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The association between neighborhood disadvantage and frailty: A retrospective case series

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Abstract

Background: Frailty predicts poorer outcomes in surgical patients. Recent studies have found socioeconomic status to be an important characteristic for surgical outcomes. We evaluated the association of Area Deprivation Index (ADI) and Social Vulnerability Index (SVI), two geospatial atlases that provide a multidimensional evaluation of neighborhood deprivation, with frailty in a surgery population.
Design & methods: A retrospective study of patients undergoing routine frailty screening was conducted 12/2020–8/2022. Frailty was measured using Fried's Frailty Phenotype (FFP) and the five-item Modified Frailty Index (mFI-5). ADI and SVI quartiles were determined using patient residence. Logistic regression models were used to evaluated associations of FFP (frail only vs not frail) and mFI-5 ($\geq$2 vs 0–1) with ADI and SVI ($\alpha = 0.05$).
Results: Of 372 screened patients, 41% (154) were women, median age was 68% (63–74), and 46% (170) identified as non-White. Across ADI and SVI quartiles, higher number of comorbidities, decreasing median income, and frailty were associated with increasing deprivation ($p < 0.01$). When controlling for age, sex, comorbidities, and BMI category, frailty by FFP was associated with the most deprived two quartiles of ADI (OR 2.61, CI: [1.35–5.03], $p < 0.01$) and the most deprived quartile of SVI (OR 2.33, [1.10–4.95], $p < 0.05$). These trends were also seen with mFI-5 scores $\geq$2 (ADI: OR 1.64, [1.02–2.63], $p < 0.05$; SVI: OR 1.71, [1.01–2.91], $p < 0.05$).
Conclusions: Surgical patients living in socioeconomically deprived neighborhoods are more likely to be frail. Interventions may include screening of disadvantaged populations and resource allocation to vulnerable neighborhoods.

Keywords
Frailty, neighborhood disadvantage, neighborhood deprivation, thoracic surgery, surgery

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Significance for public health

As the older adult population increases, there has been an increase in frail patients presenting for surgical intervention. Because frailty has been associated with poorer surgical outcomes, examining its underpinnings and highlighting potential disparities may provide opportunities to mitigate its presence in across community and surgical populations. Here in this study, we used geospatial health atlases and determined that neighborhood socioeconomic disadvantage was independently associated with frailty when adjusting demographic covariates and comorbidities. This

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association is of particular importance as it provides a multidimensional viewpoint for the association of socioeconomic status on frailty presence. Moreover, these tools provide an avenue for clinicians, surgeons, and policy makers to reduce health inequities through concerted efforts.

Introduction

As the older adult population increases, the number of frail patients presenting for surgical treatment has risen.[1] Frail patients have limited physiologic reserve and increased vulnerability to physiologic stress,[2,3] leading to increased postoperative complications and mortality seen across several surgical disciplines.[4,5] As a result, surgical and geriatric clinical societies now recommend including a frailty assessment as part of older adult (50 years old and above) preoperative surgical evaluations.[6,7] While an optimal frailty measurement has not been determined, Fried et al.'s Frailty Phenotype (FFP), a functional-based examination, and the five-item Modified Frailty Index (mFI-5), a retrospective co-morbidity-based examination, remain two commonly used tools in surgical disciplines.[2,8]

Frailty is more common in non-Hispanic Black racial/ethnic groups and in patients with lower socio-economic status (SES).[9,10] These current disparities highlight the importance of assessing SES and social determinants of health during preoperative evaluations. However, individual variables of SES such as income, insurance coverage, or occupation are not a surrogate for the impact of a patient's neighborhood and social environment.[11] One method to assess built environment and neighborhood socioeconomic disadvantage is to use validated geospatial atlases such as the Area Deprivation Index (ADI) and Social Vulnerability Index (SVI). These tools have been shown to predict surgical morbidity and mortality.[12–16] While they have independently demonstrated robust capabilities at predicting surgical outcomes, the association between neighborhood socioeconomic disadvantage and frailty presentation have remained unexplored.[17–20]

The aim of this study is to determine the association of ADI and SVI with frailty measured by FFP and mFI-5. We hypothesize that general thoracic surgery patients with greater neighborhood socioeconomic deprivation will tend to be more frail. Examining the interaction between neighborhood deprivation and frailty may provide insight into current disparities and improve risk stratification of preoperative frail patients based on neighborhood and environment.

Design & methods

Study population

This is a retrospective review of all patients who underwent routine frailty screening (new patients ≥50 years old) in a general thoracic surgery clinic at the University of Chicago Medicine from December 1, 2020 to August 31, 2022. This study was approved by the University of Chicago Institutional Review Board (IRB22-1272 on August 24, 2022).

Frailty evaluation

Frailty was determined in all patients undergoing a surgical evaluation in clinic (50 years old and above) using two standardized assessments: FFP, and mFI-5.[2,21] FFP scores patients on a scale of 0–5 (0 indicating not frail, 1–2 pre-frail, and 3–5 frail) based on the presence of the following criteria: unintentional weight loss >10 lbs or 5% of body mass in the prior year, weakness (measured by handgrip strength using a dynamometer), exhaustion (measured by the Center of Epidemiologic Studies Depression Scale), slow gait speed (walking time over a distance of 8 meters), and low physical activity (measured by the short version of the Minnesota Leisure Time Activity questionnaire).[2] For the mFI-5 assessment, patients were scored on a scale of 0–5 (0 indicating not frail, 1 pre-frail, and 2–5 frail) based on the presence of the following co-morbidities at the time of frailty screening: hypertension (requiring medication), congestive heart failure within 30 days before frailty screening, respiratory problems (chronic obstructive pulmonary disease, current pneumonia, or a forced expiratory volume in 1 s (FEV1) predicted <70%), changes in everyday activity (Eastern Cooperative Oncology Group (ECOG) Performance Status > 1), and history of diabetes.[8]

Demographic and medical information

Electronic medical records were reviewed to collect patient demographics including as age, sex (male, female), self-identified race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic/Latino, Asian/Pacific Islander, Native American/Indigenous, other, unknown/declined) insurance coverage (private or public (Medicaid/Medicare)), BMI (underweight, normal, overweight, obese), address/ZIP code to approximate median income per household using US Census Bureau records, and chief complaint (lung nodule (unknown/benign vs cancer), other). Relevant comorbidities (history of arthritis, asthma, congestive heart failure, coronary artery disease, chronic obstructive pulmonary disease/chronic lung disease, diabetes mellitus, deep vein thrombosis, depression, myocardial infarction, hypertension or kidney disease), patient comorbidity burden (the total number of comorbidities) smoking status (current, former, never smoker), and cancer history were also reviewed. All information was securely stored in a REDCap Database.[22,23]

Area deprivation index and social vulnerability index evaluation

The University of Wisconsin School of Medicine and Public Health Area Deprivation Index mapping tool

Table 1. Characteristics and components of the area deprivation index and social vulnerability index.

Last updated year	Social vulnerability index (SVI)	Area deprivation index (ADI)
	2020	2021
Source (creation or maintenance group)	Center for disease control—Agency for Toxic Substances and Disease Registry (CDC/ATSDR)	University of Wisconsin School of Medicine & Public Health
Unit of measure	Census tract codes	Census block group and ZIP code
Scoring system	National percentile (1–100)	State decile ranking (1–10)
	Higher number represents greater neighborhood disadvantage	National percentile (1–100)
		Higher number represents greater neighborhood disadvantage
Socioeconomic status variables	1. Below 150% of poverty	1. Median family income in US dollars
	2. No health insurance	2. Population below 150% the poverty level
		3. Families below poverty level
		4. Income disparity
Housing & transportation variables	3. Housing cost burden	5. Median home value
	4. Unemployment	6. Median gross rent
	5. Multi-unit housing	7. Median monthly mortgage
	6. Mobile homes	8. % owner-occupied housing units
	7. Housing crowding	
	8. No vehicles	
		9. Occupied housing units without complete plumbing
Household composition & disability variables	9. Aged 65 & older	10. % civilian labor force population 16 years & older unemployed
	10. Aged 17 & younger	
	11. Civilian with a disability	
	12. Single-parent households	
	13. No high school diploma	11. Employed population 16 years & older in white-collar occupations
		12. Single-parent households with children younger than 18
		13. Households without vehicles
		14. Households without Telephones
		15. Households with >1 person per room
		16. Population aged 25 years or older with less than 9 years of education
		17. Population aged 25 years or older with at least a high school diploma
Minority status & language variables	14. English language proficiency	N/A
	15. Race & ethnic minority status	

provides a multidimensional evaluation of regional socioeconomic conditions from census tracts through evaluation of 17 variables including income, education, employment, and housing quality.[12] The Center for Disease Control/Agency for Toxic Substances and Disease Registry (CDC/ATSDR) Social Vulnerability Index uses a composite of 15 variables, including SES, household characteristics, racial and ethnic minority status, and housing type & transportation, to rank US census tracts by social vulnerability.[24] These tools differ in scoring, variable composition, inclusion of race, and stratification of variables (Table 1).

Residence and nine-digit ZIP codes were used to calculate ADI and SVI percentile scores for each patient generated by the ADI mapping and SVI composite tools. Both tools have been validated to the census block group and census tract codes. Increased scores represent increased neighborhood disadvantage for both tools.

Statistical analysis

Patients were stratified into ADI and SVI quartiles, and Wilcoxon Rank Sum tests were performed to summarize patient demographic and clinical characteristics. Univariable logistic regression models were used to determine association of frailty with FFP (frail only vs not frail, frail and pre-frail vs not frail) and mFI-5 (score of ≥2 vs 0–1 and score of ≥1 vs 0).[25] Age, sex, BMI

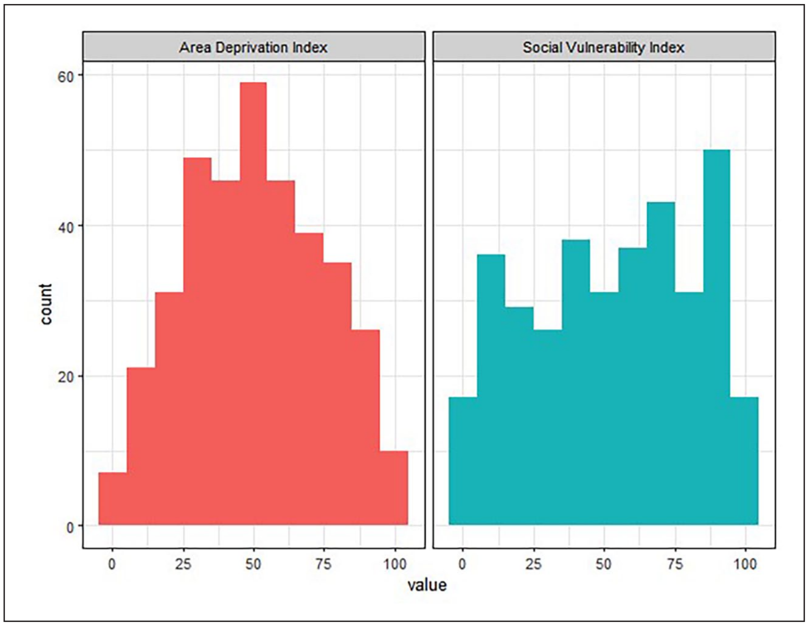

Figure 1. Distribution of area deprivation and social vulnerability within the study population.

(underweight, overweight, obese vs normal) were controlled in all multivariable models; backwards selection from univariable models was conducted independently across each model to control for significant covariates in multivariable regressions ($\alpha = 0.05$). The two most deprived quartiles from ADI and the most deprived quartile from SVI were used in final models due to cutpoints determined by the Optimal Youden Index. Receiver operating characteristic (ROC) curves were generated to determine accuracy by area under the curve (AUC) for FFP. The threshold for statistical significance was set at $\alpha = 0.05$. Statistical analyses were conducted using *R* (Foundation for Statistical Computing, Vienna, Austria).[26]

Results

Patient characteristics

A total of 372 patients were screened for frailty between December 2020 and August 2022. The median age was 68 (interquatile range (IQR): 63–74), 41% were women, and 46% identified as Hispanic, non-Hispanic Black, or other (Table 2). The majority of patients were screened as pre-frail (44%) or frail (21%) using FFP and 34% were screened as having an mFI-5 of ≥2. Median income based on ZIP code was $54,000 (IQR: $39,300–$70,900), and the majority of patients had public health insurance (75%). Histogram demonstrated normal bell curve distribution for ADI and a mild negative skew for SVI within our patient population (Figure 1).

Patient cohort stratified by ADI and SVI quartiles

Frailty was more prevalent in patients from the most deprived quartiles of ADI and SVI in comparison to the least deprived (ADI: FFP 30% vs 12%, $p = 0.001$ and mFI-5 46% vs 27%, $p < 0.001$ | SVI: FFP 33% vs 18%, $p = 0.034$ and mFI-5 45% vs 25% $p = 0.214$) (Supplemental Table 1). Patient comorbidity burden increased with greater neighborhood deprivation across ADI and SVI quartiles ($p < 0.001$). Patients in the most deprived ADI and SVI quartiles had significantly lower median income than the least deprived quartiles (ADI: $39,600 vs $78,600 and SVI: $37,900 vs $72,400, $p < 0.001$) and lower rates of private insurance than the least deprived (ADI: 13% vs 33%, $p = 0.003$, and SVI: 12% vs 27%, $p = 0.011$).

Unadjusted factors associated with FFP and mFI-5

In univariable analyses, the most deprived quartiles of ADI and SVI were associated with frailty using FFP (frail only vs not frail, odds ratio = OR: 3.497; CI: [1.946–6.409], $p < 0.01$ and OR: 3.146; CI: [1.627–6.200] $p < 0.01$, respectively) (Supplemental Table 2). These associations were also seen when including patients with pre-frail status (frail and pre-frail vs not frail, OR: 2.232; CI: [1.441–3.489] $p < 0.01$ and OR: 2.146; CI: [1.250–3.817] $p < 0.01$, respectively) (Supplemental Table 3).

Table 2. Patient demographic and clinical characteristics.

	All ($N = 372$)
Median age—years (IQR)	68 (63–74)
Sex (Female) (%)	154 (41%)
Median income—$1,000s (IQR)	54.4 (39.3–70.9)
Race (%)	
Non-hispanic white	202 (54%)
Non-hispanic black	120 (32%)
Hispanic/Latino	12 (3%)
Asian/Pacific Islander	11 (3%)
Native American/Indigenous	2 (1%)
Other	6 (2%)
Unknown/Declined	19 (5%)
Private insurance (%)	92 (25%)
BMI (kg/m^2)—(IQR)—$N = 371$	26.9 (23.0–31.6)
Underweight	18 (5%)
Normal	124 (33%)
Overweight	110 (30%)
Obese	119 (32%)
Chief complaint ($N = 367$)	
Lung nodule (Unknown/Benign)	137 (37%)
Lung nodule (Cancer)	109 (30%)
Other than lung nodule	121 (33%)
Co-morbidities (%)	
Arthritis	56 (15%)
Asthma	37 (10%)
Congestive heart failure	22 (6%)
Coronary artery disease	40 (11%)
Chronic obstructive pulmonary disease/ chronic lung disease	62 (17%)
Diabetes	85 (23%)
Deep vein thrombosis	15 (4%)
Depression	28 (8%)
History of myocardial infarct	13 (3%)
Hypertension	227 (61%)
Kidney disease	23 (6%)
Number of co-morbidities	1 (0–2)
None	81 (22%)
1	104 (28%)
2	105 (28%)
3+	82 (22%)
Cancer history ($N = 356$)	140 (39%)
Smoking status (%) ($N = 371$)	
Current smoker	72 (19%)
Former smoker	181 (49%)
Never smoker	116 (31%)
Fried's frailty phenotype	1 (0–2)
0 (No frailty)	128 (34%)
1–2 (Pre-frail)	165 (44%)
3–5 (Frail)	79 (21%)
Modified frailty (mFI-5) ($N = 371$)	1 (0–2)
0	103 (28%)
1	145 (39%)
2	84 (23%)
3	33 (9%)
4	6 (2%)
5	0 (0%)

Prior cancer history, public insurance coverage, non-Hispanic Black race/ethnicity, underweight BMI, median income, and more total comorbidities were significantly associated with FFP frail and prefrail status ($p < 0.050$, all) (Supplemental Tables 2 and 3).

The most deprived quartiles of ADI and SVI were significantly associated with mFI-5 scores of ≥. 2 versus 0–1 (OR 2.070; CI: [1.334–3.236] $p < 0.001$ and 1.919; CI:[1.165,3.152], $p = 0.001$, respectively) (Supplemental Table 2). Both indices were also significantly associated with a score of ≥1 versus 0 (OR: 2.34, $p < 0.01$ and OR: 1.970; CI: [1.103–3.698], $p = 0.027$, respectively) (Supplemental Table 3). Obese BMI, public insurance coverage, non-Hispanic Black race/ethnicity, and median income were also associated with ≥2 versus 0–1 scoring and ≥1 versus 0 scoring using mFI-5 ($p < 0.050$, all)(Supplemental Tables 2 and 3).

Adjusted factors associated with FFP and mFI-5

When controlling for age, sex, comorbidity burden, and BMI category, the two most deprived ADI quartiles were associated with frailty status determined by FFP (frail only vs not frail, OR: 2.607; CI: [1.352–5.300], $p = 0.004$) (Table 3). This association was also observed in the most deprived SVI quartile (OR: 2.330; CI: [1.096–4.953], $p = 0.028$). ADI was significantly associated with frail and pre-frail status when compared to not frail patients and adjusting for age, sex, race, BMI, and cancer history (frail and pre-frail vs not frail, OR: 1.806; CI: [1.095–2.979], $p < 0.05$) (Supplemental Table 4). However, this association was not observed in SVI. Comorbidity burden and underweight BMI were significantly associated with increasing FFP frailty (frail only vs not frail, $p < 0.050$, all), with prior cancer history and non-Hispanic Black race/ethnicity being significantly associated with frail and pre-frail status ($p < 0.050$, all) (Table 3).

When controlling for age, sex, BMI category, and insurance status, the two most deprived ADI quartiles were associated with frail status determined by mFI-5 (≥2 vs 0–1, OR 1.638; CI: [1.020–2.630], $p = 0.041$ and ≥1 vs 0, OR: 1.96; CI: [1.17–3.29], $p < 0.05$) (Table 3). The most deprived quartile of SVI was only associated with ≥2 scoring on mFI-5 (OR 1.711; CI: [1.008–2.905]; $p = 0.47$) (Supplemental Table 4); however, there were no significant associations between SVI and ≥1 scoring. Obese BMI and public insurance status were both associated with mFI-5 scoring across both ADI and SVI models (≥2 vs 0–1 and ≥1 vs 0, $p < 0.050$, all) (Table 3).

Receiver operating characteristic analysis

Receiver operating characteristic (ROC) analysis and Youden's index were used to determine the accuracy of

Table 3. Multivariable regression models identifying factors associated with Fried's frailty phenotype and modified 5-item frailty index.

	FFP (Frail only vs not frail)								mFI-5 (≥2 vs 0–1)							
	Model 1—Area deprivation index				Model 2—Social vulnerability index				Model 3—Area deprivation index				Model 4—Social vulnerability index			
	OR	95% OR CI		*p*-value	OR	95% OR CI		*p*-value	OR	95% OR CI		*p*-value	OR	95% OR CI		*p*-value
Age	1.014	0.980	1.049	0.433	1.018	0.981	1.203	0.745	0.990	0.963	1.019	0.498	0.999	0.961	1.010	0.520
Sex	1.058	0.554	2.021	0.864	1.252	0.623	2.515	0.527	1.203	0.745	1.944	0.450	1.220	0.743	2.002	0.432
Comorbidity burden	1.513	1.130	2.028	**0.005**	1.538	1.145	2.066	**0.004**	--------				--------			
Underweight vs normal (Reference)	12.915	1.443	115.587	**0.022**	7.618	0.813	71.385	0.075	1.058	0.304	3.690	0.929	1.030	0.296	3.587	0.963
Overweight vs normal (Reference)	0.672	0.305	1.482	0.325	0.547	0.238	1.259	0.156	1.567	0.857	2.866	0.145	1.540	0.830	2.855	0.171
Obese vs normal (Reference)	0.470	0.212	1.039	0.062	0.522	0.228	1.191	0.122	2.675	1.492	4.798	**0.001**	2.731	1.506	4.949	**0.001**
Insurance—Public vs Private (Reference)	--------				--------				1.513	1.130	2.028	**0.005**	4.220	2.031	9.420	<**0.001**
No cancer history vs cancer history (Reference)	--------				0.424	0.215	0.836	**0.013**	--------				--------			
ADI—2 most deprived quartiles vs. all other (Reference)	2.607	1.352	5.030	**0.004**	--------				1.638	1.020	2.630	**0.041**	--------			
SVI—Most deprived quartile vs. all other (Reference)	--------				2.330	1.096	4.953	**0.028**	--------				1.711	1.008	2.905	**0.047**

*Bold signifies statistical significance ($p < 0.05$).

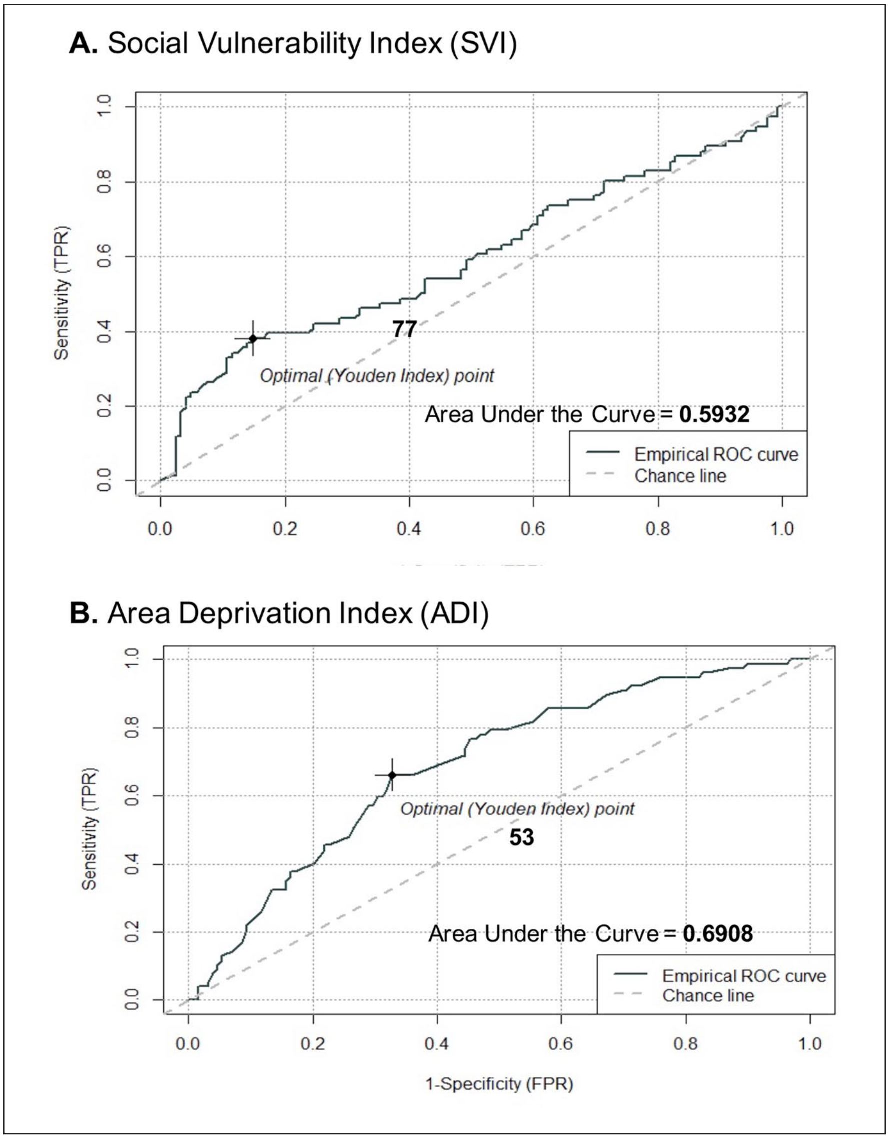

Figure 2. Receiver operating characteristic (ROC) curves evaluating social vulnerability and area deprivation accuracy of predicting frailty for Fried's frailty phenotype (FFP).

SVI and ADI as tools to predict frailty status. ROC curves revealed that ADI had greater accuracy than SVI at predicting frailty through FFP (frail only vs Not frail, 69% [ADI: 95% CI: 67.7–76.4] vs 59% [SVI: 95% CI: 50.8–67.8]) with a lower optimal Youden Index cut point (53 vs 77) (Figure 2). ADI and SVI demonstrated the similar accuracy at predicting frailty through mFI-5 (≥2 vs 0–1, 60% [ADI: 95% CI: 53.7–66.1] vs 60% [SVI: 95% CI: 53.9–66.7]) with ADI having a lower optimal Youden Index cut point (52 vs 62) (Figure 3).

Conclusions

Evaluating frailty has become important in assessing perioperative surgical risk. Most research evaluating SES or social deprivation in frailty is limited to geriatric or community-dwelling patient populations, and this study is the first to evaluate their association on frailty in a thoracic surgery population. We found that neighborhood deprivation, as measured by ADI and SVI, was associated with increased frailty and pre-frailty by FFP, independent of race/ethnicity, prior cancer history, insurance coverage, and BMI. ADI, but not SVI, was also associated with frailty by mFI-5. Our findings suggest that patients who live in disadvantaged neighborhoods, which have inherent differences in social determinants of health, are at greater risk of frailty.

Lived experiences in deprived neighborhoods can affect safety, secure access to food, social support, health behaviors, etc.—all of which are key factors in social determinants of health and may affect physiological resilience and

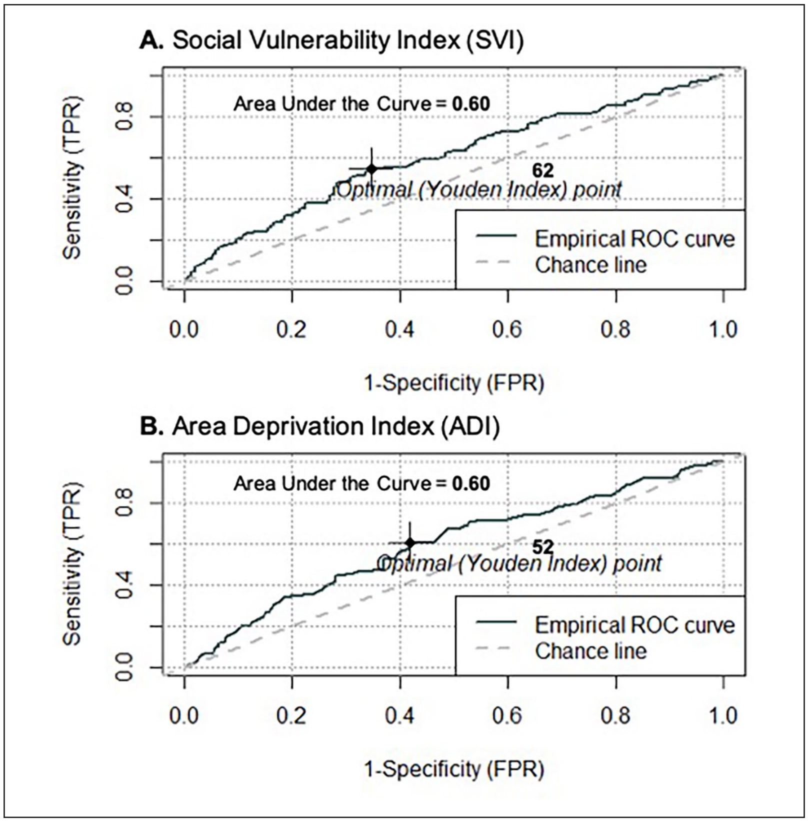

Figure 3. Receiver operating characteristic (ROC) curves evaluating social vulnerability and area deprivation accuracy of predicting modified five-item frailty index (mFI-5).

frailty. Similar to our findings, in the United Kingdom, the greatest disparities in frailty status occurred in the most deprived quintiles of a standardized poverty index (Index of Multiple Deprivation)[18] and frailty was highest in patients with both low individual socioeconomic resources and residence in deprived neighorhoods.[27] Moreover, in our present study we found that non-Hispanic Black patients had significantly greater odds of having pre-frail and frail status among thoracic surgery patients, consistent with data from the United States National Health and Aging Trends Study.[9] The associations of neighborhood socioeconomic disadvantage with racial-ethnic groups, however, are not distinctly separate from systemic and structural racism. Defined as macro-level systems, social forces, institutions, and ideologies that reinforce inequities in racial/ethnic groups, structural racism may be an additional driving factor impacting access to preventative and specialty care, healthcare delivery, and social determinants of health.[28] Our study findings suggest that living in a more disadvantaged neighborhood may contribute to an increased allostatic load, poorer health outcomes, and greater risk of developing frailty.[29]

While individual-level interventions such as exercise, nutrition, cognitive training, and geriatric management are employed to mitigate risks associated with frailty, our study highlights the additional need for initiatives addressing systemic factors within neighborhoods and environments that may affect patient outcomes.[30,31] Though employing screenings in clinic may be logistically difficult, our findings suggest a more urgent priority for those from vulnerable neighborhoods to better triage risk associated with surgical interventions. Moreover, policy interventions to dismantle the potential impacts of structural racism is a necessary adjunct to the individual efforts of patients and clinicians.

Of the two geographical indices used in this study, only ADI was associated with increases in frail status by both FFP and mFI-5. ADI, but not SVI, was also associated with increases in frail status when adjusting for race/ethnicity. Likewise, we found that ADI performed better than SVI, having greater accuracy at predicting frailty and a lower effective cut point. This may reflect differences in criteria used for these two frailty assessment tools. While both geospatial health indices aim to provide a robust representation of neighborhood disadvantage, their individual scoring and geographical resolution differ. Compared to SVI, ADI includes more SES and housing/transportation variables, lacks inclusion of race or ethnicity variables, and provides a more granular geographic resolution through ZIP code and census block groups (Table 1). Within current literature, comparisons between both geospatial indices remain understudied, though one study suggested that ADI has a greater association with mortality during the COVID-19 pandemic.[32] Moreover, the notable effect beyond race or ethnicity within ADI may also demonstrate wider use in future disparity research.

Our study has several limitations. Recruitment at a single academic center may limit generalizability due to inclusion of patients primarily from Midwestern states (e.g. Michigan, Illinois, Indiana, Wisconsin, etc.). Second, due to the utilization of census tract codes and census block groups in acquiring SVI and ADI variables, accuracy of deprivation measures may have been affected if patient location was not updated in electronic health records. Moreover, given the in clinic setting of our study, patients who lacked insurance, were pre-screened and not included in our patient population; patients who lacked a full address due to housing instability or homelessness could not be included in this study. Thus our findings my underestimate the associations in these more vulnerable patient groups. Lastly, while we selected ADI and SVI to evaluate neighborhood socioeconomic deprivation due to their key advantages, these tools are not comprehensive. Both indices lack inclusion of other important factors such as stable transportation, health literacy, food insecurity, among others, that may affect patients access to healthcare, overall health, and, ultimately, frailty.

In our study assessing the impact of neighborhood socioeconomic disadvantage on frailty in a thoracic surgery patient population, we found significant associations between increasing neighborhood deprivation measured by Area Deprivation and Social Vulnerability Indices and frailty. After adjusting for relevant covariates, increasing neighborhood socioeconomic disadvantage was directly associated with increased frailty measured through Fried's Frailty Phenotype and five-item Modified Frailty Index. On receiver operating curve analysis, ADI demonstrated increased accuracy at predicting frailty. Ultimately, our findings highlight the importance of assessing neighborhood and environmental disparities during pre-operative risk stratification for thoracic surgery patients. Interventions to improve these disparities may include additional screening of disadvantaged populations and appropriate resource allocation to vulnerable neighborhoods.

Author's note

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Author contributions

Conception & design: DF, AA, JRK, MLM Data Acquisition: DF, AA, JRK, AL, NR, AW Analysis and interpretation: RK, DF, AA, AL, JRK, MLM Drafting the manuscript: DF, AA, AL, NR, JRK, MLM Critical revision: All authors Guarantor: Maria Lucia Madariaga, MD

Declaration of conflicting interests

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Ethical approval

This study was approved by the University of Chicago Institutional Review Board (IRB22-1272 on August 24, 2022).

Supplemental Material

Supplemental material for this article is available online.

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