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Research

Loss of Functional Independence after Plastic Surgery in Older Patients: American College of Surgeons National Surgical Quality Improvement Program Database

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Background: Maintenance of functional independence is an important patient-centered outcome. As the evidence on loss of independence (LOI) in older patients undergoing plastic surgery is lacking, this study investigates the extent of LOI, identifying factors associated with LOI.

Methods: The 2021–2022 American College of Surgeons National Surgical Quality Improvement Program database was searched to identify patients (>65 years old) who underwent plastic surgery and provided data on their functional independence. The primary outcome was LOI on discharge. Data on perioperative factors, including patient characteristics and comorbidities, surgical details, and outcome measures such as operation time, length of hospital stay, surgical and medical complications, mortality, and discharge destination were extracted.

Results: Of 2112 patients who underwent plastic surgery, most were independent on discharge (n = 1838, 87%). A total of 163 patients lost their independence (LOI rate: 7.7%). Patients discharged as dependent were more likely to have experienced surgical and medical complications, and less likely to be discharged home (all <0.0001). Factors independently associated with LOI included age (1.08, $P = 0.0001$), a history of a fall within the last 6 months (2.01, $P = 0.03$), inpatient setting (2.30, $P = 0.0002$), operation time (1.00, $P = 0.01$), and length of hospital stay (1.13, $P = 0.0001$).

Conclusions: Approximately 8% of older patients undergoing plastic surgery are found to be at risk of postsurgical LOI. Future prospective and multicenter studies should evaluate the risks for short- and long-term LOI with the goal of developing interventions that optimize the care for this patient population. *(Plast Reconstr Surg Glob Open 2024; 12:e6167; doi: 10.1097/GOX.0000000000006167; Published online 12 September 2024.)*

INTRODUCTION

With the rise in life expectancy and the higher demand for plastic surgery procedures, there has been a concurrent increase in the number of older patients who undergo plastic surgery. Research has shown that older patients undergoing surgery are at increased risk for postoperative morbidity and mortality.[1]

Older patients are more likely to prioritize quality over quantity of life years.[2]

Within the field of vascular surgery, a "disablement process" phenomenon[3] has been proposed to describe a physiologic decompensation that can occur when a frail patient is subjected to surgical stress and which may lead to morbidity, loss of functional independence, or even death. This phenomenon was later verified in other types of surgery including abdominal surgery.[4]

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Evidence-based information on the risk for LOI is an important consideration during preoperative consultations as it can determine a patient's decision to undergo the procedure, particularly if said procedure is elective. Studies, for example, have indicated that older patients facing life-threatening illnesses are more inclined to reject a surgical intervention if the intervention can result in a substantial loss of function.[5]

LOI has, at the same time, been linked to postdischarge mortality.[2] Specifically, a retrospective cohort study of 9972 patients aged 65 years or older who underwent any type of inpatient operation found that LOI was directly associated with increased age, readmission and postoperative complications. Importantly, even after risk adjustment, LOI was the strongest factor associated with postdischarge mortality.[2]

Despite its high-priority as a patient-centered outcome, and its strong association with postdischarge mortality, the rate and nature of LOI within the field of plastic surgery has yet to be studied. Therefore, the aim of this study was to use data from the American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP), focusing on patients who underwent plastic surgery, to investigate the rate of LOI and identify associated factors. The ACS-NSQIP captures perioperative patient data from over 700 hospitals, thus providing a multicenter heterogeneous database. These evidence-based insights can assist in surgical decision-making.

METHODS

Data Source

The ACS-NSQIP database is a nationally validated, risk-adjusted, outcomes-based program setup to measure and improve the quality of surgical care. Clinical data are collected from more than 700 hospitals, mainly based in the United States, and cover a wide range of procedures and more than 150 perioperative surgical variables. The data are selected and entered from random medical charts by trained personnel, with the reliability, validity, and quality of the data controlled through peer reviews and audits. The aim of the patient registry is to report measures of surgical care for quality improvement. The 2021 and 2022 datasets were used as the database did not collect information on functional status on discharge before 2021. The 2023 dataset was not available at the time of analysis. Ethical approval for this retrospective analysis was obtained from our institution (Brigham and Women's Hospital, Boston, Mass.; protocol #: 2013P001244).

Patient Selection

To identify all patients who underwent a plastic surgery procedure, the datasets were filtered according to surgical specialty, excluding all but procedures performed by "plastic surgery." Only "older patients," that is, patients older than 65 years, were eligible for inclusion in the final analysis.[6,7] This cohort was filtered to exclude all cases which did not provide information on the preoperative or on-discharge functional status. As a result, a cohort of older patients who underwent plastic surgery and had a registered preoperative and on-discharge functional status was obtained. An analysis of all adult patients irrespective of age is included as supplemental material. Figure 1 illustrates the screening and selection process.

Takeaways

Question: The study aimed to investigate the extent of loss of independence (LOI) in patients (>65 years) undergoing plastic surgery and identify the factors associated with LOI.

Findings: The study, using the 2021–2022 the American College of Surgeons National Surgical Quality Improvement Program database, found that 7.7% of the 2112 patients undergoing plastic surgery experienced LOI on discharge. Key factors associated with LOI included older age, a recent history of falls, inpatient surgery setting, longer operation times, and extended hospital stays.

Meaning: Approximately 8% of patients undergoing plastic surgery are at risk of short-term LOI, with factors such as age, recent falls, and surgical details playing significant roles.

Variable Extraction

The following patient characteristics were collected: age in years, race and ethnicity as self-reported, gender as self-reported, weight in pounds, and height in inches. The weight and height were used to calculate the body mass index (BMI) using the formula [weight (pounds)/ height (inches)^2 × 703]. Data on health and comorbidities were collected: history of diabetes (treated orally or with insulin), chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), dialysis treatment, bleeding disorder, systemic sepsis, hypertension, smoking status within 1 year, metastatic cancer, corticosteroid use, preoperative blood transfusion (>1 unit whole/packed red blood cells in 72 hours before surgery), dementia or cognitive impairment, fall within the last six months, and the American Society of Anesthesiology (ASA) classification (score 1–4). The preoperative functional health status (independent, partially or totally dependent, as defined below) was collected.

The following surgical characteristics were collected: urgency (elective, emergent, or urgent), anesthesia (general, monitored anesthesia care, local, regional, spinal, other), and setting (inpatient or outpatient).

The following 30-day postoperative variables were collected: time from admission to operation (in days); operation time (in minutes); length of hospital stay (LoHS, in days); mortality; reoperation; (unplanned) readmission; surgical complications (superficial, deep and organ space infection, wound dehiscence, bleeding/transfusion); and medical complications (pneumonia, pulmonary embolism, ventilator dependence >48 h, urinary tract infection, cerebral vascular accident/stroke, cardiac arrest, myocardial infarction, sepsis, septic shock, clostridium difficile infection). Finally, data on discharge destination (home,

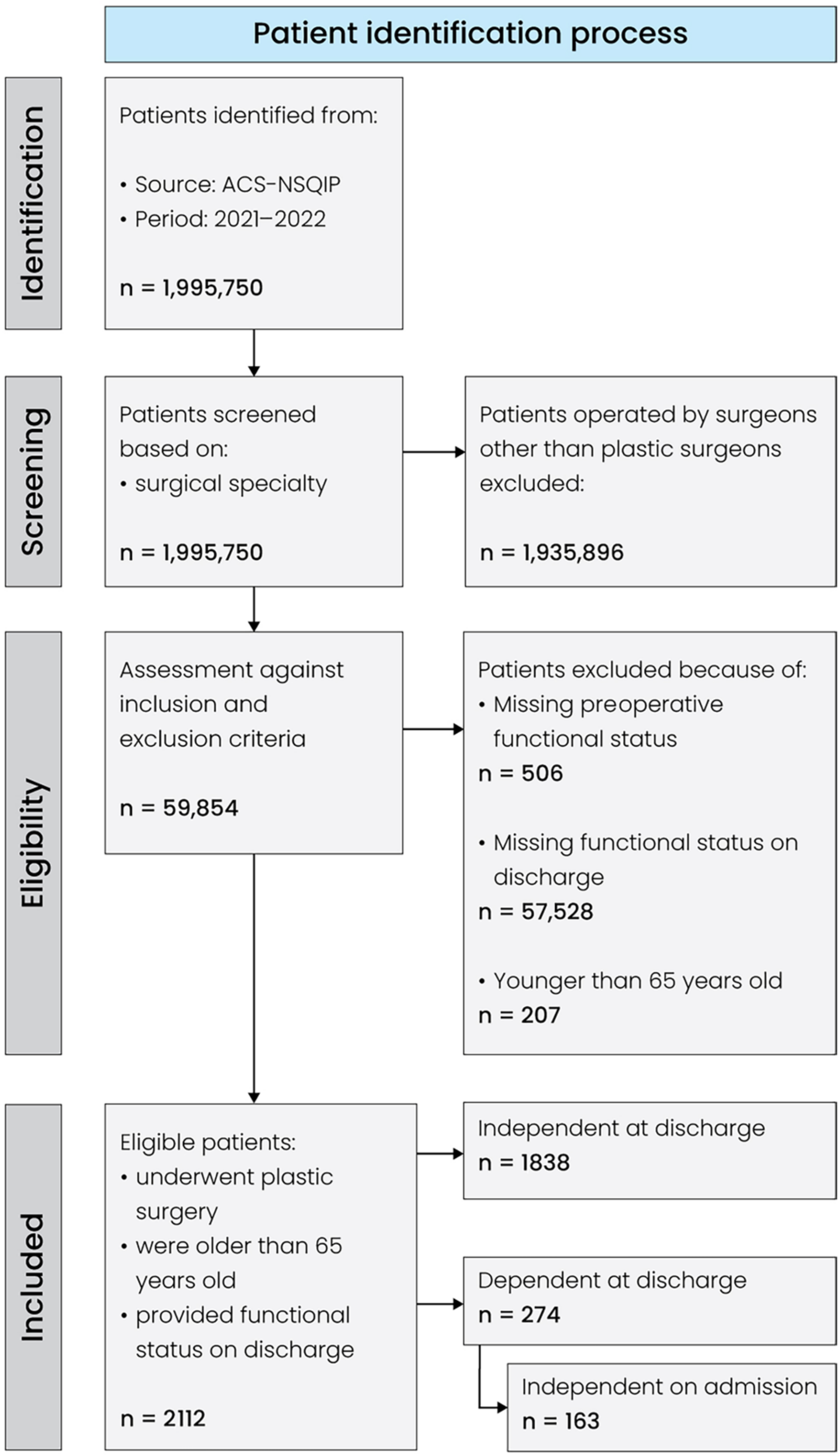

Fig. 1. Patient selection process.

acute care, and other facility) were collected. The primary outcome was functional health status on discharge.

Functional Status

As per the NSQIP user guide, functional status defines the patient's capacity to perform activities of daily living (ADLs) in the 30 days before surgery and on discharge. ADLs are defined as "the activities usually performed in the course of a normal day in a person's life," and include feeding, dressing, bathing, toileting, and mobility. If patients had a change in their functional status within the 30 days before surgery, the best functional status is reported using the following criteria:

(1) Independent: no assistance required from another person. Includes patients who are able to independently function with the use of supportive equipment, prosthetics, or devices.
(2) Partially dependent: some assistance from another person required for ADLs. Includes patients who require some assistance from another person, despite the use of supportive equipment, prosthetics, or devices.
(3) Totally dependent: total assistance required for all ADLs.

Statistical Analysis

The raw data files from the ACS-NSQIP were converted into Microsoft Excel files (V. 16, Microsoft Corporation, Redmond, Wash.) using IBM SPSS Statistics (V. 29, IBM Corporation, Armonk, N.Y.). All statistical analysis and data visualization was performed in GraphPad Prism (V. 8.00 for MacOS, La Jolla Calif.). The cohort was separated into two groups based on functional health status on discharge, that is independent or dependent (partial or total dependency). Categorical variables are presented as numbers and percentages and were assessed with Pearson chi square or Fisher exact test depending on the number of cases (less than or greater than 20 events). Continuous variables are presented as both means with SDs and medians with interquartile range (IQR). Continuous variables were assessed for normality using the D'Agostino and Pearson test, and their differences compared using the Mann-Whitney U test. To identify factors associated with LOI, a multivariate logistic regression analysis was performed on a smaller group of the cohort (specifically focusing on patients who were assigned as independent on admission). The variables included in the analysis were gender, age, BMI, ASA class, history of COPD, CHF, hypertension, fall in the past six months, or dementia, setting and urgency of surgery, operation time, LoHS, occurrence of surgical or medical complications, and need for reoperation. The multivariate logistic regression was used to calculate odds ratios (OR) and 95% confidence intervals. All *P* values smaller than 0.05 were considered statistically significant.

RESULTS

Patient Population Demographics and Characteristics

In total, 2112 plastic surgery patients were identified, most of whom were independent on discharge (n = 1838, 87%). Of those discharged as dependent, most were independent on admission, with 111 patients dependent on admission and discharge (5.3% of the cohort). Therefore, 163 patients lost their independence (LOI rate = 7.7%). Screening for independence was not performed equally across age groups, with high rates of screening seen only after 75 years (Fig. 2). (**See table, Supplemental Digital Content 1,** which displays patient demographics and comorbidities. Patients grouped according to functional health status on discharge. Reported as n (%). Significant *P* values shown in bold, **http://links.lww.com/PRSGO/D495**.) (**See table, Supplemental Digital Content 2,** which displays surgical characteristics. Patients grouped according to functional health status on discharge. Reported as n (%). Significant *P* values shown in bold, **http://links.lww.com/PRSGO/D495**.) (**See table, Supplemental Digital Content 3,** which displays peri- and postoperative outcomes. Patients grouped according to functional health status on discharge. Reported as n (%), unless otherwise stated. Significant *P* values shown in bold, **http://links.lww.com/PRSGO/D495**.) (**See table, Supplemental Digital Content 4,** which displays multivariate logistic regression of dependent functional health status on discharge, analyzing only patients classified as independent on admission. The variables included in the analysis are shown. Significant *P* values shown in bold, **http://links.lww.com/PRSGO/D495**.) (**See table, Supplemental Digital Content 5,** which displays procedure distribution. Reported as n (%). Percentages reported according to total n for each column. **http://links.lww.com/PRSGO/D495**.) (**See table, Supplemental Digital Content 6,** which displays patient age distribution. Reported as n (%), **http://links.lww.com/PRSGO/D495**.)

Patients discharged as dependent were older (82.3 ± 5.1 versus 80.3 ± 4.8 years; $P < 0.0001$; Table 1). The ratio of female-to-male patients who were independent was greater than the ratio of those who were dependent (1.82 versus 1.47). Although the overall rate of diabetes did not differ between the two groups, dependent patients were more likely to have insulin-treated diabetes (4.7% versus 9.1%; $P = 0.003$). Dependent patients were more likely to have comorbidities, including COPD (4.4% versus 11.3%; $P < 0.0001$) and CHF (4.0% versus 13.1%; $P < 0.0001$); be on dialysis (0.5% versus 2.6%; $P = 0.002$); have a bleeding disorder (4.6% versus 9.1%; $P = 0.002$), preoperative sepsis (0.0% versus 6.6%; $P < 0.0001$), or dementia (2.7% versus 19.7%; $P < 0.0001$); have had a fall in the last 6 months (5.2% versus 18.2%; $P < 0.0001$); be ventilator-dependent (0.0% versus 1.8%; $P < 0.0001$); and have received preoperative transfusions (0.4% versus 1.8%; $P = 0.01$). In terms of ASA score, no dependent patient had a score of 1, whereas most had a score of 3 (56.8 % vs. 69.7%; $P < 0.0001$).

Surgical Characteristics

Patients discharged with a dependent functional status, were less likely to have undergone elective procedures (95.9% versus 90.1%) and more likely to have undergone urgent/emergent procedures (4.1% versus 9.9%; $P < 0.0001$; Table 2). Dependent patients were more likely to have undergone inpatient procedures (26.5% versus

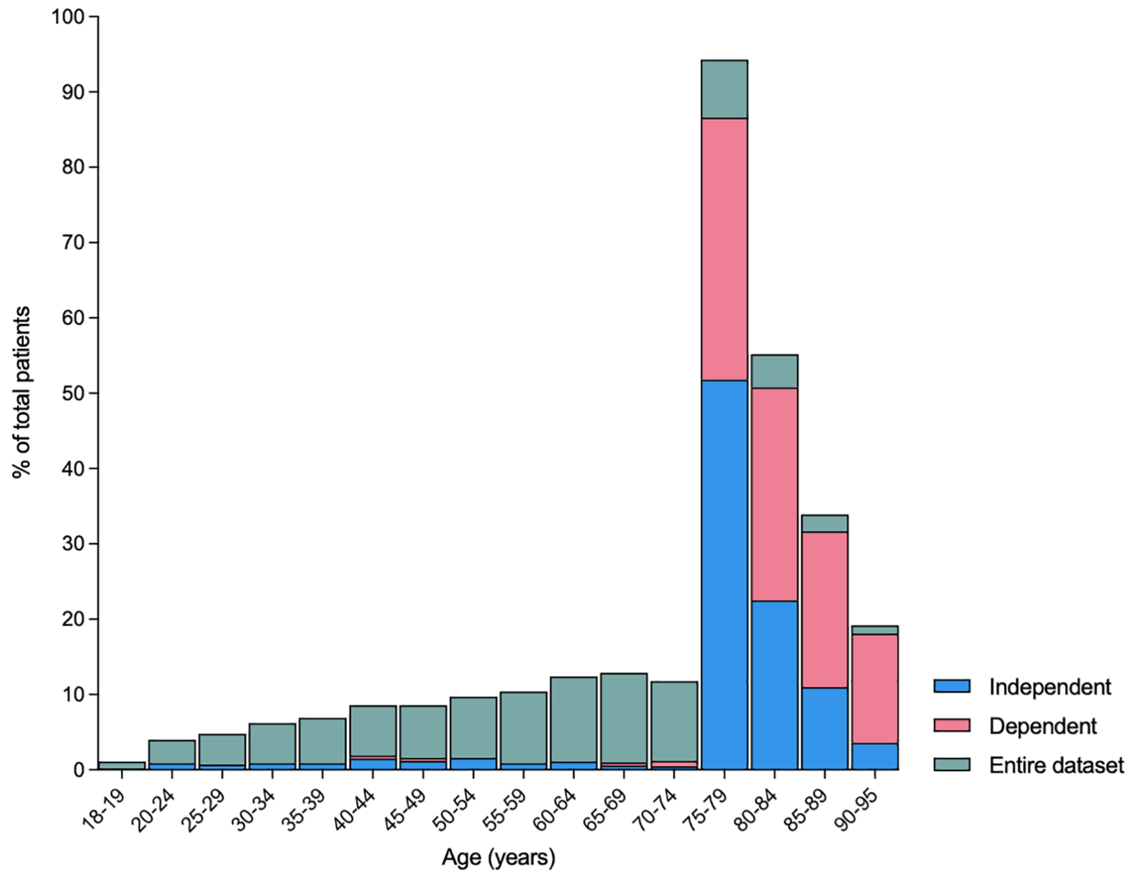

Fig. 2. Age distribution of screening for independence.

65.3%; $P < 0.0001$). Most patients in both groups received general anesthesia (77.0% versus 77.7%; $P = 0.89$).

Of the 163 patients who experienced LOI, 25.8% received a procedure on the lower extremity, 19.0% on the head and neck, 12.3% on the breast, and 12.9% on the upper extremity. In comparison to patients discharged as independent, LOI patients were more likely to have undergone a procedure on the trunk (4.4% versus 16.6%, $P < 0.0001$) or lower extremity (18.2% versus 25.8%, $P = 0.02$) and less likely to have undergone a breast procedure (38.3% versus 12.3%, $P < 0.0001$). Approximately half of the patients who experienced LOI had undergone a flap reconstruction (47.9%). In comparison to patients discharged as independent, LOI patients were more likely to have undergone a flap reconstruction (17.4% versus 47.9%, $P < 0.0001$), resection (5.0% versus 12.3%, $P < 0.0001$), or tenotomy (0.3% versus 1.8%, $P = 0.03$) and less likely to have undergone simple wound closure (15.8% versus 3.1%, $P < 0.0001$) or mastectomy (15.1% versus 1.2%, $P < 0.0001$ (Table 2) (Supplemental Digital Content 1, **http://links.lww.com/PRSGO/D495**).

Outcomes

The time from admission to operation was longer in patients discharged with a dependent functional status (0.0 ± 0.2 versus 2.0 ± 5.7 days; $P < 0.0001$; Table 3). Operation time was longer in patients discharged as dependent (104 ± 99 versus 155 ± 174 minutes; $P < 0.0001$). Patients discharged as dependent had on average longer LoHS (1.1 ± 4.0 versus 6.7 ± 9.3 days; $P < 0.0001$).

Dependent patients had higher readmission (4.5% versus 11.3%; $P < 0.0001$) and unplanned readmission (3.5% versus 9.9%; $P < 0.0001$), reoperation (2.9% versus 5.5%; $P = 0.02$) and ultimately higher mortality (0.2% versus 1.5%; $P = 0.007$), whereby mortality includes death more than 30 days after the procedure.

Both surgical (5.4% versus 16.8%; $P < 0.0001$) and medical complications (2.4% versus 10.9%; $P < 0.0001$) were more frequent in the patients discharged as dependent. Discharge destination was different between the groups, with dependent patients having lower rates of home discharge (98.7% versus 71.5%) and higher discharge to acute care (0.2% versus 1.8%) or other facilities (1.1% versus 26.6%; $P < 0.0001$).

Finally, by analyzing only the cohort of patients who had been assigned as independent on admission, a multivariate logistic analysis was performed to identify factors associated with LOI on discharge (Table 4). Risk of LOI increased with age with the odds increasing by 1.08 times for each one year increase in age. Associated surgical characteristics included an inpatient setting (OR: 2.30, $P = 0.0002$) and operation time (OR: 1.00, $P = 0.01$), whereby each minute increase was associated with a slightly more than 1.00 increase in risk of LOI. A history of a recent fall

Table 1. Patient Demographics and Comorbidities

	Independent (n = 1838)	Dependent (n = 274)	*P*
Demographics			
Age (y), mean ± SD	80.3 ± 4.8	82.3 ± 5.1	**<0.0001**
Age (y), median (IQR)	79.0 ± 7.0	81.5 ± 8.0	
BMI (kg/m^2), mean ± SD	27.3 ± 7.0	26.8 ± 8.7	0.25
BMI (kg/m^2), median (IQR)	30.7 ± 7.0	30.8 ± 8.3	
Sex			0.14
Female	1182 (64.3)	162 (59.1)	
Male	651 (35.4)	110 (40.1)	
Nonbinary	5 (0.3)	2 (0.7)	
Race			**<0.0001**
American Indian or Alaskan Native	3 (0.2)	0 (0.0)	
Asian	37 (2.0)	6 (2.2)	
Native Hawaiian or Pacific Islander	3 (0.2)	15 (5.5)	
Black or African American	63 (3.4)	0 (0.0)	
White	1085 (59.0)	190 (69.3)	
Other/unknown	647 (35.2)	63 (23.0)	
Ethnicity			
Hispanic	59 (3.2)	14 (5.1)	0.11
Preoperative health and comorbidities			
Diabetes	328 (17.8)	58 (21.2)	0.18
Insulin treated	87 (4.7)	25 (9.1)	**0.003**
COPD	81 (4.4)	31 (11.3)	**<0.0001**
CHF	80 (4.)	36 (13.1)	**<0.0001**
Dialysis	9 (0.5)	7 (2.6)	**0.002**
Bleeding disorder	84 (4.6)	25 (9.1)	**0.002**
Preoperative sepsis	0 (0.0)	18 (6.6)	**<0.0001**
Ventilator dependent	0 (0.0)	5 (1.8)	**<0.0001**
Hypertension	1201 (65.3)	195 (71.2)	0.06
Current smoker	65 (3.5)	12 (4.4)	0.49
Disseminated cancer	29 (1.6)	9 (3.3)	0.08
Corticosteroid use	92 (5.0)	15 (5.5)	0.74
Preoperative transfusions	7 (0.4)	5 (1.8)	**0.01**
Dementia	50 (2.7)	54 (19.7)	**<0.0001**
Fall within last 6 months	95 (5.2)	50 (18.2)	**<0.0001**
ASA class			**<0.0001**
1: No disturbance	12 (0.7)	0 (0.0)	
2: Mild disturbance	686 (37.3)	35 (12.8)	
3: Severe disturbance	1044 (56.8)	191 (69.7)	
4: Life-threatening	69 (3.8)	41 (15.0)	
Other/unknown	27 (1.5)	7 (2.6)	
Preoperative functional status			**<0.0001**
Independent	1829 (99.5)	163 (59.5)	
Partially or totally dependent	9 (0.5)	111 (40.5)	

Patients grouped according to functional health status on discharge. Reported as n (%). Significant *P* values shown in bold.

was identified as an associated factor (OR: 2.01; $P = 0.03$). In terms of other outcomes, LoHS (OR: 1.13; $P < 0.0001$) was directly associated with LOI, with the odds increasing by 1.13 times for each one day increase in LoHS.

DISCUSSION

LOI, a significant patient-centered outcome, impacts independent living, including daily tasks like eating and toileting, and mobility aid use. This multi-institutional retrospective analysis of plastic surgery patients identifies a 7.7% LOI rate. Several perioperative factors are associated with increased LOI. This is the first description of LOI rates in plastic surgery.

As described in a general surgery population, patients experiencing LOI are older and sicker, with those 85 years or older having a 4.4-fold increased risk for LOI compared with patients aged 65–74 years.[2] In this study we identified that each increase of one year in age "in a population of individuals 65 years of age and older" is independently associated with a rise of 1.08 in the odds of having LOI.

The prevalence of frailty in the surgical population has been reported to range from 10% to over 50%, with evidence consistently showing that frail patients face elevated risks for adverse postoperative outcomes in all surgical fields, including plastic and reconstructive surgery.[8–17] Frail patients have a substantially higher likelihood of being

Table 2. Surgical Characteristics

Characteristic	Independent (n = 1838)	Dependent (n = 274)	*P*
Urgency			**<0.0001**
Elective	1763 (95.9)	247 (90.1)	
Urgent/emergent	75 (4.1)	27 (9.9)	
Type of anesthesia			0.89
General	1416 (77.0)	213 (77.7)	
Monitored anesthesia care	312 (17.0)	42 (15.3)	
Local	56 (3.0)	11 (4.0)	
Regional	37 (2.2)	5 (1.8)	
Spinal	3 (0.2)	1 (0.4)	
Other/unknown	14 (0.8)	2 (0.7)	
Setting			**<0.0001**
Inpatient	487 (26.5)	179 (65.3)	
Outpatient	1351 (73.5)	95 (34.7)	
Year			**0.04**
2021	814 (44.3)	139 (50.7)	
2022	1024 (55.7)	135 (49.3)	
	Independent (n = 1838)	**LOI (n = 163)**	
Location			
Head and neck	419 (22.8)	31 (19.0)	0.27
Trunk	81 (4.4)	27 (16.6)	**<0.0001**
Upper extremity	226 (12.3)	21 (12.9)	0.80
Lower extremity	334 (18.2)	42 (25.8)	**0.02**
Breast	704 (38.3)	20 (12.3)	**<0.0001**
Inguinal genital	74 (4.0)	7 (4.3)	0.84
Procedure			
Flap reconstruction	319 (17.4)	78 (47.9)	**<0.0001**
Resection	92 (5.0)	20 (12.3)	**0.0001**
Skin graft	280 (15.2)	25 (15.3)	0.97
Internal fixation	54 (2.9)	8 (4.9)	0.16
Wound closure	291 (15.8)	5 (3.1)	**<0.0001**
Other			
Nerve reconstruction	38 (2.1)	2 (1.2)	0.77
Tenotomy	6 (0.3)	3 (1.8)	**0.03**
Carpectomy	5 (0.3)	2 (1.2)	0.11
Arthrotomy	36 (2.0)	2 (1.2)	0.76
Amputation	4 (0.2)	0 (0.0)	>0.99
Mastectomy	277 (15.1)	2 (1.2)	**<0.0001**
Mastopexy	26 (1.4)	0 (0.0)	0.26
Implant/expander-based breast reconstruction	65 (3.5)	10 (6.2)	0.13
Capsulectomy	73 (4.0)	2 (1.2)	0.08
Breast reduction	87 (4.7)	3 (1.8)	0.11
Breast augmentation	13 (0.7)	0 (0.0)	0.62
Panniculectomy	27 (1.5)	0 (0.0)	0.16 0.6168
Hernia repair	15 (0.8)	1 (0.6)	>0.99

Patients grouped according to functional health status on discharge. Reported as n (%). Significant *P* values shown in bold.

discharged to locations other than their homes.[10,16,18–20] Therefore, the patients with LOI in this study may have had underlying frailty, making them vulnerable to worse outcomes. Within this context, we found that a fall within six months before surgery increases the odds of having LOI by a factor of 2.01, slightly lower than the association rate described within general surgery (ie, 2.4). The association between frailty and an increased predisposition to falls is well described.[21–28]

There is variation in the LOI across different anatomical regions and surgical procedures. Lower extremity procedures contributed the most to LOI with 42 cases (25.8%), followed by head and neck procedures at 31 cases (19.0%). Upper extremity procedures present a notable impact, with 21 cases (12.9%). Interestingly, breast reconstruction procedures, though comparatively fewer in number, still exhibit significant instances of LOI, indicating the diverse range of procedures that can affect autonomy. Surgery on the head and neck, lower/upper extremity, and breast each present unique challenges and impact on independence. Procedures involving the lower extremity might impair mobility; surgery on the upper extremity could

Table 3. Peri- and Postoperative Outcomes

Characteristic	Independent (n = 1838)	Dependent (n = 274)	*P*
Time from admission to operation (d) mean ± SD	0.0 ± 0.2	0.0 ± 0.2	**<0.0001**
Time from admission to operation (d) median (IQR)	0.0 ± 0.0	0.0 ± 0.0	
Operative time (min) mean ± SD	104.3 ± 99.0	155.1 ± 174.1	**<0.0001**
Operative time (min) median (IQR)	73 ± 84	93.5 ± 141	
LoHS (d) Mean ± SD	1.1 ± 4.0	6.7 ± 9.3	**<0.0001**
LoHS (d) Median (IQR)	1.0 ± 1.0	3.0 ± 8.8	
Mortality within 30 days	3 (0.2)	4 (1.5)	**0.007**
Reoperation	53 (2.9)	15 (5.5)	**0.02**
Readmission	83 (4.5)	31 (11.3)	**<0.0001**
Unplanned readmission	65 (3.5)	27 (9.9)	**<0.0001**
Surgical complication	100 (5.4)	46 (16.8)	**<0.0001**
Superficial incisional infection	65 (3.5)	14 (5.1)	0.20
Deep incisional infection	5 (0.3)	4 (1.5)	**0.02**
Organ space infection	8 (0.4)	7 (2.6)	**0.0015**
Dehiscence	10 (0.5)	9 (3.3)	**0.0003**
Bleeding/transfusion	18 (1.0)	19 (6.9)	**<0.0001**
Medical complication	45 (2.4)	30 (10.9)	**<0.0001**
Pneumonia	9 (0.5)	4 (1.5)	0.08
Pulmonary embolism	0 (0.0)	2 (0.7)	**0.02**
Ventilator dependence >48 h	0 (0.0)	3 (1.1)	**0.002**
Urinary tract infection	17 (0.9)	0 (0.0)	0.15
Cerebral vascular accident/stroke	1 (0.1)	1 (0.4)	0.24
Cardiac arrest	0 (0.0)	1 (0.4)	0.13
Myocardial infarction	2 (0.1)	4 (1.5)	**0.003**
Deep vein thrombosis/thrombophlebitis	2 (0.1)	2 (0.7)	0.08
Sepsis	12 (0.7)	11 (4.0)	**<0.0001**
Septic shock	1 (0.1)	2 (0.7)	**0.04**
Clostridium difficile infection	4 (0.2)	2 (0.7)	0.18
Discharge destination			**<0.0001**
Home/permanent residence	1815 (98.7)	196 (71.5)	
Acute care	3 (0.2)	5 (1.8)	
Other facility	20 (1.1)	73 (26.6)	

Patients grouped according to functional health status on discharge. Reported as n (%), unless otherwise stated. Significant *P* values shown in bold.

Table 4. Multivariate Logistic Regression of Dependent Functional Health Status on Discharge, Analyzing Only Patients Classified as Independent on Admission

Variables	OR	95% CI	*P*
Inpatient setting	2.30	1.48–3.59	**0.0002**
Urgent/emergent surgery	1.05	0.48–2.15	0.90
Age (y)*	1.08	1.04–1.13	**0.0001**
ASA class (units)*	1.31	0.93–1.86	0.12
COPD	1.68	0.84–3.17	0.12
CHF	1.13	0.54–2.20	0.74
Fall within last 6 months	2.01	1.08–3.59	**0.03**
Dementia	0.29	0.07–0.91	0.05
Operation time (min)*	1.00	1.00–1.00	**0.01**
LoHS (d)*	1.13	1.09–1.18	**0.0001**
Surgical complications	1.40	0.78–2.44	0.25
Medical complications	1.47	0.67–3.08	0.31
Reoperation	0.55	0.21–1.32	0.20
Readmission	1.88	0.95–3.54	0.06

The variables included in the analysis are shown. Significant *P* values shown in bold.
*Linear variable.

affect daily tasks such as eating, dressing, and hygiene; and whole breast procedures, particularly those related to cancer treatments, may lead to psychological impacts alongside physical limitations, influencing a patient independence. These findings underscore the importance of considering both the type of surgery and the anatomical site when assessing the risk of functional impairment and LOI in patients undergoing plastic surgery

LoHS is associated with LOI, with each additional hospital day increasing the risk by 1.13. This was previously described, with, in that case, each day adding 30% risk for LOI.[2] Berian et al, suggested that the underlying reason may be deconditioning during the hospital stay.[2] In support of this, prior literature has suggested that most functional loss occurs within the first week following a procedure and may persist up to 6 months.[4] However, the prolonged stay may be because of the LOI rather than a cause of it. Lack of early mobilization of the social and healthcare support required for successful (non) home discharge can delay discharge; therefore, LOI may have necessitated unplanned nonhome discharge which may have prolonged the hospital stay.

The association between LOI and readmission should be considered. Serious postoperative complications in patients with LOI can increase readmission by seven-fold, suggesting that the reason may be the significant association of readmission with LOI and lack of preoperative support in the home.[2] We found that patients who experience LOI were 2.5 times more likely to be re-admitted. This underscores the critical role of the environment and availability of patient resources in preventing readmission.

CLINICAL IMPACT

Overall, awareness of the risk of LOI following plastic surgery and of the factors associated with a higher risk can enhance patient outcomes through three main pathways: preoperative optimization, more frequent monitoring during hospitalization, and preemptive mobilization of postdischarge care.

Preoperative optimization should include optimization of the health of patients undergoing elective procedures. This can include comprehensive health assessments, with blood tests and imaging to ensure patients are fit for surgery, and stabilization of chronic conditions such as diabetes and hypertension. For example, managing blood sugar levels in diabetic patients. Providing nutritional counseling has been shown to improve patients' health and immune function, factors critical for adequate wound healing and recovery. Mental health support and counseling can help to ensure that patients are prepared for the surgery and its outcomes.

Patients most at risk could be part of a more intensive postoperative monitoring protocol. For example, more frequent monitoring of vital signs to detect early signs of complications, and more frequent checks of the surgical sites for signs of infection, hematoma, or other complications. More regular assessments of fluid balance and nutritional intake can support recovery. A multi-disciplinary team including surgeons, nurses, physiotherapists, nutritionists, and mental health professionals to provide comprehensive care is important.

The third step is preemptive mobilization of postdischarge care, which can include early planning for discharge, involving patients and their family in the process to ensure all necessary arrangements are made as well as scheduling regular follow-up visits to monitor recovery, manage any complications, and adjust treatment plans as necessary. Caregivers who will be supporting the patient can be preemptively identified and educated, ensuring they understand the care protocols and complications. Mobilization of home care can include nursing care that would provide wound care, medication administration, and monitor overall health and physiotherapists to provide in-home rehabilitation services to restore function and mobility. Evaluation of a patient's living conditions can help ensure a safe and supportive recovery environment. Preemptive provision of aids (eg, wheelchairs) and home modifications (eg, ramp installation) can facilitate mobility and safety during recovery.

LIMITATIONS AND FUTURE WORK

This study is the first to analyze the LOI following plastic surgery using multi-institutional and diversified data collected over 2 years, based on the newly added variable of on-discharge functional status. The results and conclusions of this study should be interpreted with consideration of its limitations. For example, although the ACS-NSQIP is a valuable tool for surgical quality improvement, its limitations have been previously described. First, as participation in the ACS-NSQIP is voluntary, the participating hospitals may not be nationally representative. For example, participation is resource-intensive, requiring dedicated funds for participating, and hiring and training personnel for the data collection. Such costs may be prohibitive for smaller institutions with limited resources, and, therefore, our results may be more representative of larger US academic hospitals, as they suffer from selection bias and lower generalizability. The quality and completeness of the data directly depends on the healthcare professional performing the data collection, may be associated with intra- and inter-institutional inconsistencies and, hence, can affect the validity and reliability of the collected data. It should be mentioned that research has verified a low variance in the ACS-NSQIP's heterogeneity.[29] The ACS-NSQIP database is analyzed in a retrospective manner, which is associated with inherent biases and confounders. As data collection is standardized, the database often lacks procedure- or study-specific variables, which can limit its applicability. For example, data on seroma and hematoma, as well as long-term data, (>30 d) are relevant to plastic surgery and this study but missing from the database. Long-term data on function, mobility, and cognition are relevant but not collected by the database. Therefore, this study assesses short-term LOI after plastic surgery, whereas future studies should include more longitudinal assessments of patient-centered outcomes. We opted to include only older patients in this study, although even when not excluding any age, we saw that most patients in both groups were older than 75 years, which does not reflect the age distribution of the entire database (Supplemental Digital Content 2, **http://links.lww.com/PRSGO/D495**). This is a reflection of clinician's predisposition to collect data on independence in older patients (>75 years). Regardless of the reasons, this limits the generalizability of our results to younger populations. Future research should aim to prospectively investigate the LOI after plastic surgery across all ages. Finally, this study reports statistical correlations, while the causal-effect relationships require future study. It is worth mentioning that of the entire plastic surgery cohort (n = 59,854) only 3.8% (n = 2319) provided data on both on-admission and at-discharge functional status; therefore, the majority of the cohort was not eligible for inclusion. Finally, the goal of this study was to look at LOI in patients who underwent plastic surgery; we therefore chose to exclude all other surgeons (using the specialization variable). In a future analysis, we aim to analyze all patients to identify the factors associated with LOI following any type of surgery.

CONCLUSIONS

Approximately 8% of plastic surgery patients older than 70 years old are at risk of short term LOI. Factors associated with LOI include older age, a recent history of falls, prolonged operation times, inpatient procedures, and longer hospital stays. LOI is associated with higher rates of nonhome discharge and readmission. To optimize plastic surgery outcomes in the aging population, future studies should focus on developing clinical interventions directed at minimizing LOI with the goal of reducing readmission, nonhome discharge, and mortality after discharge.

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DISCLOSURE

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