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Evaluating associations between social risks and health care utilization in patients with chronic low back pain

Sang S. Pak[a,*], Yuxi Jiang[a], Dmytro S. Lituiev[b], Emilia H. De Marchis[c], Thomas A. Peterson[b,d]

Abstract

Introduction: Care and outcomes for patients with chronic low back pain (cLBP) are influenced by the social risk factors that they experience. Social risk factors such as food insecurity and housing instability have detrimental effects on patient health and wellness, healthcare outcomes, and health disparities.

Objectives: This retrospective cross-sectional study examined how social risk factors identified in unstructured and structured electronic health record (EHR) data for 1,295 patients with cLBP were associated with health care utilization. We also studied the impact of social risk factors, controlling for back pain–related disability on health care utilization.

Methods: Included patients who received outpatient spine and/or physical therapy services at an urban academic medical center between 2018 and 2020. Five identified social risks were financial insecurity, housing instability, food insecurity, transportation barriers, and social isolation. Outcomes included 4 categories of health care utilization: emergency department (ED) visits/hospitalizations, imaging, outpatient specialty visits related to spine care, and physical therapy (PT) visits. Poisson regression models tested associations between the presence of identified social risks and each outcome measure.

Results: Identified social risks in 12.8% of the study population (N = 166/1,295). In multivariate models, social isolation was positively associated with imaging, specialty visits, and PT visits; housing instability was positively associated with ED visits/hospitalizations and imaging; food insecurity was positively associated with ED visits/hospitalizations and specialty visits but negatively associated with PT visits; and financial strain was positively associated with PT visits but negatively associated with ED visits/hospitalization.

Conclusion: These associations were seen above and beyond other factors used as markers of socioeconomic marginalization, including neighborhood-level social determinants of health, race/ethnicity, and insurance type. Identifying and intervening on social risk factors that patients with cLBP experience may improve outcomes and be cost-saving.

Keywords: Social risk factors, Chronic low back pain, Health care utilization, Social determinants of health, Physical therapy rehabilitation

1. Introduction

Social risk factors, also known as adverse social determinants of health, such as food insecurity and housing instability, have detrimental effects on patient health and wellness, health care outcomes, and health disparities.[2,47,54] Social and neighborhood-level risk factors contribute to health risk behaviors, pain-related disability, longer hospital lengths of stays, and readmission rates.[34,53,55,58,66,68] Less is known about how

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[a] Department of Physical Therapy and Rehabilitation Science, School of Medicine, University of California San Francisco, San Francisco, CA, USA, [b] Bakar Computational Health Sciences Institute, University of California San Francisco, San Francisco, CA, USA, [c] Department of Family & Community Medicine, University of California San Francisco, San Francisco, CA, USA, [d] Department of Orthopaedic Surgery, University of California San Francisco, San Francisco, CA, USA

**Corresponding author. Address: Department of Physical Therapy and Rehabilitation Science, School of Medicine, University of California San Francisco, 1500 Owens St Suite 400, San Francisco, CA 94158. Tel.: 415-353-2570. E-mail address: sam.pak@ucsf.edu (S. S. Pak).*

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neighborhood and social risk factors affect chronic low back pain (cLBP) care.[36]

A recent systematic review calls out the independent and interdependent relationships between social risks and cLBP,[36] a leading cause of disability worldwide.[22,76,78] Despite the biopsychosocial model's comprehensive approach to understanding cLBP,[19] which integrates biological, psychological, and social aspects of health, prior studies on nonsurgical cLBP treatments have emphasized patients' biological and cognitive aspects while giving less attention to broader social factors.[43]

Previous studies of social risks and cLBP care have focused on a limited set of factors (eg, socioeconomic status and race).[29,62] Inclusion of additional social risk factors has been constrained by their underidentification by clinical teams, underreporting by patients, and underdocumentation in structured fields within electronic health records (EHR).[72,77] While there is a growing push to collect and document individual-level patient social risk factor information,[23,27,49,56] existing patient social risk data in EHRs are primarily found within free text notes and not easily extractable.

Promising new approaches leveraging machine learning are being developed to extract social risk data from free text notes.[42] Our study team previously created an annotated corpus of clinical notes using natural language processing (NLP) to evaluate the following individual-level social risk factors: housing instability, food insecurity, transportation barriers, utilities, insecurity, and social isolation.[42] Leveraging NLP models, we identified 45% more social risks using free text notes than structured data alone.[42] This work was conceptualized to enable researchers within our health system to extract patient social risk data from multiple EHR sources to enrich our understanding of the social risks our patients experience and the impact of these risks on their care.

Building upon our prior work,[42] this study aims to explore the associations between individual-level social risk factors identified within the EHR and their impact on health care utilization among patients with cLBP. We evaluated 4 primary utilization outcomes: emergency department (ED) visits or hospitalization, imaging, outpatient specialty visits related to cLBP, and physical therapy (PT) visits. We tested a set of models within our observational dataset to investigate the potential causal factors influencing health care utilization. Our data account for back pain–related disability measured using the Start Back Screening Tool (SBST) taken at the baseline visit, considering only the forward causality of back pain–related disability on health care utilization. We assume no iatrogenic effects of health care utilization on comorbidity scores during the study period, particularly as comorbidities are considered chronic in nature.

2. Methods

2.1. Data sources and patient characteristics

We conducted a retrospective cross-sectional study of adult patients with cLBP. To be included, patients had to have (1) a diagnosis of low back pain lasting at least 3 months[16] and (2) received care with our nonsurgical interdisciplinary care team for patients with cLBP between January 1, 2018 and January 1, 2020 at an urban academic medical center (University of California, San Francisco). The patients who received care from an interdisciplinary team were first seen and referred by primary care providers. Electronic health records data were queried and extracted for patients aged between 18 and 80 years with diagnosis of back pain lasting at least 3 months using related structured International Classification of Diseases-10 codes such as dorsalgia, lumbago, radiculopathy, or sciatica (Supplementary Table S1, http://links.lww.com/PR9/A250). Patients with diagnoses of cancer or other serious pathologic disorders, such as cauda equina syndrome or osteomyelitis (Supplementary Table S2, http://links.lww.com/PR9/A250 for full list), were excluded to minimize the confounding effects of these conditions on health care utilization for patients with cLBP.[4] The dataset consisted of key patient-level demographics, including age, sex, race, ethnicity, and primary health insurance type (**Table 1** for a full list of variable categories).

2.2. Individual-level social risk factors

Social risk factors were identified and extracted from both structured and unstructured EHR data.[42] We included 6 social risk factors: housing instability, food insecurity, transportation barriers, utility insecurity, financial strain, and social isolation. These domains were selected based on 4—housing, food, transportation, and utilities—being social risk domains required for reporting by the 2024 Center for Medicare & Medicaid Services Inpatient Quality Reporting measures.[23] We included financial strain as an overarching marker of difficulty accessing basic resources and social isolation, given its salient associations with adverse health and mortality outcomes[39,52,57,64] (Supplementary Table S3, http://links.lww.com/PR9/A250 for definitions of each social risk factor). Social risk data were derived by 3 methods of extraction: (1) structured data fields, including ICD-10 codes; (2) unstructured data identified by manual annotation; or (3) fields inferred by NLP hybrid model from unstructured free text clinical notes as described in a previous publication.[42] In addition to separate variables for each social risk factor, for exploratory data analysis, we created a dichotomized variable for the presence of one or more of the 6 risk factors and a continuous variable to evaluate a cumulative number of social risks (range 0–6) (**Table 1**).

2.3. Neighborhood-level social determinants

Neighborhood-level data were identified and collected from a publicly available dataset and geocoded information from primary residential ZIP (postal) codes within the EHR to provide additional contextual information for patients' socio-geographical environment. Neighborhood-level measures were (1) historical redlining (scores range 1–4; higher scores indicate greater historical redlining)[33] and (2) national Area Deprivation Index (ADI) (scores rank neighborhoods' socioeconomic disadvantage at the national level and range 10–100; higher scores indicate greater socioeconomic disadvantage at the census block group level)[50] (Supplementary Table S4, http://links.lww.com/PR9/A250 for additional detail).

2.4. Control variables

Our analyses controlled for patient demographics, health status, back pain–related disability, and chronic opioid use; all known to be associated with health care utilization for patients with cLBP.[3,17] These variables were captured through structured EHR data and 2 standardized patient-reported outcome measures collected at the initial integrated spine service or PT visit: Patient-Reported Outcomes Measurement Information System (PROMIS) and SBST. PROMIS-10 Global Health is a 10-item measure of health status that spans physical, mental, and social domains from the patient's perspective.[30] Start back screening tool is a clinical assessment tool to identify subgroups of 3 risk

Table 1

Characteristics of the 1,295 study patients with chronic low back pain.

Variables	N (%)	Median (25, 75 percentile)	Mean ± SD
Total	1,295 (100)		
Demographics			
Sex			
Male	515 (39.8)		
Female	777 (60.0)		
Unknown	3(0.2)		
Age (y)		54 (38, 68)	53.7 ± 17.5
18–34	229 (17.7)		
35–49	327 (25.3)		
50–64	323 (25.0)		
65–79	325 (25.1)		
80+	89 (6.9)		
Body mass index		25.4 (22.7, 29.5)	26.1 ± 7.2
BMI ≥25		703 (54.3)	
CCI score*		0 (0, 1)	0.6 ± 1.3
0	928 (71.7)		
1–2	262 (20.2)		
3–4	82 (6.3)		
≥5	23 (1.8)		
Race and ethnicity†			
White	573 (44.2)		
Asian	274 (21.2)		
Hispanic	147 (11.4)		
Black	124 (9.6)		
Native Hawaiian/other pacific Islander	22 (1.7)		
American Indian/Alaska native	5 (0.4)		
Other	94 (7.3)		
Declined	48 (3.7)		
Missing	8 (0.6)		
Primary insurance types			
Commercial	702 (54.2)		
Medicare	358 (27.6)		
Medi-Cal	180 (13.9)		
Uninsured	23 (1.8)		
Covered California	22 (1.7)		
Workers' Compensation	8 (0.6)		
Other	2 (0.2)		
Individual-level social risk factors‡			
Housing instability	56 (4.3)		
Food insecurity	51 (4.0)		
Transportation barriers	26 (2.0)		
Financial strain	59 (4.6)		
Social isolation	31 (2.4)		
1+ social risks	165 (12.8)		
Cumulative number of social risks		0 (0, 0)	0.2 ± 0.5
0	1,130 (87.3)		
1	117 (9.0)		
2	39 (3.0)		
3	7 (0.5)		
4	2 (0.2)		
5+	0 (0.0)		
Neighborhood-level social drivers			
Historic redlining score		3.2 (2.7, 3.8)	3.2 ± 0.8
National ADI rank		3.0 (2.4, 5.7)	5.2 ± 6.8
Health status			
STarTback baseline score			
Low risk	497 (38.4)		
Medium risk	471 (36.4)		
High risk	319 (24.6)		
Missing	8 (0.6)		
PROMIS physical T-score		42.3 (34.9, 47.7)	41.7 ± 8.6
PROMIS mental T-score		48.3 (41.1, 53.3)	47.0 ± 10.1
Health use of service			
Chronic opioid prescription	396 (30.6)		
Primary outcomes			
ED visits/hospitalizations		0 (0, 0)	0.4 ± 1.3
0 ED visits/hospitalization	1063 (82.1)		
1 ED visits/hospitalization	106 (8.2)		
≥2 ED visits/hospitalization	126 (9.7)		

(*continued on next page*)

Table 1 (*continued*)

Characteristics of the 1,295 study patients with chronic low back pain.

Variables	N (%)	Median (25, 75 percentile)	Mean ± SD
Imaging orders		0 (0, 2)	1.4 ± 2.9
0 imaging orders	866 (66.9)		
1 imaging orders	32 (2.5)		
≥2 imaging orders	397 (30.7)		
Specialty visits		1 (0, 6)	6.2 ± 13.0
0 specialty visits	626 (48.3)		
1 specialty visits	85 (6.6)		
≥6 specialty visits	361 (27.9)		
PT visits		5 (3, 9)	6.8 ± 6.6
3 PT visits	177 (13.7)		
5 PT visits	94 (7.3)		
≥9 PT visits	336 (25.9)		

* Charlson Comorbidity Index.
† Race is indicated for non-Hispanic individuals; Hispanics includes all races.
‡ Social risk data included were identified from any of the 3 sources of EHR data: structured data, unstructured data by manual annotation, and unstructured data by NLP.
ADI, area deprivation index; BMI, body mass index; PROMIS, patient-reported outcomes measurement information system; PT, physical therapy.

levels (low, medium, high) for patients with back pain–related disability to map prognostic physical and psychological factors using 9 screening items.[6,74] A marker of medical comorbidity was assessed by EHR-documented diagnosis codes using the Charlson Comorbidity Index (CCI).[12]

There is increasing evidence on the harms of opioid analgesics for cLBP.[13,40] We controlled for the chronic opioid use, defined as patients prescribed or dispensed opioid medications for more than 90 days during the course of the study period.[18] Data came from the UCSF opioid registry within the EHR vendor Epic Systems Corporation. The registry represents all patients in the health system with one or more documented opioid prescriptions filled between 2018 through 2020.

2.5. Primary outcomes

Health care utilization outcomes included (1) ED visits/hospitalization, (2) imaging, (3) outpatient visits with specialists relevant to cLBP, and (4) physical therapy (PT) visits. Utilization metrics had to occur during the study period and were captured only if they occurred within our study academic medical center. Imaging was defined as any completed imaging that included any MRI, CT scan, or X-ray of any body region since patients with cLBP have high rates of chronic pain at nonback pain sites.[25,26] Specialty care relevant to cLBP included a completed outpatient visit with one or more of the following specialists: orthopedic spine, neuro spine, pain management, orthopedic surgery, and neurosurgery. Completed PT visits were studied as a separate outcome variable. All outcome variables were treated as continuous measures.

2.6. Statistical analyses

We first computed descriptive statistics for all variables of patient cohort characteristics. We then performed univariate, bivariate, and multivariate analysis by using *t* test, correlation coefficients, and regression models.

Spearman rank correlation coefficients and point-biserial correlation coefficients[31] were used to examine pairwise relationships between each of our 4 health care utilization outcome measures and explanatory variables, including demographic information, social risk factors, health status, and neighborhood-level social determinants. Heat mapping was used to visually delineate the strongest correlated variables with each primary outcome measure (Supplementary Figure S1, http://links.lww.com/PR9/A250).

A series of Poisson regression models were constructed using R glm and stats packages where our 4 health care utilization measures were regressed on all explanatory variables. This approach was chosen due to better model fit and better convergence properties compared to negative binomial and zero-inflated models. We excluded social risk factors related to utilities from our analysis, as only one observation pertaining to this variable was captured in our cohorts. We controlled for patient demographics, health status, and chronic opioid use (Supplementary Table S5 and Table S6, http://links.lww.com/PR9/A250). The incidence rate ratios[37] were obtained along with 95% confidence intervals. We controlled for patient demographics, health status, and chronic opioid use (Supplementary Table S5 and Table S6, http://links.lww.com/PR9/A250). *P*-values were adjusted using Benjamini–Hochberg procedure.[1] ANOVA was used to assess the impact of SBST score and social risk factors on the primary outcomes. A proportional odds logistic regression model[20] was used to assess the association between SBST score and social risk factors. Lastly, we investigated causal and correlational relationships between explanatory variables on health care utilization outcomes using structural equation modeling[10] with the Lavaan R package.[15] As the package allows for Gaussian linear regression only, we transformed health care utilization variables to log2 (y + 1). We encoded relationships between the variables based on our assumptions outlined in Supplementary Figure S2, http://links.lww.com/PR9/A250. This study protocol was approved by the University of California San Francisco Institutional Review Board (19-29016).

3. Results

3.1. Study population

Table 1 describes our cohort comprised of 1,295 adult patients with a median age of 54 years (SD = 17.5). Sixty percent were female (N = 777), 44.2% non-Hispanic White (N = 573), 21.2% non-Hispanic Asian (N = 274), and 11.4% Hispanic (N = 147). Most patients had commercial insurance (54.2%), followed by Medicare (27.6%) and Medi-Cal (13.9%). Over 10% of patients (12.8%, N = 165) had at least one social risk factor identified from our 3 data extraction methods (Supplementary Figure S3, http://links.lww.com/PR9/A250). Of the 6 social risk factors, financial strain was the most commonly identified across all the data extraction methods (4.6%, N = 59). For neighborhood characteristics, close to half (43.9%, N = 568) of patients had residential addresses in regions with historic redlining scores greater than 3.

Over 90% of patients (90.9%, N = 1177) had resident addresses linked to national ADI rankings score under 10.

Individual patient health care utilization varied across our 4 primary outcomes. Physical therapy and specialty visits had the highest mean values (mean = 6.8, SD = 6.6; mean = 6.2, SD = 13.0, respectively), followed by imaging (mean = 1.4, SD = 2.9) and ED visits/hospitalization (mean = 0.4, SD = 1.3). Almost 10% of our cohort (9.7%, N = 126) had greater than one ED visit/hospitalization; 30.7% (N = 397) had greater than one completed imaging orders; 27.9% (N = 361) had greater than 5 spine health–related specialty visits; and 25.9% (N = 336) had greater than 8 PT visits. Further, nearly 38% (N = 491) used one instance of health care utilization (Supplementary Table S7, http://links.lww.com/PR9/A250).

3.2. Association of health care utilization with social risk factors and control variables

In multivariate Poisson regression, several individual social risk factors were significantly associated with our 4 health care utilization outcomes (**Fig. 1**). Social isolation was positively associated with 3 utilization outcomes: imaging (IRR = 2.02, $P < 0.01$), specialty (IRR = 1.41, $P < 0.01$), and PT visits (IRR = 1.36, $P < 0.01$); housing instability was positively associated with ED visits/hospitalizations (IRR = 2.10, $P < 0.01$) and imaging (IRR = 1.41, $P < 0.01$); food insecurity was positively associated with ED visits/hospitalizations (IRR = 2.01, $P < 0.01$) and specialty visits (IRR = 1.50, $P < 0.01$) but negatively associated with PT visits (IRR = 0.68, $P < 0.01$); financial strain was positively associated with PT visits (IRR = 1.19, $P < 0.01$) but negatively associated with ED visits/hospitalizations (IRR = 0.26, $P < 0.01$). For neighborhood-level factors, historic redlining was positively associated with ED visits/hospitalizations (IRR = 1.34, $P < 0.01$).

Among other factors commonly used as proxies of social risks, commercial (IRR = 0.32, $P < 0.01$) and Medicare (IRR = 0.37, $P < 0.01$) insurance types were both negatively associated with ED visits/hospitalization. However, Workers' Compensation payer type was positively associated with both imaging utilization (IRR = 1.68, $P = 0.03$) and PT visits (IRR = 1.70, $P < 0.01$) but negatively associated with specialty visits (IRR = 0.53, $P < 0.01$). Significant differences and variations were observed among race and ethnicity groups associated with each primary outcome: patients identified as American Indian or Alaska Native (IRR = 7.85, $P < 0.01$), Black and African American (IRR = 2.26, $P < 0.01$), and Hispanic or Latino (IRR = 1.80, $P < 0.01$) had significantly more ED visits/hospitalizations compared to patients identified as White. While having higher risk of hospitalization, Hispanic or Latino patients had significantly lower utilization of all other health care resources (imaging: IRR = 0.58, $P < 0.01$; specialty visits: IRR = 0.60, $P < 0.01$; and PT visits: IRR = 0.88, $P < 0.01$). Hawaiian/Pacific Islander and Asian patients had significantly fewer specialty (Hawaiian/Pacific Islander: IRR = 0.35, $P < 0.01$; Asian: IRR = 0.58, $P < 0.01$) and PT visits (Hawaiian/Pacific Islander: IRR = 0.71, $P < 0.01$; Asian: IRR = 0.71, $P < 0.01$). Both historic redlining (IRR = 0.96, $P < 0.01$) and higher ADI values (IRR = 0.97, $P < 0.01$) were associated with lower utilization of PT care. Historic redlining was also associated with lower use of specialty care (IRR = 0.93, $P < 0.01$) and higher hospitalization/ED visit rate (IRR = 1.34, $P < 0.01$).

Among control variables, chronic opioid prescription showed the strongest association across all health care utilization outcomes (ED visits/hospitalizations: IRR = 1.77, $P < 0.01$; imaging: IRR = 1.99, $P < 0.01$; specialty visits: IRR = 2.29, $P < 0.01$; PT visits: IRR = 1.29, $P < 0.01$). Surprisingly, higher CCI was associated with lower utilization of imaging (IRR = 0.93, $P < 0.01$), specialty (IRR = 0.93, $P < 0.01$), and PT care (IRR = 0.97, $P = 0.02$). Bivariate model results were summarized in Supplementary Table S8 and Table S9, http://links.lww.com/PR9/A250 and largely agree with the multivariate model available in Supplementary Table S10 and Table S11, http://links.lww.com/PR9/A250.

The ANOVA analysis showed that the health care utilization outcomes were affected by cumulative number of social risks when controlling for back pain–related disability from the SBST score (Supplementary Tables S12a-e, http://links.lww.com/PR9/A250). These results remained consistent after further adjustment for demographic variables (eg, age, sex, CCI score, and race/ethnicity). Health care utilization outcomes were also affected by CCI score when controlling for cumulative social risks and back pain–related disability. Further, the transportation barriers were positively associated with the SBST score (Supplementary Table S13, http://links.lww.com/PR9/A250).

3.3. Causal relations discovered through structural equation modeling

Our structural equation models showed that older age had a strong negative impact on comorbidities (measured by CCI) and a positive impact on all health care utilizations except PT visits. Among race/ethnicity factors, White patients had more specialty visits, while Black patients had more ED visits/hospitalizations. In addition, patients who identified as Asian had fewer PT visits. Back pain–related disability contributed significantly to higher health care utilization except for PT visits. No significant association was found between back pain–related disability and comorbidities. Further, among individual-level social risk factors, housing instability contributed to higher rates of ED visits/hospitalizations; social isolation contributed to higher utilization of imaging; financial insecurity contributed to fewer ED visits/hospitalizations.

4. Discussion

Our study is the first, to our knowledge, to evaluate associations between health care utilization outcomes and patient-level social risk factors identified from structured EHR fields and free text clinical notes in patients with chronic low back pain (cLBP). We studied causal inference using structural equation models between both back pain–related disability and social risk factors with health care utilization. Overall, we identified social risks in just over 10% of our cLBP patient cohort. Our multivariate models demonstrated that specific social risk factors, such as patient-level housing instability and food insecurity, in addition to neighborhood-level historic redlining, were associated with increased ED visits/hospitalizations, above and beyond other factors commonly associated with health care disparities, including identifying as a racial/ethnic group that has been subject to systemic/systematic racism/discrimination and under-insurance.[55] Our findings indicate that social risk factors and back pain–related disability (ie, SBST scores) independently influence health care utilization outcomes (Supplementary Table S12c-d, http://links.lww.com/PR9/A250). This effect remained significant even when controlling for the other factor. The CCI scores also significantly affected health care utilization when considering both social risk and SBST (Supplementary Tables S12a-e, http://links.lww.com/PR9/A250). While level of disability status has been shown to increase health care utilization in patients with cLBP,[21] our study results suggest that it is important to also account for social risk factors beyond sociodemographics and disability

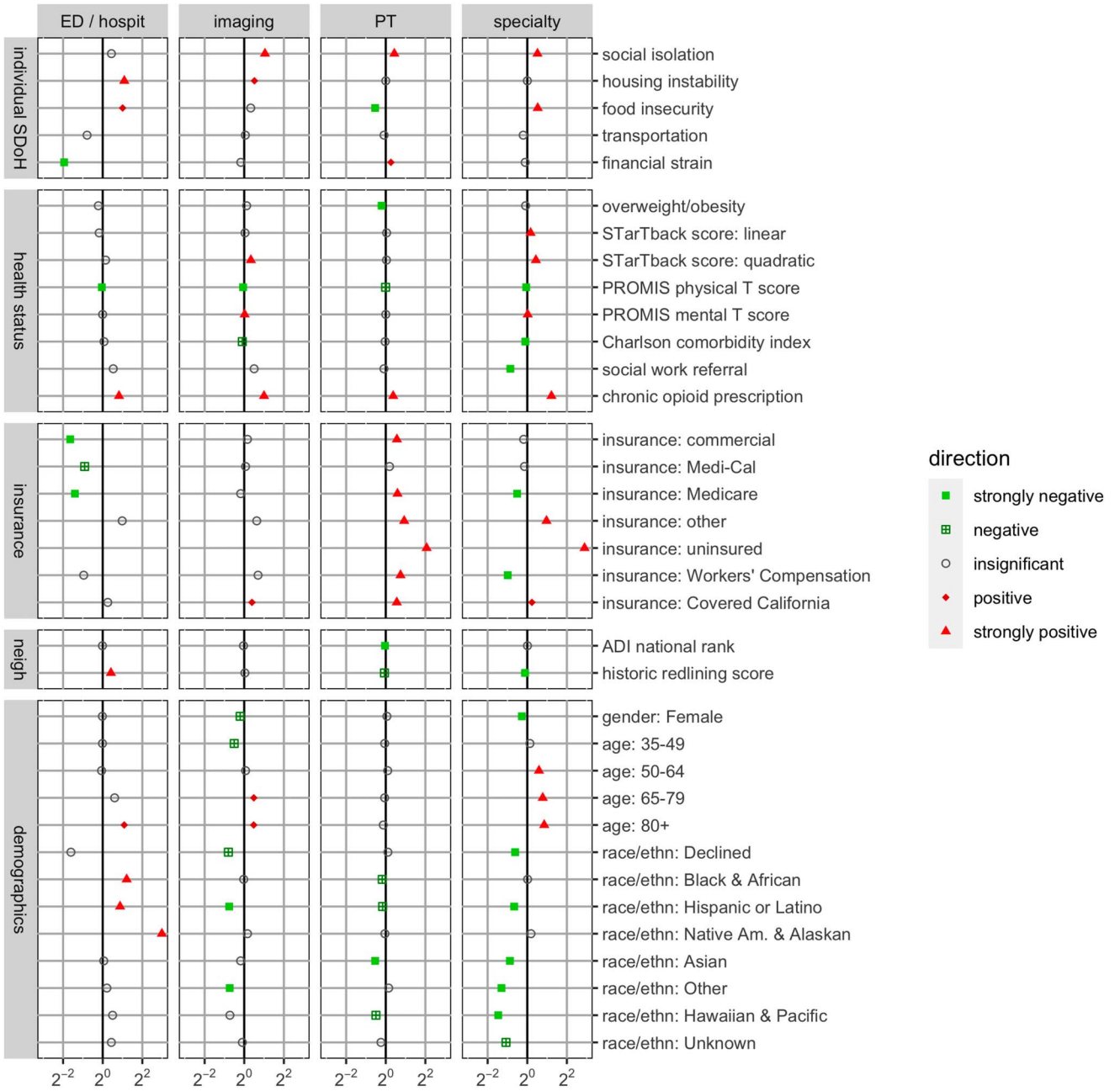

Figure 1. Multivariate associations between individual-level social risk and neighborhood-level factors with 4 health care utilization outcomes: ED visits/hospitalizations and imaging (N = 1,295 patients with cLBP). IRR (incident rate ratio) values are presented along the x-axis on a log scale. IRR values with adjusted *P*-values < 0.001 are highlighted as highly positive or negative association. For demographic variables, the reference group was non-Hispanic White ethnicity, male gender, and age under 35 years. For StartBack score, medium risk was taken as reference group for comparison. cLBP, chronic low back pain; ED, emergency department.

status (Supplementary Figure S2, http://links.lww.com/PR9/A250). Increased ED and hospital utilizations can be significant cost drivers, with over 10 times higher expenses than care delivered in urgent or primary care clinics.[73] Prior studies have demonstrated associations between increased hospital utilization in patients experiencing housing instability who have mental, behavioral, and neurodevelopmental disorders.[61] Food insecurity has similarly been associated with higher health care costs and utilization.[8] Our study suggests similar associations in patients with cLBP.

Both housing instability and social isolation were associated with receiving more imaging. As imaging is often ordered during ED visits/hospitalizations, it is not surprising that housing instability would be associated with both ED visits/hospitalizations and imaging. Social isolation trended toward more ED visits/hospitalizations, but this was not statistically significant. The existing literature has found positive associations between social isolation and higher hospitalization rates, primarily in older adult populations.[5,44,60,75] While specific studies on the association between imaging utilization and social isolation are limited, current evidence in cLBP studies suggests that nonadherence to clinical practice guidelines for early imaging orders increases unnecessary costs for outpatient services, excessive surgery, and other procedures and worse outcomes.[28,35,51]

Housing instability and social isolation were also both associated with more specialty visits. Both social isolation and financial strain were associated with more PT visits, which may be a marker of more severe cLBP but could also suggest greater engagement in self-management. Food insecurity and housing instability were associated with fewer PT visits. Previous studies in other populations, including pediatrics,[71] adults with multiple chronic diseases,[70] and patients with diabetes,[7] have also suggested that food insecurity and housing instability contribute to the development of cLBP.[59]

Our findings suggest that identifying individual patient-level social risk factors may help future studies to understand associations with utilization, given these results were significant in models that controlled for other variables commonly associated with utilization, including medical comorbidities and age,[32,63] and those that are used as proxies for health disparities, including race/ethnicity.[41] Growing efforts to identify patients' social risk factors[27] may provide future opportunities to further study on the upstream factors that may contribute to avoidable/adverse utilization (eg, ED visits/hospitalizations) while increasing access to others (eg, PT visits) to improve cLBP outcomes.

Neighborhood-level social determinants were also associated with our utilization outcomes and the aforementioned individual-level social risks.[67] Only living in areas of historic redlining was associated with more ED visits/hospitalizations in our multivariable models. Living in areas of historic redlining was negatively associated with visits to spine health–related specialty care, and both markers of adverse neighborhood-level social determinants (ie, ADI and historic redlining) were associated with fewer PT visits. A scoping review by Swope et al. outlined evidence of the association between historical redlining and current health outcomes.[69] Recent research suggests that multiple chronic conditions are affected by historical redlining, including diabetes, hypertension, stroke, poorer mental health,[46] and asthma.[45] While further research is needed to account for other potential causal factors, to our knowledge, this is the first study suggesting associations between historical redlining and utilization in patients with cLBP.

The consistent associations between adverse neighborhood-level social determinants and completing fewer PT visits may relate to different upstream factors on access to care.[99] Previous studies using area-based measures have shown that regions with higher ADI scores had population characteristics associated with decreased non-ER or preventative care, such as lower health literacy[38] and limited physical activities.[79] While other potential upstream factors, such as transportation barriers, may influence how individuals utilize care, our study showed that individual-level transportation social risk did not yield statistically significant results. This finding may suggest that data on adverse neighborhood-level determinants of health may better capture patients' overall risk of access barriers than what our patient-level data extraction techniques were able to identify in our health system's EHR data. However, prior research has demonstrated that neighborhood-level data alone is inadequate at capturing patients' individual experiences with social risk factors compared to social risks identified through standardized screening, which our study health system was not conducting during the study period.[11,14] It is possible that as data collection on individual social risks expands, we will see both a higher level of social risks in our patient population and different associations with utilization.

The biopsychosocial model within conservative cLBP literature has a limited focus on social factors, including employment, family relationships, and socioeconomic factors.[43] Additional social risks, such as living situations and environmental factors, have been less commonly reported.[42,43] Our study indicates that while social risk factors in general are associated with health care utilization in patients with cLBP, certain social risk factors may have greater impacts on specific types of utilizations evidenced by the strong association between social isolation and ED visits/hospitalizations (Supplementary Figures S4 and S5, http://links.lww.com/PR9/A250). These utilization metrics can be costly and burdensome on patients and are not always evidence-based.[28,51] Growing awareness of the importance of patients' social risk factors on health and wellness has led to recent incentives for health systems to increase the identification of, and subsequent intervention on patients' social risk factors, with the underlying goal of improving health equity.[27] Increasing health care team awareness of patients' social contexts—including individual-level social risk factors and neighborhood-level social determinants—can help identify patients who may benefit from further elicitation concerning their priorities and desires for assistance, leading to more shared decision making in the delivery methods and treatment options.[24,48,60,65]

4.1. Limitations

There are several study limitations. First, our dataset identified low prevalence of social risk factors in our patient cohort across all EHR data sources. This may be related to underidentification of social risk factors and/or a low prevalence of social risks our study population experienced and/or disclosed. Further, they received care from a multidisciplinary team and may have had more access to care compared to those out-of-care patients with cLBP. This difference may have resulted in selection bias related to a lower experience of SDoH compared to other patients with cLBP. While we used social risk data extracted from both structured and unstructured data, NLP techniques are still in the research stage. Second, our patient cohort was limited to a single large urban medical center; our findings may not be generalizable to other settings. Third, our study data could not distinguish between the types of utilization for our study outcomes (eg, some ED visits/hospitalizations may be unavoidable and/or may have been unrelated to patients' cLBP care). While we narrowed the types of specialty visits to be more specific to cLBP care, we could not verify that specialty visits were specific to patients' cLBP care. Similarly, we did not narrow imaging beyond MRIs, CT scans, X-rays, and having a diagnosis of cLBP. Further, we could not verify that PT visits were only for patients' cLBP. However, since patients with cLBP often have chronic overlapping pain conditions, this PT utilization metric will still capture overall PT utilization. To our knowledge, this study remains the first to explore patients with cLBP's individual social risk factors identified from multiple sources of EHR data, as well as neighborhood-level social determinants. It is important to understand how patients' social contexts affect their utilization outcomes.

5. Conclusion

Our study demonstrated that multiple patient-level social risk factors were associated with higher rates of often avoidable/unnecessary utilization outcomes in patients with cLBP, including ED visits/hospitalizations and imaging, while associated with lower preventative utilization outcomes, such as PT visits. Social risks contributed above and beyond other markers of experience of socioeconomic marginalization and discrimination, including race/ethnicity, insurance type, and living in areas of historic

redlining. This study supports the growing quality incentives around identifying and intervening on patient's social risk factors.

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Data: The dataset generated and/or analysed during the current study is not publicly available due to data owned and compiled by UCSF but is available from the corresponding author on reasonable request.

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