

# Existing Social Determinant of Health Metrics are Poor Predictors of Surgical Outcomes and Patient Disposition following Lumbar Fusion Procedures

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## INTRODUCTION:

Lumbar fusion is among the most common surgical procedures performed annually in the United States with rates continuing to grow each year. Previously, literature has assessed predictors of poor outcomes following lumbar fusion including patient demographics. Socioeconomic status (SES) is one factor known to influence patient outcomes. However, there is little literature describing the best metric to define social determinants of health and how that metric impacts spine surgery outcomes. Therefore, our primary objective was to compare patients' baseline, postoperative, and magnitude of improvement (postoperative minus preoperative) in patient-reported outcome measures (PROMs) following lumbar fusion as a function of three national SES indexes. Secondarily, we sought to compare the effectiveness of each index at predicting clinical outcomes.

**METHODS:** We retrospectively identified patients who underwent primary, elective lumbar fusions from 2014 to 2020 with baseline and one-year postoperative PROMs. The Area Deprivation Index (ADI), Distressed Communities Index (DCI), and the Centers for Disease Control and Prevention Social Vulnerability Index (SVI) were utilized to determine community-level SES. These indexes provide a single numerical score or percentile value that is assigned as a measure of community-level SES encompassing several factors. Community-level SES was collated by matching patients' home addresses to the most granular area provided by each respective index. In order of increasing granularity, these areas were zip code for DCI, census tract for SVI, and census block for ADI. Patients were grouped based on their social vulnerability quartile in each index with 1 = high SES and 4 = low SES. Multivariate regression for  $\Delta$ PROMs was performed based on SES index quartile while controlling for baseline demographics and surgical characteristics. A Youden's index was constructed to generate an area under the curve (AUC) and evaluate the predictive value of the three indexes in determining each 90-day readmissions, complication rate, and non-home discharges.

**RESULTS:** We identified 1,199 patients who met inclusion criteria. Patients predominantly lived in communities with higher overall SES ( $p < 0.001$ ): 537 (44.8%) in the lowest DCI quartile, 527 (44.0%) in the lowest SVI quartile, and 345 (28.8%) in the lowest ADI quartile. In contrast, only 103 (8.6 %) patients lived in communities with the highest DCI quartile, 91 (7.6%) in the highest SVI quartile, and 57 (4.8%) in the highest ADI quartile. Patients in the distressed communities were significantly more likely to be smokers, have greater BMI, and be non-white ( $P < 0.05$ ). Comorbidity burden, measured through age adjusted Elixhauser Comorbidity Index, was not significantly different in populations living in different SES communities. DCI and SVI demonstrated significantly worse preoperative visual analog scale (VAS) back pain, VAS neck pain, and Oswestry Disability Index (ODI) scores (all  $p < 0.05$ ), whereas ADI only identified worse baseline preoperative ODI ( $p = 0.001$ ) in patients from distressed communities (Table 1). Patients improved in all outcome measures and the magnitude of improvement was not different based on the SES metric used. AUC of each SES index ranged from 0.495-0.520 in predicting complications, 0.467-0.489 in predicting readmission rate, and 0.478-0.593 in predicting non-home discharge with each metric having overlapping confidence (Table 2).

## DISCUSSION AND CONCLUSION:

Baseline PROMs are typically lower in patients who live in areas of greater social vulnerability. None of the three SES metrics evaluated were independent predictor of greater magnitude of improvement in PROMs. Additionally, all three social indexes had similar poor results in predicting complication rates and 90-day readmission rates. SVI was better at predicting non-home discharge than ADI or DCI, but it was still a poor predictor and the difference was not significant. There is a need for better social determinant of health metrics to stratify a patient's risk of having worse postoperative outcomes.

Table 1. Patient reported outcome measures based on community-level social vulnerability.

FROM Measure	SES Index	Collection Time Point	Quartile 1	Quartile 2	Quartile 3	Quartile 4	P-value	
ODI	ADI	Preoperative	44.2 (17.1)	47.9 (17.4)	51.2 (19.0)	47.6 (16.4)	<b>0.001*</b>	
		Postoperative	24.8 (20.2)	26.5 (20.0)	26.3 (19.8)	30.2 (19.7)	0.227	
		Delta	-19.26 (19.8)	-22.11 (21.4)	-23.20 (21.0)	-16.90 (18.3)	0.104	
	DCI	Preoperative	-0.001*	-0.001*	-0.001*	-0.001*	—	
		Postoperative	46.0 (17.5)	47.4 (18.0)	46.0 (16.2)	53.2 (18.7)	<b>0.010*</b>	
		Delta	26.2 (20.2)	24.5 (18.6)	26.7 (20.9)	39.0 (18.5)	<b>0.040*</b>	
	SVI	Preoperative	-19.79 (20.9)	-23.33 (20.7)	-20.72 (20.0)	-21.83 (21.8)	0.205	
		Postoperative	45.9 (17.0)	47.8 (17.7)	48.4 (19.1)	52.0 (18.5)	<b>0.043*</b>	
		Delta	23.9 (18.9)	28.6 (21.0)	28.7 (21.3)	31.6 (18.7)	<b>0.000*</b>	
	VAS Back	ADI	Preoperative	4.55 (2.38)	6.81 (2.59)	7.20 (2.20)	7.21 (2.48)	<b>0.000*</b>
			Postoperative	3.35 (2.70)	3.41 (2.85)	3.37 (2.68)	3.93 (2.69)	0.528
			Delta	-3.24 (2.96)	-3.41 (3.26)	-3.82 (2.93)	-2.83 (3.14)	0.276
DCI		Preoperative	-0.001*	-0.001*	-0.001*	-0.001*	—	
		Postoperative	6.61 (2.38)	6.83 (2.36)	6.92 (2.48)	7.95 (1.92)	<b>&lt;0.001*</b>	
		Delta	3.37 (2.77)	3.36 (2.78)	3.39 (2.76)	3.87 (2.72)	0.455	
SVI		Preoperative	-3.27 (3.15)	-3.48 (3.11)	-3.38 (2.98)	-3.97 (2.96)	0.460	
		Postoperative	3.29 (2.69)	3.26 (2.86)	3.41 (2.84)	3.83 (2.57)	0.054	
		Delta	-3.41 (3.03)	-3.48 (3.37)	-3.23 (3.11)	-3.50 (2.48)	0.865	
VAS Leg		ADI	Preoperative	6.90 (2.30)	6.96 (2.44)	7.30 (2.23)	7.34 (2.23)	0.228
			Postoperative	2.73 (3.01)	3.07 (3.04)	3.14 (2.95)	3.34 (3.21)	0.025
			Delta	-4.19 (3.60)	-3.90 (3.55)	-4.15 (3.13)	-3.14 (3.10)	0.391
	DCI	Preoperative	-0.001*	-0.001*	-0.001*	-0.001*	—	
		Postoperative	6.81 (2.42)	7.00 (2.29)	7.11 (2.21)	7.70 (2.14)	<b>0.000*</b>	
		Delta	2.89 (2.59)	2.82 (2.99)	3.40 (3.21)	3.82 (2.97)	<b>0.015*</b>	
	SVI	Preoperative	6.66 (3.45)	6.16 (3.43)	5.78 (3.41)	5.86 (3.62)	0.790	
		Postoperative	6.87 (2.40)	7.07 (2.29)	7.22 (2.34)	7.28 (2.34)	0.202	
		Delta	-4.08 (3.61)	-4.24 (3.60)	-3.78 (3.84)	-3.03 (3.34)	0.155	
	PCS-12	ADI	Preoperative	38.4 (8.70)	30.3 (6.60)	29.7 (7.67)	29.7 (6.63)	0.017
			Postoperative	38.4 (11.4)	38.3 (10.9)	37.7 (10.5)	35.6 (11.4)	0.444
			Delta	7.47 (11.8)	7.86 (11.9)	7.71 (11.8)	5.76 (12.9)	0.634
DCI		Preoperative	-0.001*	-0.001*	-0.001*	-0.001*	—	
		Postoperative	30.5 (8.92)	30.5 (8.04)	30.0 (8.19)	30.2 (8.00)	0.834	
		Delta	37.8 (11.1)	38.6 (11.1)	37.5 (10.5)	37.6 (10.3)	0.543	
SVI		Preoperative	7.36 (11.8)	8.31 (11.9)	7.26 (12.3)	7.17 (11.6)	0.625	
		Postoperative	30.8 (8.52)	30.8 (8.56)	29.8 (8.44)	29.9 (8.63)	0.251	
		Delta	38.4 (11.2)	38.4 (11.0)	37.2 (10.7)	36.7 (9.98)	0.412	
SVI		Preoperative	7.46 (11.6)	8.10 (12.2)	7.90 (11.8)	6.40 (12.2)	0.819	
		Postoperative	-0.001*	-0.001*	-0.001*	-0.001*	—	
		Delta	-0.001*	-0.001*	-0.001*	-0.001*	—	

Table 2. Predictive Effects of The Three Respective Socioeconomic Status Indexes.

Variable	AUC	95% CI	Sensitivity	Specificity
<b>Complications</b>				
ADI	0.520	(0.482 – 0.559)	0.540	0.533
Distress	0.512	(0.473 – 0.551)	0.183	0.876
SVI	0.495	(0.456 – 0.534)	0.396	0.659
<b>Readmission</b>				
ADI	0.489	(0.402 – 0.576)	0.149	0.919
Distress	0.493	(0.417 – 0.569)	0.565	0.518
SVI	0.467	(0.381 – 0.553)	0.106	0.933
<b>Non-Home Discharge</b>				
ADI	0.478	(0.431 – 0.524)	0.122	0.894
Distress	0.504	(0.457 – 0.550)	0.263	0.780
SVI	0.593	(0.445 – 0.541)	0.261	0.788