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Psychiatric disorders and major spine surgery: epidemiology and perioperative outcomes. — Source link

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Psychiatric disorders and major spine surgery: epidemiology and perioperative outcomes

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Abstract: Study Design. Analysis of the National Hospital Discharge Survey database from 1990 to 2007.Objective. To evaluate the influence of preoperative depression, anxiety, schizophrenia or dementia on in hospital (1) adverse events, (2) mortality and (3) non-routine discharge in patients undergoing major spine surgery.Summary of Background Data. Psychiatric comorbidity is a known risk factor for impaired health-related quality of life and poor long-term outcomes following spine surgery, yet little is known about its impact in the perioperative spine surgery setting.Methods. Using the National Hospital Discharge Survey database, all patients undergoing either spinal fusion or laminectomy between 1990 and 2007 were identified and separated into groups with and without psychiatric disorders. Multivariable regression analysis was performed for each of the outcome variables.Results. Between 1990 and 2007, a total estimated number of 5,382,343 spinal fusions and laminectomies were performed. The prevalence of diagnosed depression, anxiety and schizophrenia among the study population increased significantly over time. Depression, anxiety, schizophrenia and dementia were associated with higher rates of non-routine discharge. Depression, schizophrenia and dementia were associated with higher rates of adverse events. Dementia was the only psychiatric disorder associated with a higher risk of in hospital mortality.Conclusion. Patients with preoperative psychiatric disorders undergoing major spine surgery are at increased risk for perioperative adverse events and post hospitalization care, but its effect in perioperative mortality is more limited. Pre-surgical psychological screening of spine surgery candidates might ultimately lead to the enhancement of perioperative outcomes in this growing segment of the US population.

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EPIDEMIOLOGY

Psychiatric Disorders and Major Spine Surgery

Epidemiology and Perioperative Outcomes

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Study Design. Analysis of the National Hospital Discharge Survey database from 1990 to 2007.

Objective. To evaluate the influence of preoperative depression, anxiety, schizophrenia, or dementia on in-hospital (1) adverse events, (2) mortality, and (3) nonroutine discharge in patients undergoing major spine surgery.

Summary of Background Data. Psychiatric comorbidity is a known risk factor for impaired health-related quality of life and poor long-term outcomes after spine surgery, yet little is known about its impact in the perioperative spine surgery setting.

Methods. Using the National Hospital Discharge Survey database, all patients undergoing either spinal fusion or laminectomy between 1990 and 2007 were identified and separated into groups with and without psychiatric disorders. Multivariable regression analysis was performed for each of the outcome variables.

Results. Between 1990 and 2007, a total estimated number of 5,382,343 spinal fusions and laminectomies were performed. The prevalence of diagnosed depression, anxiety, and schizophrenia among the study population increased significantly over time. Depression, anxiety, schizophrenia, and dementia were associated with higher rates of nonroutine discharge. Depression, schizophrenia, and dementia were associated with higher rates of adverse events. Dementia was the only psychiatric disorder associated with a higher risk of in-hospital mortality.

Conclusion. Patients with preoperative psychiatric disorders undergoing major spine surgery are at increased risk for perioperative adverse events and posthospitalization care, but its effect in perioperative mortality is more limited. Presurgical psychological screening of candidates undergoing spine surgery might ultimately lead to the enhancement of perioperative outcomes in this growing segment of the US population.

Key words: spinal fusion, laminectomy, depression, anxiety, schizophrenia, dementia, perioperative, complications, risk factors, mortality, discharge, epidemiology.

Level of Evidence: N/A

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Psychiatric disorders are common in the United States and internationally. Depression and anxiety disorders represent the 2 most frequently diagnosed disorders, with a current global prevalence of 6% to 10% and 7.3%, respectively.[1,2] Schizophrenia is a less common disorder with a lifetime prevalence slightly below 1%.[3] Dementia, primarily attributable to the Alzheimer disease, affects more than 6% of people older than 60 years in the United States.[4] According to a recent study, the number of older adults experiencing a psychiatric disorder will double by 2030.[2]

Numerous studies, predominantly in the fields of neurology and cardiology, have linked the presence of pre-existing comorbid psychiatric conditions to increased health risks, poor treatment outcomes, and higher use of health care resources[2,5–13]; however, research examining the impact of concomitant psychiatric conditions in short-term perioperative settings is scarce.[14] Despite growing evidence that psychological factors affect long-term outcomes after spine surgery, research evaluating their impact in the perioperative spine surgery setting is scant.[15–18] In particular, there is a paucity of information on perioperative outcomes in patients with psychiatric comorbidity undergoing laminectomy and spinal fusion, procedures whose demands have dramatically increased during the past 3 decades in the United States.[19–29]

This study provides an analysis of the impact of preexisting psychiatric disorders on perioperative outcomes in a large cohort of individuals admitted to US hospitals for spinal fusion or laminectomy, from 1990 to 2007. The aim of this study was to evaluate the association between psychiatric comorbidity and in-hospital (1) adverse events, (2) mortality, and (3) nonroutine disposition rates in patients undergoing major spine surgery.

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MATERIALS AND METHODS

This study was exempt from approval of our institutional review board because all data used in this project were deidentified beforehand and available for public use. The National Hospital Discharge Survey (NHDS) database, an initiative fostered by the National Center for Health Statistics in 1965,[30] was the source for all demographic and medical data subject to analysis. A stratified multistage probability design was used by the NHDS to retrieve a sample of discharges from nonfederal short-stay hospitals (average length of stay <30 d) in the United States.[31] Besides principal demographic information, NHDS collected medical information of up to 7 discharge diagnoses and up to 4 procedures. In the NHDS dataset, medical diagnoses and procedures were classified using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) codes.[32,33]

Our study population consisted of all adult patients aged 18 years or older undergoing either primary spinal fusion or laminectomy during a 17-year time span, ranging from 1990 to 2007 (Table 1). The spine procedures were identified using the corresponding *ICD-9-CM* codes: laminectomy (3.09), primary cervical fusion (81.01–81.03), primary thoracic fusion (81.04–81.05), and primary lumbar fusion (81.06–81.08). We opted not to include patients undergoing revision spinal procedures. To determine the 5 most frequent primary diagnoses, *ICD-9* codes were sorted by frequency. Concurrent medical comorbidities and inpatient adverse events were also *ICD-9-CM* based (Addendum). Mental disorders were further split into subgroups to analyze their influence on inpatient outcomes after major spine surgery: depression (*ICD-9-CM* 296.2, 296.3, 296.5, 296.9, 300.4, 301.12, 309.0, 311.x), anxiety (*ICD-9-CM* 300.x, 309.24, 309.28), schizophrenia (*ICD-9-CM* 295.x), and dementia (*ICD-9-CM* 290.x). We opted to analyze the influence of these 4 mental disorders due to their relatively high prevalence in society. We did not sort *ICD-9* codes by frequency to determine whether a subject did or did not have a mental health diagnosis.

Table 1 portrays patients' characteristics (age, sex, primary diagnosis, and presence or absence of comorbidities) of the entire cohort as well as of the following 5 subgroups: patients with a preoperative diagnosis of (1) depression, (2) anxiety, (3) schizophrenia, (4) dementia, and (5) patients without any of these diagnoses. Table 2 depicts in-hospital factors (type and number of spinal procedures, presence or absence of perioperative complications, need for blood transfusion, length of hospital stay, and mortality).

The (1) presence of adverse events, (2) mortality, and (3) discharge to a rehabilitation facility constituted the 3 dependent dichotomous outcome variables. Data concerning the variable "discharge to a rehabilitation facility" were only available from 2001 to 2007. On the basis of the large sample size, we assumed a normal distribution of the data. χ^2 test was used to analyze categorical data, and independent-samples *T* test was used for continuous data. Both tests were used to find differences in patients' characteristics between subgroups. For the purpose of analyzing whether depression, anxiety, schizophrenia, or dementia were independent predictors of a negative postoperative in-hospital outcome (complications, mortality, discharge to a rehabilitation facility), all variables present in at least 2% of the population[34] were included in a multivariable binary logistic regression model; for postoperative adverse events, due to their lower rates of occurrence, a 1% cutoff value was adopted. We evaluated all psychiatric comorbidities as separate diagnoses without weighing their importance. The adoption of multivariable regression models allowed us to control for potential confounders such as the co-occurrence of multiple psychiatric disorders and isolate the effect of each individual psychiatric disorder on inpatient outcomes. A *P* value less than 0.001 was deemed to be statistically significant in all analyses, based on the large sample size.

RESULTS

An estimated number of 5,382,343 discharges after spinal fusion and/or laminectomy were retrieved from the NHDS database between 1990 and 2007. Male patients accounted for 50% of the study sample. The mean age was 54 ± 15 years. Among the entire study population, 4.5% experienced depression, 2.5% experienced anxiety, 0.2% experienced schizophrenia, and 2.0% experienced dementia (Table 1). Among patients with psychiatric comorbidities, 84% had 1, 16% had 2, and 0.4% had 3 psychiatric diagnoses. The prevalence of depression, anxiety, and schizophrenia among the study population clearly increased over time, although the prevalence of dementia remained basically unaltered (Table 3).

Overall, the most common diagnosis requiring spine surgery was lumbar spinal stenosis without neurogenic claudication in 16% of patients, followed by cervical disc displacement without myelopathy (15%), lumbar disc displacement without myelopathy (11%), lumbar intervertebral disc degeneration (7.8%), and cervical spondylosis without myelopathy (5.6%).

More than two-thirds of patients with depression and anxiety were younger females ($P < 0.001$). In contrast, patients with schizophrenia were primarily younger males ($P < 0.001$). On average, 43% of patients without psychiatric disorders had at least 1 comorbidity. More than 60% of the patients with any of the 4 defined mental disorders also had additional comorbidities. The most frequent comorbidities consisted of hypertensive disease (27%), chronic pulmonary disease (8.7%), and diabetes mellitus (8.2%) (Table 4).

The length of hospital stay was significantly shorter in patients with either depression or anxiety (4.2 ± 5.9 d and 3.9 ± 4.0 d, respectively) than patients without psychiatric diseases (4.7 ± 7.4 d) ($P < 0.001$). On the contrary, length of hospital stay in individuals with either preoperative schizophrenia or dementia had significantly increased (13 ± 21 d and 11 ± 12 d, respectively) (Table 2). Compared with patients without psychiatric comorbidity burden (5.2%), the rates of discharge to rehabilitation facilities after surgery were higher in patients with any of these 4 mental disorders (depression: 8.3%, anxiety: 8.3%, schizophrenia: 28%, dementia: 17%).

TABLE 1. Patient Characteristics (n = 5,382,343)

Parameter	Total, %	No Mental Disorders, %	*P*	Depression, %	*P*	Anxiety, %	*P*	Schizo-phrenia, %	*P*	Dementia, %	*P*
% of the total cohort	100	92		4.5		2.5		0.2		2.0	
Sex											
Male	50	51	<0.001	33	<0.001	32	<0.001	71	<0.001	49	<0.001
Female	50	49		67		68		29		51	
Age (years ± SD)	54 ± 15	54 ± 15	<0.001	53 ± 13	<0.001	53 ± 13	<0.001	49 ± 12	<0.001	58 ± 16	<0.001
≥1 comorbidities*	45	43	<0.001	61	<0.001	60	<0.001	63	<0.001	70	<0.001
Five most frequent diagnoses											
Lumbar spinal stenosis without neurogenic claudication	16	16	<0.001	17	<0.001	17	<0.001	4.1	<0.001	1.1	<0.001
Cervical disc displacement without myelopathy	15	16	<0.001	14	<0.001	12	<0.001	12	<0.001	0	<0.001
Lumbar disc displacement without myelopathy	11	11	<0.001	8.5	<0.001	11	0.56	4.6	<0.001	0	<0.001
Lumbar intervertebral disc degeneration	7.8	7.6	<0.001	13	<0.001	9.7	<0.001	4.0	<0.001	0	<0.001
Cervical spondylosis without myelopathy	5.6	5.6	<0.001	6.8	<0.001	7.2	<0.001	0.8	<0.001	0	<0.001

**Other than mental disorders.*
SD indicates standard deviation.

TABLE 2. Hospitalization Factors (n = 5,382,343)

	Total, %	No Mental Disorders, %	*P*	Depression, %	*P*	Anxiety, %	*P*	Schizophrenia, %	*P*	Dementia, %	*P*
Spinal procedure											
Laminectomy	37	37	<0.001	31	<0.001	30	<0.001	26	<0.001	62	<0.001
Atlas-axis fusion	0.7	0.7	<0.001	0.4	<0.001	0.8	<0.001	2.9	<0.001	1.5	<0.001
Cervical fusion anterior column, anterior technique	31	32	<0.001	31	0.002	31	0.04	33	<0.001	11	<0.001
Cervical fusion posterior column, posterior technique	3.2	3.1	<0.001	3.8	<0.001	4.3	<0.001	13	<0.001	5.9	<0.001
Thoracic fusion anterior column, anterior technique	1.0	0.9	<0.001	0.7	<0.001	0.6	<0.001	0.3	<0.001	7.0	<0.001
Thoracic fusion posterior column, posterior technique	2.6	2.5	<0.001	0.9	<0.001	2.2	<0.001	3.1	0.011	14	<0.001
Lumbar fusion anterior column, anterior technique	5.6	5.5	<0.001	7.0	<0.001	8.6	<0.001	1.5	<0.001	2.4	<0.001
Lumbar fusion posterior column, posterior technique	5.2	5.3	<0.001	5.2	0.50	5.6	<0.001	3.0	<0.001	1.1	<0.001
Lumbar fusion anterior column, posterior technique	24	24	<0.001	24	<0.001	27	<0.001	21	<0.001	11	<0.001
Number of spinal procedures											
1	90	90	<0.001	90	0.024	90	0.34	96	<0.001	86	<0.001
≥2	9.9	9.8		9.7		10		4.1		14	
≥1 adverse events	16	15	<0.001	15	<0.001	15	<0.001	33	<0.001	30	<0.001
Days of care (days ± SD)	4.8 ± 7.6	4.7 ± 7.4	<0.001	4.2 ± 5.9	<0.001	3.9 ± 4.0	<0.001	13 ± 21	<0.001	11 ± 12	<0.001
Need for blood transfusion	3.4	3.3	<0.001	4.2	<0.001	4.5	<0.001	6.9	<0.001	5.0	<0.001
Mortality	0.4	0.4	<0.001	0.1	<0.001	0	<0.001	0	<0.001	3.2	<0.001

SD indicates standard deviation.

TABLE 3. Prevalence of Psychiatric Comorbidity Among Spine Surgical Procedures Over Time (%)

	1990–1995	1996–2001	2002–2007
Depression	1.0	2.9	7.4
Anxiety	0.8	1.3	4.1
Schizophrenia	0	0.1	0.3
Dementia	2.2	1.9	1.9

When compared with patients without psychiatric comorbidity (15%), the rate of perioperative adverse events was higher in patients with concomitant schizophrenia (33%) and dementia (30%), and comparable in patients with preoperative depression (15%) and anxiety (15%) (Table 2). The most frequent adverse event was acute posthemolytic anemia, with patients with dementia exhibiting the highest occurrence rates (12%, *vs*. those without mental disorders: 6.0%) (Table 5). More than 5% of the patients with schizophrenia experienced a pulmonary embolism after surgery (*vs*. those without mental disorders: 0.1%) (Table 5).

As to in-hospital death, rates were clearly higher in patients with dementia (3.2%, *vs*. those without mental conditions: 0.4%), but lower in patients with preoperative depression (0.1%), anxiety (0%), and schizophrenia (0%) ($P < 0.001$) (Table 2).

Multivariable Analysis

Multivariable binary logistic regression models revealed significantly increased odds for discharge to a rehabilitation facility after spine surgery in patients with any of the 4 mental illnesses, compared with patients without these conditions (schizophrenia: OR = 4.3, 95% confidence interval [CI]: 4.0–4.6, $P < 0.001$; depression: OR = 1.4, 95% CI: 1.3–1.4, $P < 0.001$; anxiety: OR = 1.2, 95% CI: 1.2–1.2, $P < 0.001$; dementia: OR = 1.1, 95% CI: 1.1–1.1, $P < 0.001$; Table 6). Likewise, all mental disorders but anxiety, were associated with significantly higher odds for postoperative adverse events (schizophrenia: OR = 2.3, 95% CI: 2.2–2.5, $P < 0.001$; dementia: OR = 1.2, 95% CI: 1.2–1.3, $P < 0.001$; depression: OR = 1.04, 95% CI: 1.03–1.1, $P < 0.001$; Table 7). Dementia was the only mental disorder independently associated with a higher risk of inpatient mortality (OR = 6.6, 95% CI: 6.3–6.8, $P < 0.001$; Table 8). Although schizophrenia had no effect on postoperative mortality, the presence of preoperative depression and anxiety was linked to lower odds for in-hospital death (depression: OR = 0.45, 95% CI: 0.40–0.52, $P < 0.001$; anxiety: OR = 0.26, 95% CI: 0.20–0.35, $P < 0.001$; Table 8).

DISCUSSION

In this study of nationally representative data collected between 1990 and 2007, we have demonstrated that a preoperative psychiatric condition is an independent risk factor for nonroutine discharge disposition and the development of in-hospital adverse events after major spine surgery. Its effect on perioperative mortality seems to be more limited, with only dementia being associated with a higher risk of death.

We were able to identify a considerable increase in the prevalence of clinically diagnosed depression, anxiety, and schizophrenia in patients undergoing spine surgery over time. The prevalence of dementia remained basically unaltered during the 17-year time span. Recent evidence suggests that the global prevalence of depression ranges from 6% to 10% worldwide.[2] In our study, the frequency of depression among patients undergoing spine surgery has increased from 1% in 1990–1995 to 7.4% in the 2002–2007 time period, reaching the levels seen in the general population, although it is known that there is a higher prevalence of psychiatric disorders in patients with chronic neck and back pain.[35]

Females accounted for more than two-thirds of spine surgery admissions with concomitant depression or anxiety; this clear female sex-dominance is, in fact, consistent with previous research.[36] Although evidence suggests that schizophrenia affects males and females with equal frequency,[37] we found that patients experiencing schizophrenia undergoing spine surgery were predominantly males. The sex-specific prevalence of dementia was evenly distributed in our study cohort, which is consistent with the previous studies suggesting that neither males nor females are at increased risk of developing dementia at any given age.[38,39]

Psychiatric comorbidity is deemed a risk factor for several medical conditions, such as diabetes, metabolic syndrome, and coronary artery disease.[9,12,13] Particularly in spine surgery, depression and anxiety have been associated with impaired health-related quality of life and poor long-term outcomes, such as increased pain intensity and higher levels of perceived disability.[15–18] In addition, Walid and Robinson[40] have shown that preoperative depression was responsible for higher health care expenditure costs in patients undergoing major spine surgery. Despite these relevant inferences, research evaluating the impact of psychiatric comorbidity in the perioperative spine surgery setting is scant.

This study indicates that the presence of one or more of the examined psychiatric disorders increased the risk for nonroutine disposition after major spine surgery. Our findings were in line with earlier studies suggesting that pre-existing psychiatric and affective disorders in patients with orthopedic conditions were independent risk factors for higher health care resource use.[40,41]

A preadmission diagnosis of depression, schizophrenia, or dementia was an independent risk factor for in-hospital adverse events after spine surgery. In consistency with our study, Hu *et al*[42] demonstrated an increased overall complication rate in patients with a preoperative diagnosis of dementia undergoing diverse inpatient major surgical procedures. A recent study examining the monetary costs associated with care of dementia demonstrated a substantial financial burden.[43] A study conducted by Beresnevaite *et al*[14] showed that depression was linked to perioperative complications after coronary artery bypass graft surgery.

TABLE 4. Comorbidities: Bivariate Analysis of Patients Undergoing Spine Surgery (n = 5,382,343)

Parameter	Total, %	No Mental Disorders, %	*P*	Depression, %	*P*	Anxiety, %	*P*	Schizophrenia, %	*P*	Dementia, %	*P*
Hypertensive disease	27	27	<0.001	37	<0.001	39	<0.001	35	<0.001	28	0.008
Diabetes mellitus	8.2	8.2	0.002	7.9	<0.001	8.2	0.52	5.5	<0.001	9.3	<0.001
Diabetes with organ damage	0.7	0.8	<0.001	0.7	0.001	0.2	<0.001	1.1	<0.001	0.7	<0.001
Obesity	3.5	3.3	<0.001	6.7	<0.001	6.8	<0.001	0.5	<0.001	4.2	<0.001
Chronic pulmonary disease	8.7	8.4	<0.001	15	<0.001	14	<0.001	10	<0.001	6.5	<0.001
Moderate–severe renal disease	0.3	0.2	<0.001	0.5	<0.001	0	<0.001	10	<0.001	1.0	<0.001
Mild liver disease	0.1	0.1	<0.001	0.2	<0.001	0	<0.001	0	<0.001	0.4	<0.001
Moderate–severe liver disease	0	0	<0.001	0	0.031	0	<0.001	0	1	0.2	<0.001
Myocardial Infarction	1.8	1.9	<0.001	1.5	<0.001	1.3	<0.001	0.3	<0.001	2.1	<0.001
Chronic coronary artery disease	6.7	6.8	<0.001	5.5	<0.001	4.9	<0.001	12	<0.001	5.8	<0.001
Atrial fibrillation	2.0	2.0	<0.001	1.2	<0.001	0.8	<0.001	0.3	<0.001	3.0	<0.001
Congestive heart failure	1.3	1.3	<0.001	1.9	<0.001	2.0	<0.001	0.6	<0.001	1.3	0.21
Peripheral vascular disease	0.6	0.6	<0.001	0.5	<0.001	1.4	<0.001	0	<0.001	0.2	<0.001
Cerebrovascular disease	0.7	0.7	<0.001	0.7	<0.001	0.3	<0.001	0.4	<0.001	0.7	0.59
Chronic alcoholism	0.3	0.3	<0.001	0.7	<0.001	1.6	<0.001	0.2	0.051	0.8	<0.001
Nutritional deficiency	0.3	0.3	<0.001	0.4	<0.001	0.2	<0.001	0	<0.001	2.2	<0.001
Osteoporosis	1.6	1.6	<0.001	2.7	<0.001	2.7	<0.001	8.7	<0.001	2.7	<0.001
Thyroid disease	4.9	4.6	<0.001	10	<0.001	9.5	<0.001	1.1	<0.001	6.6	<0.001
Connective tissue disease	1.3	1.3	<0.001	2.2	<0.001	0.9	<0.001	0.3	<0.001	0.7	<0.001
Ulcer disease	0.5	0.4	<0.001	0.5	0.022	1.3	<0.001	0	<0.001	1.6	<0.001
Hemiplegia	0.5	0.4	<0.001	0.1	<0.001	0.3	<0.001	1.2	<0.001	3.6	<0.001
Aids	0	0	<0.001	0.3	<0.001	0	<0.001	0	0.085	0.3	<0.001
Any tumor	0.5	0.3	<0.001	0.1	<0.001	0	<0.001	0.6	0.59	11	<0.001
Leukemia	0.1	0.1	<0.001	0.1	<0.001	0	<0.001	0	0.002	0.4	<0.001
Lymphoma	0.2	0.2	$P < 0.001$	0.2	0.12	0.2	0.71	0	$P < 0.001$	0.9	<0.001
Metastatic solid tumor	0.6	0.2	$P < 0.001$	0.4	$P < 0.001$	0.3	$P < 0.001$	0	$P < 0.001$	18	<0.001

TABLE 5. Adverse Events: Bivariate Analysis of Patients Undergoing Spine Surgery (n = 5,382,343)

Parameter	Total, %	No Mental Disorders, %	*P*	Depression, %	*P*	Anxiety, %	*P*	Schizophrenia, %	*P*	Dementia, %	*P*
Surgery-related complications											
Wound complications	1.8	1.7	<0.001	1.9	<0.001	2	<0.001	13	<0.001	4	<0.001
Acute postoperative anemia	5.5	6.0	<0.001	4	<0.001	4.3	<0.001	0.7	<0.001	12	<0.001
General complications											
Complications not elsewhere classified	4.9	4.9	<0.001	4.0	<0.001	2.1	<0.001	1.6	<0.001	8.1	<0.001
Acute renal failure	0.3	0.3	<0.001	0.6	<0.001	0.1	<0.001	0.6	<0.001	1.0	<0.001
Acute myocardial infarction	0.2	0.2	<0.001	0	<0.001	0	<0.001	0	<0.001	0.2	0.35
Ventricular arrhythmias and arrest	0.1	0.1	<0.001	0.1	0.001	0	<0.001	0	<0.001	0.1	0.001
Iatrogenic hypotension	0.1	0.1	<0.001	0.2	<0.001	0.5	<0.001	0	<0.001	0	<0.001
Pulmonary embolism	0.2	0.1	<0.001	0.6	<0.001	0.3	<0.001	5.5	<0.001	1.2	<0.001
Induced mental disorder	0.9	0.8	<0.001	1.0	<0.001	2.3	<0.001	1.2	0.001	1.6	<0.001
Pneumonia, pulmonary congestion	1.0	1.0	<0.001	0.5	<0.001	0.1	<0.001	0.6	<0.001	2.3	<0.001
Pulmonary insufficiency	1.2	1.3	<0.001	0.5	<0.001	0.4	<0.001	3.2	<0.001	1.5	<0.001
Deep venous thrombosis	0.4	0.4	<0.001	0.3	<0.001	0.5	<0.001	3.4	<0.001	1.4	<0.001
Intubation or mechanical ventilation	0.6	0.6	<0.001	0.4	<0.001	0.1	<0.001	0	<0.001	0.7	<0.001
Transfusion of blood	3.4	3.3	<0.001	4.2	<0.001	4.5	<0.001	6.9	<0.001	5.0	<0.001
Conversion of cardiac rhythm	0.1	0.1	<0.001	0.1	<0.001	0.2	<0.001	0	0.006	0.1	0.17

TABLE 6. Multivariable Analysis of Predictors of Nonroutine Discharge After Spine Surgery (n = 2,740,439)

Predictor	OR	95% CI	
		Lower	Upper
Schizophrenia	4.3	4.0	4.6
2 or more spinal procedures	2.3	2.2	2.5
Pulmonary insufficiency	1.8	1.7	1.8
Male sex	1.5	1.5	1.6
Atlas-axis fusion	1.5	1.4	1.6
Thoracic fusion posterior column, posterior technique	1.4	1.3	1.5
Diabetes mellitus	1.4	1.4	1.4
Pneumonia and pulmonary congestion	1.4	1.3	1.4
Depression	1.4	1.3	1.4
Complications not elsewhere classified	1.3	1.3	1.3
Chronic pulmonary disease	1.3	1.3	1.3
Wound complication	1.3	1.3	1.3
Geographic, West compared with South	1.2	1.2	1.2
Hypertension	1.2	1.2	1.2
Geographic, Northeast compared with South	1.2	1.2	1.2
Transfusion	1.2	1.2	1.2
Number of beds, 200–299 compared with 300–499	1.2	1.2	1.2
Anxiety	1.2	1.2	1.2
Number of beds, 6–99 compared with 300–499	1.1	1.1	1.2
Geographic, Midwest compared with South	1.1	1.1	1.1
Chronic coronary artery disease	1.1	1.1	1.1
Dementia	1.1	1.1	1.1
Number of beds, 100–199 compared with 300–499	1.1	1.1	1.1
Atrial fibrillation	1.1	1.1	1.1
Days of care	1.1	1.1	1.1
Age	1.1	1.1	1.1
Acute postoperative anemia	1.04	1.02	1.1
Thyroid disease	0.80	0.79	0.82
Lumbar fusion anterior column, anterior technique	0.73	0.69	0.77
Cervical fusion posterior column, posterior technique	0.72	0.68	0.77
Lumbar fusion anterior column, posterior technique	0.67	0.63	0.71
Laminectomy	0.58	0.55	0.61
Lumbar fusion posterior column, posterior technique	0.48	0.45	0.51
Cervical fusion anterior column, anterior technique	0.32	0.30	0.34
Thoracic fusion anterior column, anterior technique	1.1	1.0	1.2
Number of beds, >500 compared with 300–499	1.0	1.0	1.03
Obesity	0.99	0.97	1.0

CI indicates confidence interval.

TABLE 7. Multivariable Analysis of Predictors of Adverse Events After Spine Surgery (n = 5,382,343)

Predictor	OR	95% CI	
		Lower	Upper
Schizophrenia	2.3	2.2	2.5
Lumbar fusion posterior column, posterior technique	2.2	2.1	2.3
Lumbar fusion anterior column, posterior technique	1.7	1.6	1.8
2 or more spinal procedures	1.6	1.5	1.6
Thoracic fusion posterior column, posterior technique	1.5	1.4	1.6
Thoracic fusion anterior column, anterior technique	1.5	1.4	1.5
Lumbar fusion anterior column, anterior technique	1.4	1.3	1.4
Geographic, Midwest compared with South	1.4	1.4	1.4
Atrial fibrillation	1.3	1.3	1.4
Dementia	1.2	1.2	1.3
Atlas-axis fusion	1.2	1.1	1.2
Chronic pulmonary disease	1.2	1.2	1.2
Geographic, West compared with South	1.2	1.2	1.2
Geographic, Northeast compared with South	1.2	1.1	1.2
Days of care	1.1	1.1	1.1
Number of beds, 200–299 compared with 300–499	1.1	1.1	1.1
Male sex	1.1	1.1	1.1
Depression	1.04	1.03	1.1
Age	1.02	1.02	1.02
Number of beds, >500 compared with 300–499	0.97	0.97	0.98
Diabetes mellitus	0.96	0.95	0.96
Anxiety	0.95	0.93	0.96
Chronic coronary artery disease	0.94	0.93	0.95
Obesity	0.94	0.93	0.96
Number of beds, 100–199 compared with 300–499	0.91	0.91	0.92
Thyroid disease	0.89	0.88	0.90
Hypertension	0.88	0.87	0.88
Number of beds, 6–99 compared with 300–499	0.85	0.84	0.86
Laminectomy	0.67	0.65	0.70
Cervical fusion anterior column, anterior technique	0.31	0.30	0.32
Cervical fusion posterior column, posterior technique	1.1	1.0	1.1

CI indicates confidence interval.

Dementia was the only psychiatric disorder independently associated with a higher risk of perioperative mortality after spine surgery. In particular, depression and anxiety showed significantly lower odds for in-hospital death. The paradoxical decrease of mortality rates among patients with depression or anxiety may seem puzzling at first, given the augmented comorbidity burden and increased health care resource utilization of psychiatric patients. One explanation for this finding is that they may be more inclined, compared with the general population, to estimate bodily sensations and changes as indicators for a catastrophic illness.[44] Additionally, hypochondriac traits are more commonly found in patients with psychiatric disorders, especially depression.[45] This underlying fear of illness may ultimately lead to both

TABLE 8. Multivariable Analysis of Predictors of Mortality After Spine Surgery (n = 5,382,343)

Predictor	OR	95% CI	
		Lower	Upper
Pulmonary insufficiency	9.9	9.5	10
Dementia	6.6	6.3	6.8
Pneumonia and pulmonary congestion	3.5	3.3	3.7
Atrial fibrillation	3.3	3.1	3.4
2 or more spinal procedures	2.1	1.5	3.1
Complications not elsewhere classified	1.6	1.6	1.7
Transfusion	1.5	1.4	1.6
Geographic, West compared with South	1.3	1.3	1.4
Diabetes mellitus	1.2	1.2	1.3
Wound complication	1.2	1.2	1.3
Chronic pulmonary disease	1.1	1.05	1.1
Age	1.1	1.1	1.1
Days of care	1.02	1.02	1.02
Chronic coronary artery disease	0.83	0.79	0.88
Male sex	0.83	0.80	0.85
Hypertension	0.72	0.70	0.75
Number of beds, 100–199 compared with 300–499	0.71	0.68	0.74
Number of beds, >500 compared with 300–499	0.60	0.58	0.63
Obesity	0.53	0.47	0.61
Thyroid disease	0.53	0.48	0.58
Cervical fusion posterior column, posterior technique	0.53	0.37	0.76
Depression	0.45	0.40	0.52
Laminectomy	0.36	0.25	0.52
Acute postoperative anemia	0.36	0.33	0.40
Number of beds, 200–299 compared with 300–499	0.33	0.31	0.34
Anxiety	0.26	0.20	0.35
Cervical fusion anterior column, anterior technique	0.25	0.17	0.35
Lumbar fusion posterior column, posterior technique	0.21	0.15	0.31
Lumbar fusion anterior column, anterior technique	0.20	0.13	0.28
Lumbar fusion anterior column, posterior technique	0.14	0.10	0.20
Number of beds, 6–99 compared with 300–499	0.11	0.10	0.13
Atlas-axis fusion	0.07	0.048	0.10
Geographic, Midwest compared with South	1.1	1.0	1.1
Geographic, Northeast compared with South	1.0	1.0	1.0
Thoracic fusion anterior column, anterior technique	0.68	0.47	1.0
Thoracic fusion posterior column, posterior technique	0.61	0.43	0.88
Schizophrenia	*		

**The odds ratio could not be calculated because of the low number of deaths in patients with schizophrenia.*
CI indicates confidence interval.

increased levels of attention by health care professionals and a higher use of resources.[46] Moreover, the frustration and difficulties some clinicians may encounter while treating patients with psychiatric disorders, along with characteristic low levels of self-efficacy for managing pain, symptoms, and function,[47] may contribute to explain the underlying reasons for an increased nonroutine discharge rate after spine surgery in this population. Another hypothetical approach to further understanding these findings is that a pre-existing diagnosis of psychiatric illness may unconsciously encourage physicians to deliver a superior level of care to these more susceptible patients, so as to avoid life-threatening complications. In line with our findings, a recent study conducted by Bozic *et al*[48] demonstrated that no mental disorders, except dementia, were independent risk factors for 90-day postoperative mortality after total knee arthroplasty.

Several shortcomings primarily associated with the analysis of data from administrative databases should be kept in mind to better interpret our findings.[49] First, all clinical information available in the NHDS database concerning diagnoses, procedures, and adverse events was identified using *ICD-9* codes. Due to the extensive sample study size of our study, potential mistakes in misclassification of the codes adopted in this study cannot be elided. However, misclassification errors tend to be equally distributed among groups subject to comparison in large-scale studies.[50] In addition, because of the nature of the NHDS, we cannot confirm whether a particular diagnosis was made before or during the period of hospitalization; also, information detailing the surgical procedure, such as length of surgery, amount of blood loss, and type of anesthesia remains unknown. An additional limiting factor is that data regarding medication use were not available; hence, we cannot verify that the patients with pre-existing comorbid psychiatric conditions were being adequately treated prior to hospital admission. Finally, the NHDS, in consistency with the Nationwide Inpatient Sample database, fails to capture postdischarge outcomes; therefore, data concerning complications and mortality rates after hospital discharge, as well as readmission rates remain undetected. It is also important to note that the large sample size of this study might identify statistically significant differences that are not clinically relevant or reproducible. Furthermore, the reader should be aware that odds ratios calculated by binomial logistic regression overestimate the true effect if the outcomes of interest are common (>10%) as in adverse events and nonroutine discharges; therefore the point estimates obtained in our study should be interpreted with due caution.

CONCLUSION

This study provides evidence that patients with preoperative psychiatric disorders undergoing major spine surgery are at increased risk for perioperative adverse events and posthospitalization care. With the exception of dementia, its effect in perioperative mortality seems to be more limited; the presence of depression or anxiety seems to be a protective factor for mortality. Additional research should investigate causes for the decreased perioperative mortality in patients with affective disorders. This information may prove useful to spine specialists involved in the preoperative evaluation of this growing segment of the US population.

➢ Key Points

- ❑ The prevalence of diagnosed depression, anxiety, and schizophrenia among patients undergoing major spine surgery clearly increased between 1990 and 2007.
- ❑ Patients with psychiatric disorders undergoing major spine surgery present with higher rates of comorbidities.
- ❑ Preoperative psychiatric disorders are associated with higher odds of perioperative adverse events and posthospitalization care after major spine surgery.
- ❑ Dementia is the only psychiatric disorder associated with higher odds of perioperative mortality after major spine surgery.

References

1. Baxter AJ, Scott KM, Vos T, et al. Global prevalence of anxiety disorders: a systematic review and meta-regression. *Psychol Med* 2013;43:897–910.
2. Reynolds CF, 3rd, Cuijpers P, Patel V, et al. Early intervention to reduce the global health and economic burden of major depression in older adults. *Annu Rev Public Health* 2012;33:123–35.
3. Perala J, Suvisaari J, Saarni SI, et al. Lifetime prevalence of psychotic and bipolar I disorders in a general population. *Arch Gen Psychiatry* 2007;64:19–28.
4. Ferri CP, Prince M, Brayne C, et al. Global prevalence of dementia: a Delphi consensus study. *Lancet* 2005;366:2112–7.
5. de Miguel-Diez J, Carrasco-Garrido P, Rejas-Gutierrez J, et al. The influence of heart disease on characteristics, quality of life, use of health resources, and costs of COPD in primary care settings. *BMC Cardiovasc Disord* 2010;10:8.
6. Graven LJ, Grant J. The impact of social support on depressive symptoms in individuals with heart failure: update and review. *J Cardiovasc Nurs* 2013;28:429–43.
7. Nemeroff CB, Goldschmidt-Clermont PJ. Heartache and heartbreak–the link between depression and cardiovascular disease. *Nat Rev Cardiol* 2012;9:526–39.
8. Hill J, Fillit H, Shah SN, et al. Patterns of healthcare utilization and costs for vascular dementia in a community-dwelling population. *J Alzheimers Dis* 2005;8:43–50.
9. Jakobsen AH, Foldager L, Parker G, et al. Quantifying links between acute myocardial infarction and depression, anxiety and schizophrenia using case register databases. *J Affect Disord* 2008;109:177–81.
10. Ruo B, Rumsfeld JS, Hlatky MA, et al. Depressive symptoms and health-related quality of life: the Heart and Soul Study. *JAMA* 2003;290:215–21.
11. Zhao Y, Kuo TC, Weir S, et al. Healthcare costs and utilization for Medicare beneficiaries with Alzheimer's. *BMC Health Serv Res* 2008;8:108.
12. Enger C, Weatherby L, Reynolds RF, et al. Serious cardiovascular events and mortality among patients with schizophrenia. *J Nerv Ment Dis* 2004;192:19–27.
13. Kagal UA, Torgal SS, Patil NM, et al. Prevalence of the metabolic syndrome in schizophrenic patients receiving second-generation antipsychotic agents–a cross-sectional study. *J Pharm Pract* 2012;25:368–73.

14. Beresnevaite M, Benetis R, Taylor GJ, et al. Depression predicts perioperative outcomes following coronary artery bypass graft surgery. *Scand Cardiovasc J* 2010;44:289–94.
15. Aalto TJ, Malmivaara A, Kovacs F, et al. Preoperative predictors for postoperative clinical outcome in lumbar spinal stenosis: systematic review. *Spine (Phila Pa 1976)* 2006;31:E648–63.
16. Epker J, Block AR. Presurgical psychological screening in back pain patients: a review. *Clin J Pain* 2001;17:200–5.
17. Seebach CL, Kirkhart M, Lating JM, et al. Examining the role of positive and negative affect in recovery from spine surgery. *Pain* 2012;153:518–25.
18. Slover J, Abdu WA, Hanscom B, et al. The impact of comorbidities on the change in Short-Form 36 and Oswestry scores following lumbar spine surgery. *Spine (Phila Pa 1976)* 2006;31:1974–80.
19. Gray DT, Deyo RA, Kreuter W, et al. Population-based trends in volumes and rates of ambulatory lumbar spine surgery. *Spine (Phila Pa 1976)* 2006;31:1957–63; discussion 64.
20. Memtsoudis SG, Kirksey M, Ma Y, et al. Metabolic syndrome and lumbar spine fusion surgery: epidemiology and perioperative outcomes. *Spine (Phila Pa 1976)* 2012;37:989–95.
21. Memtsoudis SG, Vougioukas VI, Ma Y, et al. Perioperative morbidity and mortality after anterior, posterior, and anterior/posterior spine fusion surgery. *Spine (Phila Pa 1976)* 2011;36:1867–77.
22. Taylor VM, Deyo RA, Cherkin DC, et al. Low back pain hospitalization. Recent United States trends and regional variations. *Spine (Phila Pa 1976)* 1994;19:1207–12; discussion 13.
23. Angevine PD, Arons RR, McCormick PC. National and regional rates and variation of cervical discectomy with and without anterior fusion, 1990–1999. *Spine (Phila Pa 1976)* 2003;28:931–9; discussion 40.
24. Bono CM, Lee CK. Critical analysis of trends in fusion for degenerative disc disease over the past 20 years: influence of technique on fusion rate and clinical outcome. *Spine (Phila Pa 1976)* 2004;29:455–63; discussion Z5.
25. Cherkin DC, Deyo RA, Loeser JD, et al. An international comparison of back surgery rates. *Spine (Phila Pa 1976)* 1994;19:1201–6.
26. Rajaee SS, Bae HW, Kanim LE, et al. Spinal fusion in the United States: analysis of trends from 1998 to 2008. *Spine (Phila Pa 1976)* 2012;37:67–76.
27. Davis H. Increasing rates of cervical and lumbar spine surgery in the United States, 1979–1990. *Spine (Phila Pa 1976)* 1994;19:1117–23; discussion 23–4.
28. Deyo RA, Gray DT, Kreuter W, et al. United States trends in lumbar fusion surgery for degenerative conditions. *Spine (Phila Pa 1976)* 2005;30:1441–5; discussion 6–7.
29. Ma Y, Passias P, Gaber-Baylis LK, et al. Comparative in-hospital morbidity and mortality after revision versus primary thoracic and lumbar spine fusion. *Spine J* 2010;10:881–9.
30. Dennison C, Pokras R. Design and operation of the National Hospital Discharge Survey: 1988 redesign. *Vital Health Stat 1* 2000;39:1–42.
31. Hall MJ, DeFrances CJ, Williams SN, et al. National Hospital Discharge Survey: 2007 summary. *Natl Health Stat Report* 2010;29:1–20, 4.
32. Bhattacharyya T, Iorio R, Healy WL. Rate of and risk factors for acute inpatient mortality after orthopaedic surgery. *J Bone Joint Surg Am* 2002;84-A:562–72.
33. Memtsoudis SG, Gonzalez Della Valle A, Besculides MC, et al. In-hospital complications and mortality of unilateral, bilateral, and revision TKA: based on an estimate of 4,159,661 discharges. *Clin Orthop Relat Res* 2008;466:2617–27.
34. Lemeshow S, Teres D, Klar J, et al. Mortality Probability Models (MPM II) based on an international cohort of intensive care unit patients. *JAMA* 1993;270:2478–86.
35. Demyttenaere K, Bruffaerts R, Lee S, et al. Mental disorders among persons with chronic back or neck pain: results from the World Mental Health Surveys. *Pain* 2007;129:332–42.
36. Kessler RC, Berglund P, Demler O, et al. The epidemiology of major depressive disorder: results from the National Comorbidity Survey Replication (NCS-R). *JAMA* 2003;289:3095–105.
37. Castle DJ, Wessely S, Murray RM. Sex and schizophrenia: effects of diagnostic stringency, and associations with and premorbid variables. *Br J Psychiatry* 1993;162:658–64.
38. Hebert LE, Scherr PA, McCann JJ, et al. Is the risk of developing Alzheimer's disease greater for women than for men? *Am J Epidemiol* 2001;153:132–6.
39. Kukull WA, Higdon R, Bowen JD, et al. Dementia and Alzheimer disease incidence: a prospective cohort study. *Arch Neurol* 2002;59:1737–46.
40. Walid MS, Robinson JS. Economic impact of comorbidities in spine surgery. *J Neurosurg Spine* 2011;14:318–21.
41. Vissers MM, Bussmann JB, Verhaar JA, et al. Psychological factors affecting the outcome of total hip and knee arthroplasty: a systematic review. *Semin Arthritis Rheum* 2012;41:576–88.
42. Hu CJ, Liao CC, Chang CC, et al. Postoperative adverse outcomes in surgical patients with dementia: a retrospective cohort study. *World J Surg* 2012;36:2051–8.
43. Hurd MD, Martorell P, Delavande A, et al. Monetary costs of dementia in the United States. *N Engl J Med* 2013;368:1326–34.
44. Weck F, Neng JM, Richtberg S, et al. Dysfunctional beliefs about symptoms and illness in patients with hypochondriasis. *Psychosomatics* 2012;53:148–54.
45. Escobar JI, Gara M, Waitzkin H, et al. DSM-IV hypochondriasis in primary care. *Gen Hosp Psychiatry* 1998;20:155–9.
46. Thomson AB, Page LA. Psychotherapies for hypochondriasis. *Cochrane Database Syst Rev* 2007;4:CD006520.
47. Porter LS, Keefe FJ, Garst J, et al. Self-efficacy for managing pain, symptoms, and function in patients with lung cancer and their informal caregivers: associations with symptoms and distress. *Pain* 2008;137:306–15.
48. Bozic KJ, Lau E, Kurtz S, et al. Patient-related risk factors for postoperative mortality and periprosthetic joint infection in Medicare patients undergoing TKA. *Clin Orthop Relat Res* 2012;470:130–7.
49. Memtsoudis SG. Limitations associated with the analysis of data from administrative databases. *Anesthesiology* 2009;111:449; author reply 50–1.
50. Tseng VL, Yu F, Lum F, et al. Risk of fractures following cataract surgery in Medicare beneficiaries. *JAMA* 2012;308:493–501.