

Research Article

The Differing Effects of Ethnicity on Mental Health Outcomes Among Patients Undergoing Lumbar Fusion Surgery

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Introduction

Few studies have explored the effect of ethnicity on postoperative mental health outcomes. This study aims to evaluate the effect of ethnicity on changes in mental health outcomes following lumbar fusion (LF).

Methods

A surgical database was retrospectively reviewed for primary, single, or multilevel, lumbar fusion with posterior instrumentation procedures. Patients were propensity score matched to account for differences in demographics. 12-Item Short Form and Veterans RAND (SF-12 and VR-12) Mental Composite Score (MCS), 9-Item Patient Health Questionnaire (PHQ-9), Visual Analogue Scale (VAS) back, VAS leg, and Oswestry Disability Index (ODI) were recorded. A minimum clinically important difference (MCID) was calculated. Patients were grouped according to ethnicity: African-American, Hispanic, Asian/Other, and Caucasian. Differences between groups in baseline characteristics and mean outcome scores were evaluated. Ethnicity was assessed as a predictor of mental health outcomes and achievement of MCID was evaluated using regression analysis.

Results

The study included 224 patients, 43 African-American, 40 Hispanic, 22 Asian/Other, and 119 Caucasian. Groups differed in age, comorbidity score, and insurance collected ($p < 0.05$). African-Americans had the longest postoperative stay (47.3 hours; $p = 0.032$). Groups differed in preoperative SF-12 and VR-12 MCS, but not PHQ-9 ($p < 0.001$, both). Groups demonstrated differences in postoperative SF-12 MCS ($p \leq 0.021$), VR-12 MCS ($p \leq 0.028$), PHQ-9 ($p = 0.009$). VAS back, VAS leg, and ODI demonstrated significantly different scores ($p \leq 0.041$, all). Ethnicity was not a predictor of mental health outcomes at

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any timepoint and did not demonstrate an impact on achievement of MCID. Majority of individuals achieved an MCID by 1-year for all outcomes.

Discussion

Preoperative mental health scores demonstrated significant differences based on a patient's ethnicity but was resolved by 2-years. Ethnicity did not demonstrate significant effects on the ability to achieve an MCID for mental health outcomes. These results suggest that patients of differing backgrounds may require alternative preoperative counseling.



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INTRODUCTION

The rate of lumbar fusion (LF) surgeries for treatment of degenerative spinal pathologies has risen over the past decade (Martin et al. 2019). With many individuals electing to undergo this procedure for symptom relief, clinicians have sought to track patients' health through the assessment of patient-reported outcome measures (PROMs) prior to and following fusion. Mental health, as measured by the 12-Item Short Form (SF-12) Mental Component Score (MCS) and the 9-Item Patient Health Questionnaire (PHQ-9) PROMs, has been shown to be impacted by fusion surgery and may also predict postoperative outcomes (Abtahi et al. 2015; Patel et al. 2019). However, few studies have considered which factors play a role in the progression of these mental health outcomes. Prior investigations of the general population have demonstrated that the prevalence and chronicity of mental health issues may differ depending on ethnic group, possibly as a result of cultural stigmas or societal stressors (Williams 2018). Thus, further evaluation is needed to determine patient characteristics that may affect mental health status in the context of LF surgery outcomes.

Previous spine research studies have assessed the potential impacts of race on outcomes. In fact, investigators have reported that racial minorities may experience differences in diagnoses and rates of mortality or morbidity following spine surgery (Taylor et al. 2005; Alosch, Riley, and Skolasky 2009). Schoenfeld et al. considered mental health, as measured by SF-36, and reported worse baseline mental health scores and greater improvement in postoperative MCS for African Americans as compared to others undergoing spine surgery (Schoenfeld et al. 2012). Though several studies reported no differences in PROMs between racial groups, some have established that differences may exist in patient perceptions of health outcome and disability (El-samadicy et al. 2018). Given these potential disparities in health outcomes, it is also imperative to consider patient perceptions of mental health not only statistically, but also

clinically via the minimum clinically important difference (MCID) measure. Ethnicity and race may need to be considered when analyzing the MCID, which is the threshold at which patients truly perceive noticeable changes in their health. This is due to the fact that different ethnic groups may have varying cultural stigmas and beliefs about mental health as a whole (Bracke, Delaruelle, and Verhaeghe 2019), which can perhaps affect different patients' self-reporting and awareness of this outcome.

With greater information as to the role that race plays in postoperative mental health specifically, spine surgeons may be more aware of potential variances in patients' individual experiences during recovery and can be better equipped to circumvent any adversities through preoperative or postoperative mental health counseling. Therefore, the purpose of our study is to evaluate the effect of ethnicity on postoperative changes in mental health outcomes following LF procedures.

METHODS

PATIENT POPULATION

Prospectively recorded data were retrospectively reviewed using a single provider surgical database for LF procedures performed between October 2013 and January 2020. Inclusion criteria were primary, single- or multi-level, anterior, lateral, or transforaminal lumbar interbody fusion (ALIF, LLIF, TLIF) procedures with posterior instrumentation performed for the treatment of degenerative spinal pathology. Exclusion criteria were missing/unreported ethnicity or preoperative mental health data as well as procedures indicated for infection, trauma, or malignancy. All procedures were performed by the senior author at a single tertiary academic medical institution.

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DATA COLLECTION

Patient demographics, preoperative medical diagnoses and spinal pathology, and perioperative characteristics were collected for all patients. Demographic information included age, body mass index (BMI), gender, diabetes mellitus status, smoking status, American Society of Anesthesiologists (ASA) physical status classification, Charlson Comorbidity Index (CCI), and insurance/payment received. Pre-existing medical diagnoses included myocardial infarction, congestive heart failure, hypertension, peripheral vascular disease, chronic lung disease, liver disease, renal failure, gastrointestinal bleed, arthritis, cancer metastasis, and acquired immunodeficiency syndrome (AIDS). Preoperative spinal pathology included recurrent herniated nucleus pulposus, degenerative scoliosis, degenerative spondylolisthesis, and isthmic spondylolisthesis. Perioperative characteristics included number of levels fused, operative duration (from skin incision to closure), estimated blood loss (EBL), and postoperative length of stay.

PROMs were collected at preoperative and 6-week, 12-week, 6-month, 1-year, and 2-year postoperative timepoints for the SF-12 MCS, 12-Item Veterans RAND (VR-12) MCS, and PHQ-9. The SF-12 MCS and VR-12 MCS provide assessments of general mental health while the PHQ-9 is used to assess levels of depressive symptoms specifically based on the Diagnostic and Statistical Manual of Mental Disorders IV/V criteria for major depressive disorder. PROMs were administered using a secure online portal and were completed by patients either in clinic using a provided tablet or at home using a personal device prior to meeting with the clinician.

STATISTICAL ANALYSIS

Patients were categorized into groups according to self-reported race/ethnicity as follows: Caucasian, African American, Hispanic, Asian/Other. In order to control for differences in baseline demographics, a nearest neighbor propensity score was used to match Caucasian patients to non-Caucasian patients. Patient demographics, prevalence of medical diagnoses and spinal pathology, and perioperative characteristics were compared among groups using the chi-square test and analysis of variance (ANOVA) for categorical and continuous variables, respectively. Mean scores for each PROM were compared among groups at each timepoint using ANOVA. Multiple regression analysis assessed ethnicity as a predictor of mental health PROMs

while holding constant the effect of the visual analog scale (VAS) back, VAS leg, and Oswestry Disability. Index (ODI) at each timepoint. Achievement of an MCID was determined by comparing postoperative PROM improvement from preoperative baseline to the following previously established baseline values: 4.7 (SF-12 MCS) (Parker et al. 2013), 4.9 (VR-12 MCS) (Zhou et al. 2018), and 3.0 (PHQ-9) (Lynch et al. 2020). The proportion of patients achieving an MCID in each measure was compared among groups using simple logistic regression at each timepoint.

RESULTS

A total of 350 patients were initially identified as eligible for inclusion. Among this initial cohort, race/ethnicity groups significantly differed in age, gender, BMI, CCI, insurance/payment received, prevalence of arthritis, congestive heart failure, and history of gastrointestinal bleeding. Following propensity score matching, 224 patients were included in the final study cohort, of whom 119 were Caucasian, 43 African American, 40 Hispanic, and 22 Asian/Other. The cohort's mean age was 50.8 years, 71.0% were male, and the average BMI was 30.8 kg/m². Following propensity score matching, groups significantly differed only by age ($p=0.009$), CCI score ($p=0.039$), insurance/payment received ($p<0.001$) (Table 1). Most patients underwent a single-level procedure (91.1%) and suffered from degenerative spondylolisthesis (50.8%). Mean operative time was 142.6 minutes, mean EBL was 56.3 mL, and mean length of stay was 38.1 hours. Postoperative length of stay significantly varied by group ($p=0.032$), ranging from 21.2 hours for Hispanics to 47.3 hours for African Americans.

SF-12 PCS scores significantly differed among groups at preoperative ($p<0.001$), 12-week ($p=0.008$), and 6-month ($p=0.021$) timepoints. Post-hoc analysis demonstrated the following significant differences in SF-12 MCS: preoperative: African American versus Caucasian (42.7 ± 11.7 vs 49.2 ± 12.0 , $p=0.010$) and Hispanic versus Caucasian (41.4 ± 10.8 vs 49.2 ± 12.0 , $p=0.002$); 12-weeks: Hispanic versus Caucasian (44.7 ± 16.7 vs 53.6 ± 10.2 , $p=0.018$); 6-months: Hispanic versus Caucasian (44.5 ± 12.9 vs 53.5 ± 10.2 , $p=0.021$). VR-12 MCS differed significantly among groups at preoperative ($p=0.003$), 12-weeks ($p=0.004$), 6-months ($p=0.021$), and 1-year ($p=0.028$) timepoints. Post-hoc analysis demonstrated the following significant differences in VR-12 MCS: preoperative: Hispanic versus Caucasian (43.0 ± 12.0 vs 50.3 ± 11.8 , $p=0.003$), 12-weeks: Hispanic versus Caucasian (46.1



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Table 1. Propensity Score-Matched Patient Demographics

Characteristic	Total (n=224)	Caucasian (n=119)	African American (n=43)	Hispanic (n=40)	Asian/Other (n=22)	*p-value
Age (mean $\pm$ SD, years)	50.8 $\pm$ 11.6	51.6 $\pm$ 12.5	50.6 $\pm$ 10.3	45.9 $\pm$ 9.1	55.7 $\pm$ 11.1	0.009
BMI (mean $\pm$ SD, kg/m ²)	30.8 $\pm$ 6.4	30.6 $\pm$ 6.6	31.9 $\pm$ 6.2	32.0 $\pm$ 6.2	27.9 $\pm$ 5.3	0.053
Gender						0.390
Female	29.0% (65)	30.3% (36)	20.9% (9)	27.5% (11)	40.9% (9)	
Male	71.0% (159)	69.7% (83)	79.1% (34)	72.5% (29)	59.1% (13)	
Diabetic Status						0.212
Non-Diabetic	89.3% (200)	93.3% (111)	86.1% (37)	85.0% (34)	81.8% (18)	
Diabetic	10.7% (24)	6.7% (8)	13.9% (6)	15.0% (6)	18.2% (4)	
Smoking Status						0.871
Non-Smoker	86.2% (193)	85.7% (102)	83.7% (36)	87.5% (35)	90.9% (20)	
Smoker	13.8% (31)	14.3% (17)	16.3% (7)	12.5% (5)	9.1% (2)	
ASA score						0.743
≤ 2	80.3% (175)	81.7% (94)	81.4% (35)	79.5% (31)	71.4% (15)	
> 2	19.7% (43)	18.3% (21)	18.6% (8)	20.5% (8)	28.6% (6)	
CCI Score						0.039
< 1	31.7% (71)	30.3% (36)	23.3% (10)	50.0% (20)	22.7% (5)	
≥ 1	68.3% (153)	69.7% (83)	76.7% (33)	50.0% (20)	77.3% (17)	
Insurance						<0.001
Medicare/Medicaid	6.3% (14)	9.2% (11)	2.3% (1)	0.0% (0)	9.1% (2)	
WC	41.5% (93)	27.7% (33)	58.1% (25)	70.0% (28)	31.8% (7)	
Private	52.2% (117)	63.1% (75)	39.6% (17)	30.0% (12)	59.1% (13)	
Medical Diagnosis						
Myocardial Infarction	4.0% (9)	4.2% (5)	2.3% (1)	2.5% (1)	9.1% (2)	0.565
CHF	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	-
Hypertension	31.3% (70)	32.8% (39)	27.9% (12)	27.5% (11)	36.4% (8)	0.114
PVD	0.5% (1)	0.8% (1)	0.0% (0)	0.0% (0)	0.0% (0)	0.829
Chronic Lung Disease	1.3% (3)	0.8% (1)	2.3% (1)	2.5% (1)	0.0% (0)	0.742
Liver Disease	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	-
Renal Failure	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	-
GI Bleed	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	-
Arthritis	10.7% (24)	13.5% (16)	9.3% (4)	2.5% (1)	13.6% (3)	0.258
Cancer Metastasis	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	-
AIDS	0.5% (1)	0.8% (1)	0.0% (0)	0.0% (0)	0.0% (0)	0.829

BMI = body mass index; ASA = American Society of Anesthesiologists; CCI = Charlson Comorbidity Index; WC = workers' compensation; PVD = peripheral vascular disease; GI = gastrointestinal; SD = standard deviation; CHF = congestive heart failure

*p-value calculated using either chi-square (categorical) or ANOVA (continuous)

Boldface indicates statistical significance

± 16.4 vs 55.7 ± 10.1 , $p=0.007$), 6-months: Hispanic versus Caucasian (47.0 ± 13.4 vs 56.1 ± 10.3 , $p=0.011$), and 1-year: Hispanic versus Caucasian (45.5 ± 13.5 vs 55.2 ± 11.1 , $p=0.016$). PHQ-9 differed significantly among groups at the 6-month timepoint only ($p=0.009$). Post-hoc analysis demonstrated the following significant differences at

Table 2. Perioperative Characteristics

Characteristic	Total (n=224)	Caucasian (n=119)	African American (n=43)	Hispanic (n=40)	Asian/Other (n=22)	*p-value
Spinal Pathology						
Recurrent HNP	17.4% (39)	16.0% (19)	13.9% (6)	25.0% (10)	18.2% (4)	0.180
Degen Scoli.	6.7% (15)	7.6% (9)	7.0% (3)	5.0% (2)	4.6% (1)	0.920
Degen Spond.	50.8% (95)	52.4% (54)	57.1% (20)	43.3% (13)	42.1% (8)	0.590
Isthmic Spond.	33.7% (62)	34.3% (35)	28.6% (10)	35.7% (10)	36.8% (7)	0.905
Number of Levels						0.253
1-Level	91.1% (204)	94.1% (112)	88.4% (38)	82.5% (33)	95.5% (21)	
2-Levels	8.5% (19)	5.0% (6)	11.6% (5)	17.5% (7)	4.5% (1)	
3-Levels	0.4% (1)	0.9% (1)	0.0% (0)	0.0% (0)	0.0% (0)	
Operative Time (Mean $\pm$ SD; min)	142.6 $\pm$ 60.5	136.1 $\pm$ 47.3	162.2 $\pm$ 77.3	147.3 $\pm$ 79.2	130.7 $\pm$ 39.4	0.071
EBL (Mean $\pm$ SD; mL)	56.3 $\pm$ 35.0	55.6 $\pm$ 34.3	50.9 $\pm$ 31.4	64.4 $\pm$ 41.5	55.7 $\pm$ 31.9	0.369
Length of Stay (Mean $\pm$ SD; hours)	38.1 $\pm$ 25.3	37.4 $\pm$ 23.1	47.3 $\pm$ 30.1	21.2 $\pm$ 23.1	36.5 $\pm$ 25.8	0.032

HNP = herniated nucleus pulposus; degen = degenerative; scoli = scoliosis; spond = spondylolisthesis; EBL = estimated blood loss; SD = standard deviation

*p-value calculated using either chi-square (categorical) or ANOVA (continuous)

Boldface indicates statistical significance

6-months: Hispanic versus Caucasian (10.0 ± 7.6 vs 4.8 ± 5.7 , $p=0.011$) and Hispanic versus Asian/Other (10.0 ± 7.6 vs 3.1 ± 3.6 , $p=0.038$) ([Table 3](#)).

VAS back, VAS leg, and ODI significantly differed among groups at all timepoints ($p \leq 0.041$, all), with the exception of VAS back at 6-months ($p=0.070$). Multiple regression did not identify ethnicity as a significant predictor of any mental health PROM at any timepoint when the effects of VAS back, VAS leg, and ODI were held constant ($p > 0.05$, all) ([Table 3](#)). A majority of patients in the Caucasian, African American, and Hispanic groups achieved an MCID overall in all mental health outcome measures, while patients in the Asian/Other group only achieved an overall MCID for the PHQ-9. Proportion of MCID achievement did not significantly differ among groups at any individual timepoint nor overall ($p > 0.05$, all) ([Table 4](#)).

DISCUSSION

Depression has been shown to negatively affect surgical outcomes, with reports of increased likelihood of postoperative complications and increased odds of readmission (Rasouli et al. 2016; Akins et al. 2015). While a wide variety of baseline characteristics place patients at increased risk for depression, race/ethnicity has been reported to be a significant contributor to discrepancies in mental health status. In particular, past studies have demonstrated that certain minority populations may be at increased risk for depression (Dunlop et al. 2003). Several factors may influence these disparities, such as differences in preoperative pain and disability, as well as socio-economic, educational, and cultural influences (Walker, Strom Williams, and Egede 2016; Haider et al. 2013), all of which have their own individual effects on mental health outcomes and potential im-

provements (Dunlop et al. 2003). Our study sought to determine the influence race/ethnicity has on mental health outcomes among patients that underwent lumbar spinal fusion.

Our results demonstrated that both African American and Hispanic patients may experience different mental health outcomes, pain, and disability as compared to Caucasians. These results are supported by current literature that has identified disparities among African American and Hispanic populations in terms of mental health as well as pain and disability (Riley et al. 2002; Aufiero et al. 2017). These findings align with a substantial body of literature that demonstrates racial disparities in mental health. Previous studies have found that African American and Hispanic populations reported more severe and disabling depression as compared to Caucasians, and are at greater risk of experiencing significant stressors (Dunlop et al. 2003; Williams et al. 2007). One study examining eight distinct categories of stressors found that African Americans and American-born Hispanics were more likely to experience multiple classes of stressors than Caucasians, placing them at increased likelihood of depressive symptoms (Sternthal, Slopen, and Williams 2011). In addition to life stressors and preoperative depression, racial/ethnic minorities may also be at an increased risk of suffering from more serious and debilitating pain (Magni et al. 1990; Reyes-Gibby et al. 2007), which was also demonstrated in the current study. Collectively, these results highlight the importance of identifying potential shortcomings in healthcare and provide insight for physicians so that they are better able to account for and address disparities in mental health and facilitate better outcomes for all patients (Egede 2006).

While all patients are expected to benefit from surgical intervention, our study demonstrated significant differ-

Table 3. Mental Health Outcomes by Ethnicity

PROM	Caucasian Mean±SD, (n)	African American Mean±SD, (n)	Hispanic Mean±SD, (n)	Asian/Other Mean±SD, (n)	†p-value	*p-value
SF-12 MCS						
Preop	49.2 ± 12.0 (119)	42.7 ± 11.7 (43)	41.4 ± 10.8 (40)	49.1 ± 10.0 (22)	<0.001	0.069
6-weeks	52.4 ± 10.9 (86)	48.4 ± 11.6 (27)	47.2 ± 12.6 (22)	49.2 ± 13.9 (11)	0.619	0.357
12-weeks	53.6 ± 10.6 (86)	47.3 ± 13.5 (21)	44.7 ± 16.7 (19)	53.8 ± 6.5 (11)	0.008	0.462
6-months	53.5 ± 10.2 (70)	52.4 ± 10.7 (14)	44.5 ± 12.9 (18)	53.1 ± 10.8 (11)	0.021	0.333
1-year	52.3 ± 10.4 (59)	50.9 ± 9.5 (16)	43.9 ± 12.5 (15)	51.9 ± 9.4 (7)	0.058	0.359
2-years	51.1 ± 11.9 (47)	46.1 ± 9.9 (9)	50.9 ± 15.1 (9)	60.3 ± 4.5 (5)	0.213	0.226
VR-12 MCS						
Preop	50.3 ± 11.8 (111)	45.5 ± 11.7 (38)	43.0 ± 12.0 (39)	50.0 ± 9.8 (20)	0.003	0.111
6-weeks	53.1 ± 11.2 (86)	50.6 ± 11.6 (23)	48.3 ± 13.9 (20)	49.9 ± 14.9 (11)	0.354	0.475
12-weeks	55.7 ± 10.1 (85)	49.7 ± 11.3 (19)	46.1 ± 16.4 (18)	55.5 ± 5.5 (10)	0.004	0.407
6-months	56.1 ± 10.3 (69)	54.0 ± 11.9 (14)	47.0 ± 13.4 (18)	55.5 ± 9.8 (11)	0.021	0.268
1-year	55.2 ± 11.1 (59)	54.0 ± 8.9 (15)	45.5 ± 13.5 (15)	55.5 ± 10.2 (7)	0.028	0.353
2-years	53.7 ± 12.0 (47)	48.2 ± 11.7 (8)	52.1 ± 15.8 (9)	63.5 ± 3.5 (5)	0.184	0.178
PHQ-9						
Preop	6.9 ± 6.8 (66)	9.8 ± 6.9 (19)	10.0 ± 7.8 (23)	5.9 ± 4.9 (16)	0.098	0.442
6-weeks	4.9 ± 5.5 (59)	7.5 ± 5.9 (18)	5.7 ± 6.4 (16)	5.8 ± 6.4 (13)	0.439	0.997
12-weeks	3.8 ± 4.1 (60)	5.4 ± 4.2 (16)	7.9 ± 7.2 (10)	4.4 ± 3.8 (10)	0.055	0.213
6-months	4.8 ± 5.7 (66)	6.6 ± 7.4 (16)	10.0 ± 7.6 (18)	3.1 ± 3.1 (9)	0.009	0.478
1-year	5.9 ± 7.3 (37)	3.2 ± 3.9 (10)	7.9 ± 7.9 (12)	3.3 ± 3.6 (4)	0.383	0.264
2-years	4.6 ± 5.7 (24)	10.5 ± 9.0 (4)	5.2 ± 6.3 (6)	5.7 ± 6.7 (3)	0.396	0.337
VAS Back						
Preop	6.3 ± 2.3 (115)	7.4 ± 2.5 (41)	7.2 ± 2.2 (36)	6.0 ± 2.5 (21)	0.033	
6-weeks	3.8 ± 2.5 (108)	4.7 ± 2.8 (37)	5.4 ± 2.8 (31)	3.6 ± 2.6 (16)	0.009	
12-weeks	3.6 ± 2.7 (101)	5.2 ± 2.6 (33)	5.7 ± 2.4 (22)	3.7 ± 2.8 (15)	0.001	
6-months	3.8 ± 2.8 (97)	4.1 ± 2.6 (25)	5.4 ± 2.6 (27)	3.7 ± 2.9 (15)	0.073	
1-year	3.4 ± 3.0 (53)	3.7 ± 3.0 (18)	5.3 ± 2.6 (14)	0.3 ± 0.6 (5)	0.011	
2-years	2.8 ± 2.6 (32)	4.2 ± 2.5 (8)	6.7 ± 3.1 (5)	3.5 ± 4.0 (4)	0.040	
VAS Leg						

Preop	5.5 ± 2.8 (113)	6.1 ± 2.9 (38)	6.5 ± 2.8 (36)	4.6 ± 3.0 (21)	0.060
6-weeks	2.9 ± 2.8 (107)	3.1 ± 3.1 (34)	4.9 ± 3.4 (30)	3.5 ± 2.8 (16)	0.014
12-weeks	2.5 ± 2.7 (101)	2.8 ± 3.0 (33)	4.7 ± 2.8 (22)	3.3 ± 2.7 (15)	0.011
6-weeks	2.7 ± 2.7 (98)	2.8 ± 2.8 (25)	4.9 ± 2.9 (27)	2.5 ± 2.9 (15)	0.004
1-year	2.4 ± 3.0 (54)	3.0 ± 2.9 (18)	4.6 ± 3.2 (14)	0.0 ± 0.0 (5)	0.013
2-years	1.9 ± 2.5 (32)	4.0 ± 3.5 (8)	5.8 ± 4.3 (5)	2.9 ± 3.8 (4)	0.041
ODI					
Preop	41.8 ± 16.0 (115)	47.7 ± 18.4 (41)	50.3 ± 18.6 (36)	40.3 ± 15.3 (21)	0.022
6-weeks	34.1 ± 19.6 (107)	41.6 ± 20.6 (36)	47.5 ± 20.9 (31)	39.5 ± 22.5 (16)	0.009
12-weeks	28.5 ± 18.0 (100)	36.1 ± 18.3 (34)	44.3 ± 18.2 (23)	30.9 ± 19.6 (15)	0.002
6-months	25.1 ± 20.2 (98)	33.0 ± 17.6 (25)	41.6 ± 17.4 (27)	21.5 ± 16.4 (15)	<0.001
1-year	22.2 ± 21.3 (53)	24.6 ± 16.2 (18)	37.9 ± 20.7 (14)	7.2 ± 9.7 (5)	0.017
2-years	19.3 ± 19.1 (32)	27.0 ± 19.8 (8)	58.8 ± 35.2 (5)	20.0 ± 25.1 (4)	0.005

†p-values calculated using one-way ANOVA to evaluate differences in mean scores

*p-values calculated using multiple regression to assess ethnicity as a predictor of mental health outcomes while holding constant the effects of VAS back, VAS leg, and ODI

Boldface indicates statistical significance; SD = standard deviation

ences in SF-12 MCS, VR-12 MCS, and PHQ-9 between Hispanics and Caucasians or Hispanics and Asians/others. The larger effect noted in VR-12 and SF-12 may be due to the more general scope of mental health assessed by these measures, while PHQ-9 specifically screens for major depressive disorder. The most variation in mental health outcomes was observed amongst Hispanics, a finding which has been similarly reported in previous studies (Priest et al. 2013; Geller et al. 2014; Pole et al. 2005). Current literature states that there are often fluctuations in postoperative outcomes among individuals of different ethnicities due to cultural influences. This concept plays into how these individuals perceive their symptoms, if they seek treatment, and how they cope with symptoms (Sue and Chu 2003), which can make identifying mental illnesses, such as depression, among patients from different cultures more challenging (Kokanovic et al. 2008; Lehti, Hammarström, and Mattsson 2009). Patients may therefore be unaware of their depressive symptoms or underreport on the severity of their symptoms. Additionally, differences in access to treatment have been demonstrated, with the Substance Abuse and Mental Health Services Administration (SAMHSA) reporting that only 34% of Hispanics receive mental health treatments as compared to the U.S. average of 45% (Tables and Cbhsq 2019). This discrepancy in treatment availability may lead to individuals managing symptoms without a formal diagnosis and potentially worsening their chances of improvement (Bukh et al. 2013). Pain and disability can also act as significant drivers of poorer mental health (Gayman, Brown, and Cui 2011), so it remains important for studies exploring mental health outcomes in surgery to address this connection.

Our study found significant differences in pain and disability among racial/ethnic groups at all timepoints. Other studies observed similar differences in osteoarthritic patients (Vaughn et al. 2019), and among individuals suffering from chronic pain (Green et al. 2003). Interestingly, once the effects of these physical health differences were held constant, mental health outcomes for all ethnicities were similar. This finding suggests that apparent differences in mental health scores may largely be a byproduct of discrepancies in both pain and disability. This is supported by previous literature demonstrating the association between pain and depressive symptoms, specifically among spine surgery patients (Strøm et al. 2018). Debilitating, chronic pain may significantly influence the severity of depressive symptoms and rates of depression (Green et al. 2003; Salerno, Browning, and Jackson 2002; Hong et al. 2014). Alternatively, this may be a product of the observed difference in workers' compensation prevalence between groups, which has been reported to have negative effects on pain and disability (Prasarn et al. 2012). Due to these disparities, certain demographics may be at increased risk for adverse mental health and clinicians may need to adjust postoperative treatment to optimize outcomes.

Although various differences were observed among racial/ethnic groups at preoperative and postoperative timepoints, ethnicity did not demonstrate a significant impact on rates of MCID achievement with the majority of

patients achieving clinically significant improvement by 1 year for all outcomes. While there were differences in mean scores based on ethnicity, these results suggest that all patients have a reasonable likelihood of experiencing significant improvement regardless of race/ethnicity, even if the mental health of some patients may improve to a greater degree than others. The literature supports our results with one study examining the effects of race/ethnicity on surgical outcomes and reporting no significant differences between groups for change in postoperative satisfaction from baseline (Schoenfeld et al. 2012). Additionally, the same study found that regardless of race, higher rates of improvement were reported with surgical management as compared to non-operative treatment following lumbar spine surgery (Schoenfeld et al. 2012). Although it is widely known that depression is a preoperative risk factor for patients undergoing spine procedures (Elsamadicy et al. 2017), surgery can ultimately lead to improvements in mental health regardless of race/ethnicity.

LIMITATIONS

There are several limitations in our study that need to be considered. Significant demographic differences among ethnic groups were mainly found in terms of the proportion of patients who made payments through Workers' Compensation. Previous literature has demonstrated generally poorer outcomes among Workers' Compensation populations, so this factor may act as a confounder in our analysis. Generalizability is another limitation of our study as all of the patients included underwent their procedure at a single institution by a single spine fellowship-trained surgeon. Lastly, there are limitations associated with the use of patient reported questionnaires because they are prone to bias; also, depression was not quantified in terms of diagnosis by a qualified mental health provider. However, these scores still provide valuable information for clinicians and researchers alike. Future studies with a larger patient sample drawn from multiple institutions and surgeons may strengthen our findings and improve generalizability.

CONCLUSION

Mental health scores demonstrated significant differences based on ethnicity for SF-12 and VR-12 at all preoperative and intermittent postoperative timepoints; however, the achievement of clinically important difference did not significantly vary by ethnicity. Pain and disability scores differed by ethnicity at every time point. However, once these effects were controlled for, ethnicity was not a significant, independent predictor of mental health outcomes. These results suggest that although significant differences in mental health outcomes may exist for some ethnic/racial groups, it is likely that these disparities are a result of external factors, rather than an intrinsic difference in response to lumbar fusion surgery.

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Table 4. Minimum Clinically Important Difference by Ethnicity

PROM	Caucasian %, (n)	African American %, (n)	Hispanic %, (n)	Asian/Other %, (n)	*p-value
SF-12 MCS					
6-weeks	41.9% (36)	51.9% (14)	45.5% (10)	18.2% (2)	0.262
12-weeks	45.3% (39)	47.6% (10)	36.8% (7)	27.3% (3)	0.607
6-months	42.9% (30)	50.0% (7)	44.4% (8)	18.2% (2)	0.353
1-year	40.7% (24)	56.3% (9)	46.7% (7)	28.6% (2)	0.581
2-years	40.4% (19)	33.3% (3)	55.6% (5)	40.0% (2)	0.801
Overall	56.7% (59)	67.7% (23)	74.2% (23)	40.0% (6)	0.090
VR-12 MCS					
6-weeks	41.9% (36)	63.6% (14)	40.0% (8)	0.0% (0)	0.163
12-weeks	44.7% (38)	47.4% (9)	50.0% (9)	40.0% (4)	0.957
6-months	49.3% (34)	50.0% (7)	61.1% (11)	22.2% (2)	0.282
1-year	49.1% (29)	53.3% (8)	40.0% (6)	33.3% (2)	0.776
2-years	37.8% (17)	28.6% (2)	55.6% (5)	40.0% (2)	0.714
Overall	61.4% (62)	71.0% (22)	73.3% (22)	46.1% (6)	0.275
PHQ-9					
6-weeks	40.0% (22)	42.9% (6)	53.3% (8)	30.8% (4)	0.671
12-weeks	37.7% (20)	58.3% (7)	33.3% (3)	20.0% (2)	0.305
6-months	36.5% (19)	54.5% (6)	34.5% (5)	25.0% (2)	0.595
1-year	36.1% (13)	83.3% (5)	50.0% (4)	50.0% (2)	0.168
2-years	26.1% (6)	50.0% (1)	50.0% (3)	33.3% (1)	0.684
Overall	57.1% (32)	54.7% (11)	57.9% (11)	58.3% (11)	0.956

* p-values calculated using simple logistic regression



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