

Figure 2:

Adjusted cross-sectional regressions examining the impact of number of different psychiatric classes on BREAST-Q scores per domain for postoperative years 1–3. Dashed lines indicate the range for a 4-point, minimally important clinical difference from 0. Models were adjusted for: age, BMI, smoking status, race/ethnicity, radiation, and reconstruction modality.

Table 1a.

Demographics of Study Population

	Overall Breast Reconstruction Patients with/ without History of Psychiatric Diagnosis (n = 7414)	No History of Psychiatric Diagnosis (n = 3703)	History of Psychiatric Diagnosis (n = 3711)	p value
Age, mean years (SD)	50.0 (10.2)	50.4 (10.3)	49.7 (10.0)	0.005
Race, n (%)				<0.001
White	6087 (82.1)	2902 (78.4)	3185 (85.8)	
Black	607 (8.2)	358 (9.7)	249 (6.7)	
Asian	437 (5.9)	285 (7.7)	152 (4.1)	
Other/Unknown	283 (3.8)	158 (4.3)	125 (3.4)	
Ethnicity, n (%)				0.044
Hispanic	457 (6.2)	243 (6.6)	214 (5.8)	
Non-Hispanic	6679 (90.1)	3305 (89.3)	3374 (90.9)	
Unknown	278 (3.7)	155 (4.2)	123 (3.3)	
Smoking Status, n (%)				<0.001
Never	4430 (59.8)	2544 (68.7)	1886 (50.8)	
Former	2045 (27.6)	866 (23.4)	1179 (31.8)	
Current	539 (7.3)	39 (1.1)	500 (13.5)	
Unknown	400 (5.4)	254 (6.9)	146 (3.9)	
Hypertension, n (%)	1818 (24.5)	802 (21.7)	1016 (27.4)	<0.001
Diabetes, n (%)	526 (7.1)	248 (6.7)	278 (7.5)	0.183
BMI, mean kg/m2 (SD)	25.9 (5.3)	25.8 (5.3)	26.1 (5.3)	0.022
History of Bariatric Surgery, n (%)	31 (0.4)	14 (0.4)	17 (0.5)	0.593
Marital Status, n (%)				<0.001
Single	1278 (17.2)	544 (14.7)	734 (19.8)	
Married	5320 (71.8)	2806 (75.8)	2514 (67.7)	
Separated	94 (1.3)	33 (0.9)	61 (1.6)	
Divorced	517 (7.0)	224 (6.0)	293 (7.9)	
Life/Domestic Partner	27 (0.4)	4 (0.1)	23 (0.6)	
Widowed	176 (2.4)	92 (2.5)	84 (2.3)	
Religion				0.255
Christian	4262 (57.5)	2150 (58.1)	2112 (56.9)	
Non-Christian	1171 (15.8)	564 (15.2)	607 (16.4)	
Other/Unknown	216 (2.9)	118 (3.2)	98 (2.6)	
None	1765 (23.8)	871 (23.5)	894 (24.1)	
Insurance				<0.001
Private	5870 (79.2)	2952 (79.7)	2918 (78.6)	
Medicare	1217 (16.4)	617 (16.7)	600 (16.2)	
Medicaid	262 (3.5)	95 (2.6)	167 (4.5)	
Self-pay	55 (0.7)	34 (0.9)	21 (0.6)	

	Overall Breast Reconstruction Patients with/ without History of Psychiatric Diagnosis (n = 7414)	No History of Psychiatric Diagnosis (n = 3703)	History of Psychiatric Diagnosis (n = 3711)	p value
Unknown	10 (0.1)	5 (0.1)	5 (0.1)	

Abbreviations: *n* Number of patients, *SD* Standard Deviation

p value for categorical data calculated using Chi-Square test, continuous data calculated using Student's t-test

Table 1b.

Cancer Characteristics of Study Population

	Overall Breast Reconstruction Patients with/ without History of Psychiatric Diagnosis (n = 7414)	No History of Psychiatric Diagnosis (n = 3703)	History of Psychiatric Diagnosis (n = 3711)	p value
Malignancy History, n (%)				<0.001
None	555 (7.5)	322 (8.7)	233 (6.3)	
Localized Tumor	6804 (91.8)	3360 (90.7)	3444 (92.8)	
Metastatic	55 (0.7)	21 (0.6)	34 (0.9)	
Chemotherapy, n (%)				<0.001
Neoadjuvant	869 (11.7)	279 (7.5)	590 (15.9)	
Adjuvant	2191 (29.6)	894 (24.1)	1297 (35.0)	
None	4354 (58.7)	2530 (68.3)	1824 (49.2)	
Radiation, n (%)				<0.001
Preoperative	549 (7.4)	257 (6.9)	292 (7.9)	
Postoperative	1424 (19.2)	592 (16.0)	832 (22.4)	
None	5441 (73.4)	2854 (77.1)	2587 (69.7)	
Reconstruction Method, n (%)				0.008
Autologous	867 (11.7)	470 (12.7)	397 (10.7)	
Implant	6547 (88.3)	3233 (87.3)	3314 (89.3)	
Timing of Reconstruction, n (%)				0.058
Immediate	7034 (94.9)	3535 (95.5)	3499 (94.3)	
Delayed	361 (4.9)	161 (4.3)	200 (5.4)	
Immediate/Delayed	19 (0.3)	7 (0.2)	12 (0.3)	
Laterality of Reconstruction, n (%)				<0.001
Unilateral	2761 (37.2)	1488 (40.2)	1273 (34.3)	
Bilateral	4653 (62.8)	2215 (59.8)	2438 (65.7)	
Lymphedema, n (%)	668 (9.0)	224 (6.0)	444 (12.0)	<0.001
Hormone Therapy, n (%)	2738 (36.9)	1226 (33.1)	1512 (40.7)	<0.001

Abbreviations: *n* Number of patients, *SD* Standard Deviation

p value for categorical data calculated using Chi-Square test, continuous data calculated using Student's t-test

Table 2.

Prevalence of psychiatric disorders by type and number of class(es)

Number of Classes	Number of Patients[a] (n = 3711)	Anxiety Disorders[b] (n = 3710)	Depressive Disorders[b] (n = 2043)	Substance Related Disorders[b] (n = 1224)	Stress and Adjustment Disorders[b] (n = 1054)	Schizophrenia and Psychotic Disorders[b] (n = 104)	Bipolar Disorder[b] (n = 50)	Personality Disorders[b] (n = 48)	Other Disorder[b] (n = 270)	Sum of Diagnosis Classes[c] (N = 8618)
1	1696 (45.7)	1085 (64)	198 (11.7)	305 (18)	88 (5.2)	4 (0.2)	2 (0.1)	0 (0)	14 (0.8)	1696 (19.7)
2	1135 (30.6)	985 (43.4)	676 (29.8)	349 (15.4)	190 (8.4)	13 (0.6)	8 (0.4)	6 (0.3)	43 (1.9)	2270 (26.3)
3	585 (15.8)	553 (31.5)	514 (29.3)	252 (14.4)	333 (19)	19 (1.1)	12 (0.7)	5 (0.3)	67 (3.8)	1755 (20.4)
4	205 (5.5)	202 (24.6)	192 (23.4)	120 (14.6)	174 (21.2)	25 (3)	9 (1.1)	14 (1.7)	84 (10.2)	820 (9.5)
5	68 (1.8)	67 (19.7)	67 (19.7)	49 (14.4)	57 (16.8)	28 (8.2)	16 (4.7)	13 (3.8)	43 (12.6)	340 (3.9)
6	20 (0.5)	20 (16.7)	20 (16.7)	20 (16.7)	19 (15.8)	13 (10.8)	3 (2.5)	8 (6.7)	17 (14.2)	120 (1.4)
7	2 (0.1)	2 (14.3)	2 (14.3)	2 (14.3)	2 (14.3)	2 (14.3)	0 (0)	2 (14.3)	2 (14.3)	14 (0.2)

Abbreviations: *n* Number of patients

Sum of diagnosis classes = *number of patients * number of classes*

A: percentages are column percents describing the *number of patients per number of classes/total number of patients*

B: percentages are row percents describing the *total disorder type/number of classes*

C: percentages are column percents describing the *number of classes/total*

Table 3.

Mixed effects models examining the impact of having any psychiatric diagnosis prior to breast reconstruction on BREAST-Q scores for all BREAST-Q domains

	Unadjusted Model				Adjusted Model[a]			
	β	SE	(95% CI)	p	β	SE	(95% CI)	p
SATBR (n = 2962)								
Psychiatric Diagnosis	−3.78	0.62	(−4.99, −2.56)	<0.001	−3.46	0.63	(−4.70, −2.23)	<0.001
PWBC (n = 3214)								
Psychiatric Diagnosis	−4.26	0.52	(−5.27, −3.24)	<0.001	−3.58	0.52	(−4.61, −2.56)	<0.001
PSYCH (n = 2949)								
Psychiatric Diagnosis	−7.91	0.69	(−9.25, −6.57)	<0.001	−7.29	0.71	(−8.67, −5.91)	<0.001
SEX (n = 2865)								
Psychiatric Diagnosis	−9.10	0.79	(−10.65, −7.55)	<0.001	−7.99	0.81	(−9.57, −6.40)	<0.001

Abbreviations: *n* Number of Patients Included, *β* Beta Coefficient, *SE* Standard Error, *95% CI* 95% Confidence Interval, *p* p value, *SATBR* Satisfaction with Breast Domain, *PWBC* Physical Well-being of the Chest Domain, *PSYCH* Psychosocial Well-being Domain, *SEX* Sexual Well-being Domain

Reference cohort for all comparisons = No Psychiatric Diagnosis

[a]Mixed effects model adjusted for fixed effects: age at reconstruction, body mass index (BMI), race/ethnicity, and radiation status. Random effect is patient

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Table 4.

Cross-sectional linear regressions examining the impact of prevalent psychiatric disorder classes on BREAST-Q scores at year 1, 2, and 3 postoperatively for all BREAST-Q domains

	Unadjusted Model			Adjusted Model			Unadjusted Model			Adjusted Model			Unadjusted Model			Adjusted Model		
	β	(95% CI)	p	β	(95% CI)	p	β	(95% CI)	p	β	(95% CI)	p value	β	(95% CI)	p	β	(95% CI)	p
Satisfaction with Breast	**Postoperative Year 1 (n = 1360)**						**Postoperative Year 2 (n = 1258)**						**Postoperative Year 3 (n = 1032)**					
Anxiety Disorders	−5.59	(−7.60, −3.57)	<0.001	−3.25	(−5.44, −1.05)	0.004	−3.65	(−5.74, −1.57)	0.001	−1.94	(−4.16, 0.28)	0.087	−4.51	(−6.72, −2.31)	<0.001	−3.15	(−5.52, −0.77)	0.009
Depressive Disorders	−6.74	(−9.15, −4.33)	<0.001	−3.54	(−6.19, −0.90)	0.009	−5.02	(−7.56, −2.47)	<0.001	−3.36	(−6.08, −0.64)	0.015	−5.60	(−8.26, −2.94)	<0.001	−2.86	(−5.73, 0.01)	0.051
Substance Use Disorders	−4.10	(−7.17, −1.04)	0.009	−0.15	(−3.87, 3.58)	0.939	−3.98	(−7.08, −0.87)	0.012	−2.15	(−5.93, 1.63)	0.264	−2.39	(−5.58, 0.80)	0.142	−2.11	(−6.11, 1.89)	0.300
Stress and Adjustment Disorders	−6.19	(−9.17, −3.21)	<0.001	−2.64	(−5.73, 0.46)	0.095	−4.04	(−7.11, −0.97)	0.010	−1.06	(−4.25, 2.14)	0.517	−4.89	(−8.03, −1.75)	0.002	−2.17	(−5.39, 1.06)	0.188
Physical Well-Being of Chest	**Postoperative Year 1 (n = 1362)**						**Postoperative Year 2 (n = 1253)**						**Postoperative Year 3 (n = 1030)**					
Anxiety Disorders	−4.38	(−6.11, −2.66)	<0.001	−2.27	(−4.15, −0.39)	0.018	−4.01	(−5.87, −2.16)	<0.001	−1.43	(−3.41, 0.55)	0.157	−5.56	(−7.56, −3.56)	<0.001	−3.95	(−6.15, −1.75)	<0.001
Depressive Disorders	−5.71	(−7.77, −3.65)	<0.001	−3.02	(−5.28, −0.75)	0.009	−6.74	(−9.00, −4.48)	<0.001	−4.75	(−7.17, −2.32)	<0.001	−6.43	(−8.84, −4.03)	<0.001	−3.48	(−6.14, −0.82)	0.010
Substance Use Disorders	−3.28	(−5.89, −0.66)	0.014	0.51	(−2.68, 3.69)	0.754	−3.75	(−6.54, −0.97)	0.008	−1.18	(−4.55, 2.19)	0.492	−3.80	(−6.70, −0.90)	0.010	0.58	(−3.12, 4.29)	0.757
Stress and Adjustment Disorders	−5.75	(−8.28, −3.21)	<0.001	−2.95	(−5.61, −0.30)	0.029	−6.95	(−9.68, −4.23)	<0.001	−3.68	(−6.53, −0.83)	0.011	−4.96	(−7.82, −2.11)	0.001	−1.37	(−4.36, 1.62)	0.368
Psychosocial Well-Being	**Postoperative Year 1 (n = 1359)**						**Postoperative Year 2 (n = 1251)**						**Postoperative Year 3 (n = 1028)**					
Anxiety Disorders	−7.90	(−10.06, −5.75)	<0.001	−4.36	(−6.72, −2.00)	<0.001	−7.32	(−9.56, −5.07)	<0.001	−3.70	(−6.11, −1.2)9	0.003	−7.33	(−9.79, −4.87)	<0.001	−3.50	(−6.21, −0.80)	0.011
Depressive Disorders	−10.18	(−12.75, −7.62)	<0.001	−6.51	(−9.35, −3.66)	<0.001	−10.22	(−12.95, −7.49)	<0.001	−6.76	(−9.71, −3.80)	<0.001	−10.76	(−13.70, −7.83)	<0.001	−6.73	(−9.99, −3.47)	<0.001
Substance Use Disorders	−7.44	(−10.72, −4.16)	<0.001	−3.45	(−7.44, 0.54)	0.090	−5.23	(−8.62, −1.85)	0.002	−0.96	(−5.07, 3.15)	0.647	−6.46	(−10.02, −2.89)	<0.001	−2.60	(−7.15, 1.94)	0.261

	Unadjusted Model			Adjusted Model			Unadjusted Model			Adjusted Model			Unadjusted Model			Adjusted Model		
	β	**(95% CI)**	**p**	**β**	**(95% CI)**	**p**	**β**	**(95% CI)**	**p**	**β**	**(95% CI)**	**p value**	**β**	**(95% CI)**	**p**	**β**	**(95% CI)**	**p**
Stress and Adjustment Disorders	−8.82	(−12.01, −5.62)	<0.001	−3.31	(−6.64, 0.02)	0.052	−10.59	(−13.89, −7.28)	<0.001	−5.78	(−9.26, −2.30)	0.001	−10.50	(−13.99, −7.02)	<0.001	−6.03	(−9.70, −2.37)	0.001
Sexual Well-Being	**Postoperative Year 1 (n = 1268)**						**Postoperative Year 2 (n = 1197)**						**Postoperative Year 3 (n = 992)**					
Anxiety Disorders	−9.02	(−11.52, −6.53)	<0.001	−4.65	(−7.38, −1.92)	<0.001	−7.33	(−9.90, −4.77)	<0.001	−3.84	(−6.58, −1.09)	0.006	−8.94	(−11.83, −6.05)	<0.001	−5.37	(−8.55, −2.20)	0.001
Depressive Disorders	−12.55	(−15.50, −9.59)	<0.001	−8.19	(−11.46, −4.91)	<0.001	−10.20	(−13.31, −7.08)	<0.001	−6.80	(−10.14, −3.46)	<0.001	−11.71	(−15.23, −8.20)	<0.001	−7.25	(−11.13, −3.36)	<0.001
Substance Use Disorders	−8.29	(−12.10, −4.49)	<0.001	−2.25	(−6.84, 2.33)	0.335	−7.13	(−10.95, −3.31)	<0.001	−1.38	(−6.02, 3.27)	0.561	−5.94	(−10.10, −1.78)	0.005	−0.32	(−5.61, 4.97)	0.906
Stress and Adjustment Disorders	−10.39	(−14.07, −6.72)	<0.001	−4.05	(−7.90, −0.20)	0.039	−9.49	(−13.24, −5.74)	<0.001	−4.43	(−8.34, −0.52)	0.026	−10.75	(−14.92, −6.57)	<0.001	−5.32	(−9.72, −0.92)	0.018

Reference cohort for all comparisons = No Psychiatric Diagnosis

Abbreviations: *β* Beta Coefficient, *95% CI* 95% Confidence Interval, *p* p value, *ref* Reference Group, *SATBR* Satisfaction with Breast Domain, *PWBC* Physical Well−being of the Chest Domain, *PSYCH* Psychosocial Well-being Domain, *SEX* Sexual Well-being Domain

Adjusted models include covariates: age at reconstruction, body mass index (BMI), race/ethnicity, radiation status, other prevalent psychological classes

Table 5.

Cross sectional linear regressions examining the impact of number of psychiatric disorder class(es) on BREAST-Q scores at years 1, 2, and 3, postoperatively for all BREAST-Q domains

	Unadjusted Model			Adjusted Model			Unadjusted Model			Adjusted Model			Unadjusted Model			Adjusted Model		
	β	(95% CI)	p	β	(95% CI)	p	β	(95% CI)	p	β	(95% CI)	p value	β	(95% CI)	p	β	(95% CI)	p
Satisfaction with Breast	**Postoperative Year 1 (n = 1344)**						**Postoperative Year 2 (n = 1242)**						**Postoperative Year 3 (n = 1013)**					
Number of Classes																		
One	−4.20	(−6.62, −1.78)	0.001	−3.77	(−6.18, −1.37)	0.002	−0.66	(−3.15, 1.84)	0.606	−0.76	(−3.20, 1.69)	0.544	−2.46	(−5.14, 0.22)	0.072	−2.80	(−5.39, −0.20)	0.035
Two	−7.52	(−10.38, −4.65)	<0.001	−6.23	(−9.09, −3.36)	<0.001	−3.96	(−6.95, −0.97)	0.009	−3.19	(−6.17, −0.21)	0.036	−4.58	(−7.73, −1.43)	0.004	−4.99	(−8.08, −1.91)	0.002
Three or More	−9.27	(−12.58, −5.95)	<0.001	−7.92	(−11.28, −4.55)	<0.001	−7.99	(−11.46, −4.52)	<0.001	−7.11	(−10.57, −3.65)	<0.001	−8.21	(−11.71, −4.71)	<0.001	−8.49	(−11.96, −5.01)	<0.001
Physical Wellbeing of Chest	**Postoperative Year 1 (n = 1346)**						**Postoperative Year 2 (n = 1237)**						**Postoperative Year 3 (n = 1011)**					
Number of Classes																		
One	−3.34	(−5.41, −1.26)	0.002	−2.82	(−4.88, −0.75)	0.007	−2.55	(−4.75, −0.34)	0.024	−2.64	(−4.82, −0.46)	0.018	−2.65	(−5.06, −0.23)	0.032	−2.56	(−4.97, −0.15)	0.037
Two	−5.42	(−7.87, −2.97)	<0.001	−4.43	(−6.89, −1.98)	<0.001	−4.67	(−7.31, −2.04)	0.001	−4.32	(−6.97, −1.67)	0.001	−6.14	(−8.97, −3.30)	<0.001	−5.67	(−8.53, −2.81)	<0.001
Three or More	−8.84	(−11.67, −6.00)	<0.001	−7.49	(−10.37, −4.60)	<0.001	−9.79	(−12.87, −6.71)	<0.001	−8.62	(−11.71, −5.53)	<0.001	−10.64	(−13.79, −7.48)	<0.001	−9.64	(−12.86, −6.42)	<0.001
Psychosocial Wellbeing	**Postoperative Year 1 (n = 1343)**						**Postoperative Year 2 (n = 1235)**						**Postoperative Year 3 (n = 1009)**					
Number of Classes																		
One	−5.69	(−8.25, −3.12)	<0.001	−5.40	(−7.98, −2.81)	<0.001	−2.95	(−5.60, −0.31)	0.029	−2.91	(−5.57, −0.26)	0.031	−4.45	(−7.39, −1.51)	0.003	−4.58	(−7.54, −1.62)	0.002
Two	−9.35	(−12.38, −6.32)	<0.001	−8.88	(−11.95, −5.80)	<0.001	−7.49	(−10.68, −4.31)	<0.001	−7.05	(−10.30, −3.81)	<0.001	−9.20	(−12.65, −5.74)	<0.001	−9.10	(−12.61, −5.59)	<0.001
Three or More	−15.42	(−18.93, −11.90)	<0.001	−14.22	(−17.85, −10.60)	<0.001	−16.60	(−20.28, −12.91)	<0.001	−15.73	(−19.49, −11.98)	<0.001	−15.80	(−19.64, −11.96)	<0.001	−15.44	(−19.40, −11.48)	<0.001
Sexual Wellbeing	**Postoperative Year 1 (n = 1270)**						**Postoperative Year 2 (n = 1181)**						**Postoperative Year 3 (n = 973)**					

	Unadjusted Model			Adjusted Model			Unadjusted Model			Adjusted Model			Unadjusted Model			Adjusted Model		
	β	(95% CI)	p	β	(95% CI)	p	β	(95% CI)	p	β	(95% CI)	p value	β	(95% CI)	p	β	(95% CI)	p
Number of Classes																		
One	−6.38	(−9.34, −3.41)	<0.001	−5.86	(−8.85, −2.87)	<0.001	−3.47	(−6.51, −0.44)	0.025	−3.20	(−6.21, −0.18)	0.038	−5.06	(−8.53, −1.60)	0.004	−5.13	(−8.60, −1.65)	0.004
Two	−12.48	(−15.98, −8.98)	<0.001	−11.49	(−15.05, −7.94)	<0.001	−8.89	(−12.53, −5.25)	<0.001	−7.95	(−11.63, −4.27)	<0.001	−12.39	(−16.50, −8.29)	<0.001	−12.34	(−16.49, −8.19)	<0.001
Three or More	−17.30	(−21.36, −13.23)	<0.001	−15.68	(−19.87, −11.49)	<0.001	−16.13	(−20.31, −11.94)	<0.001	−14.56	(−18.81, −10.32)	<0.001	−15.87	(−20.44, −11.31)	<0.001	−15.65	(−20.33, −10.97)	<0.001

Reference cohort for all comparisons = No Psychiatric Diagnosis

Abbreviations: *β* Beta Coefficient, *95% CI* 95% Confidence Interval, *p* p value, *ref* Reference Group, *SATBR* Satisfaction with Breast Domain, *PWBC* Physical Well-being of the Chest Domain, *PSYCH* Psychosocial Well-being Domain, *SEX* Sexual Well-being Domain

Adjusted models include covariates: age at reconstruction, body mass index (BMI), race/ethnicity, radiation status