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Cohort study examining social determinants of health and their association with mortality among hospitalised adults in New York and California

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ABSTRACT

Background Adults in the US face significant disparities in health as a result of the social determinants of health (SDOH). While the link between SDOH and mortality is well-established, their impact on outcomes after hospitalisation is less understood.

Methods Among adults aged 18–84 years hospitalised in New York (NY) during the period of 2000–2009 and in California (CA) from during the period of 2000–2006, we examined the association between 1-year post-hospitalisation mortality and a community-level SDOH combined index (comprising six component domains) using Kaplan-Meier survival analysis and multivariable Cox proportional-hazard models to estimate the mortality HR (adjusted HR (aHR)) adjusted for age, gender, race, ethnicity and Charlson Comorbidity Index. We also studied subcohorts in NY and CA grouped by hospitalisation conditions (subgroups with chronic or acute disease).

Results In NY, the overall 1-year mortality rate was 8.9% (9.7% for chronic diseases and 13.2% for acute diseases). In CA, the overall 1-year mortality rate was 8.3% (12.6% for chronic diseases and 15.8% for acute diseases). In both states, the 1-year risk of death was significantly lower for those in the best (Q4) SDOH (combined index) compared with the worst (Q1 is the reference category). In NY, the aHR was 0.964 ($p<0.001$ and 95% CI 0.950 to 0.978), while in CA, the aHR: 0.83 ($p<0.001$ and 95% CI 0.825 to 0.842). Similar patterns were observed for the disease cohorts in both states. The Economic and Education domains of SDOH showed stronger and more consistent associations with mortality risk compared with the domains of Neighbourhood, Food Access, Community and Social Context, and Healthcare.

Conclusions This study demonstrates a significant association between worse SDOH and higher post-hospitalisation mortality. The findings emphasise the importance of community-level SDOH in patient care planning and discharge strategies to reduce health disparities.

WHAT IS ALREADY KNOWN ON THIS TOPIC

Social determinants of health (SDOH) have a significant influence on health outcomes and addressing community-level social determinants may reduce health disparities. However, the specific impact of these SDOH on post-discharge outcomes for hospitalised individuals remains uncertain.

WHAT THIS STUDY ADDS

This retrospective population-based cohort study, encompassing millions of hospitalised adults in New York and California, reveals that worse SDOH are associated with higher 1-year mortality rates. Individuals from communities with worse SDOH face elevated mortality risks post-hospitalisation, with certain factors having a more pronounced impact.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

The findings highlight the importance of integrating the SDOH into the care planning for hospitalised patients. These results demonstrate the need for health policy to recognise community-level SDOH and the challenges patients encounter after discharge, enabling healthcare systems to effectively achieve equitable and better health outcomes.

In medicine, social and environmental characteristics are recognised as pivotal determinants driving health disparities among population groups.[1 2] The relationship between health outcomes and these factors, such as socioeconomic status traces back to the Fundamental Causes of Disease theory, which underscored the significance of social determinants of health (SDOH) on health outcomes.[3–7] Ongoing research examining SDOH and their role in health inequities highlights an urgent need to understand their impact on hospitalised patients and their health outcomes.[8 9]

To understand the relationship between social drivers and health outcomes, a closer examination of SDOH measures is

Table 1 Characteristics of all adults, and subcohorts with chronic and acute diseases in NY and CA

	NY inpatient			CA inpatient		
	All (n=5 076 939)	Chronic disease (n=534 813)	Acute disease (n=113 711)	All (n=5 924 864)	Chronic disease (n=567 127)	Acute disease (n=136 950)
Age						
Mean age (SD)	57 (18)	67 (12)	64 (17)	61 (20)	67 (13)	65 (17)
18–44 years	27.8%	5.3%	16.4%	29.1%	5.7%	15.0%
45–64 years	31.3%	33.3%	23.9%	31.9%	33.2%	22.1%
65–84 years	40.9%	61.4%	59.8%	39.0%	61.1%	62.9%
Gender						
Male	47.3%	54.7%	49.3%	47.5%	58.1%	50.8%
Female	52.7%	45.3%	50.7%	52.5%	41.9%	49.2%
Race						
Non-Hispanic white	63.8%	68.5%	66.8%	78.9%	78.9%	80.9%
Black	18.3%	14.6%	17.6%	7.0%	6.7%	6.7%
Asian	1.6%	1.4%	1.6%	6.3%	7.1%	6.2%
Other	16.34%	15.5%	14.0%	7.9%	7.3%	6.2%
Ethnicity						
Non-Hispanic	91.8%	93.6%	92.8%	84.6%	87.5%	87.4%
Hispanic	8.3%	6.4%	7.8%	15.4%	12.5%	12.6%
Insurance						
Private	38.0%	33.3%	25.5%	39.6%	30.7%	22.9%
Medicare	38.6%	53.2%	56.1%	38.8%	55.8%	60.6%
Medicaid	17.6%	10.4%	13.6%	17.6%	11.0%	13.8%
Uninsured	5.8%	3.2%	4.8%	4.0%	2.5%	2.7%
Comorbidity						
CCI (0)	53.8%	30.0%	39.2%	53.8%	31.7%	27.6%
Chronic disease						
Cardiovascular disease	11.4%	78.0%	–	8.9%	75.2%	–
Cerebrovascular disease	3.2%	22.0%	–	2.9%	24.8%	–
Pneumonia	3.2%	–	100.0%	3.7%	–	100.0%
All-cause mortality						
Overall mortality (%)	28.5%	34.0%	43.9%	33.2%	47.0%	60.6%
1-year mortality rate	8.9%	9.7%	13.2%	8.3%	12.6%	15.8%
SDOH index (SD)						
SDOH mean index value	0.76 (0.12)	0.76 (0.12)	0.75 (0.12)	0.84 (0.07)	0.84 (0.07)	0.84 (0.07)
Worst (Q1)		0.730 (0.046)			0.653 (0.085)	

Continued

Table 1 Continued

	NY inpatient			CA inpatient		
	All (n=5 076 939)	Chronic disease (n=534 813)	Acute disease (n=113 711)	All (n=5 924 864)	Chronic disease (n=567 127)	Acute disease (n=136 950)
Worse (Q2)		0.816 (0.016)			0.793 (0.020)	
Better (Q3)		0.868 (0.013)			0.852 (0.016)	
Best (Q4)		0.922 (0.230)			0.911 (0.022)	
SDOH total proportion						
Worst (Q1)	24.2%	21.9%	24.6%	20.6%	20.2%	22.1%
Worse (Q2)	24.5%	23.9%	24.6%	27.4%	27.9%	28.9%
Better (Q3)	26.0%	27.6%	27.2%	27.4%	27.7%	27.8%
Best (Q4)	25.3%	26.6%	23.6%	24.6%	24.2%	21.2%

CA, California; CCI, Charlson Comorbidity Index; NY, New York; SDOH, social determinants of health.

needed.[10–12] Previous studies have consistently found an association between socioeconomic status and health outcomes.[13 14] Additionally, robust associations have been established between mortality rates and socioeconomic indicators.[15 16] Particularly noteworthy are the vulnerabilities faced by populations with chronic diseases in disadvantaged neighbourhoods, which are evidenced by higher incidences of cardiovascular disease, increased mortality from heart failure and coronary heart disease, and elevated mortality from hospitalisation with acute myocardial infarction.[17–19]

A critical gap in knowledge exists in understanding outcomes related to hospital admissions in the context of SDOH. Since many hospitalisations are driven by preventable chronic diseases and treatable acute diseases, it is important to investigate the degree of association between SDOH and health outcomes among subgroups with these conditions. To better understand the association between health outcomes after hospitalisation and SDOH, we must consider all six domains of SDOH (Economic Stability, Neighbourhood and Physical Environment, Education, Community and Social Context, Food Access, and Healthcare). Each domain has an important role that is influenced by state and national health policies.[20]

In this study, we assess the association between a multi-dimensional index of SDOH and its six component domains with all-cause mortality during the year following hospitalisation in the states of New York (NY) and California (CA). We also aim to explore the relationship between community-level SDOH and mortality among subgroups with chronic diseases and acute diseases.[21 22] By undertaking this investigation, we seek to contribute our understanding of how SDOH influences health outcomes in hospitalised patients and inform policymakers about the importance of SDOH to reduce health disparities within the healthcare system.

METHODS

Data source

This cohort study examines hospitalisations using inpatient claims data from the states of NY and CA. It focuses on patients aged 18–84 years hospitalised in either state based on their discharge dates. In NY, data were obtained from the Statewide Planning and Research Cooperative System claims and included 37 529 146 inpatient admissions from 1995 to 2014. In CA, data were obtained from the Office of Statewide Health Planning and Development claims and included 47 459 012 inpatient admissions from 1995 to 2011. Mortality data from the US Vital Statistics for each state were linked to each patient, excluding deaths that occurred before discharge, with observational follow-up periods ranging from 2000 to 2014 for NY and years 2000 to 2011 for CA.

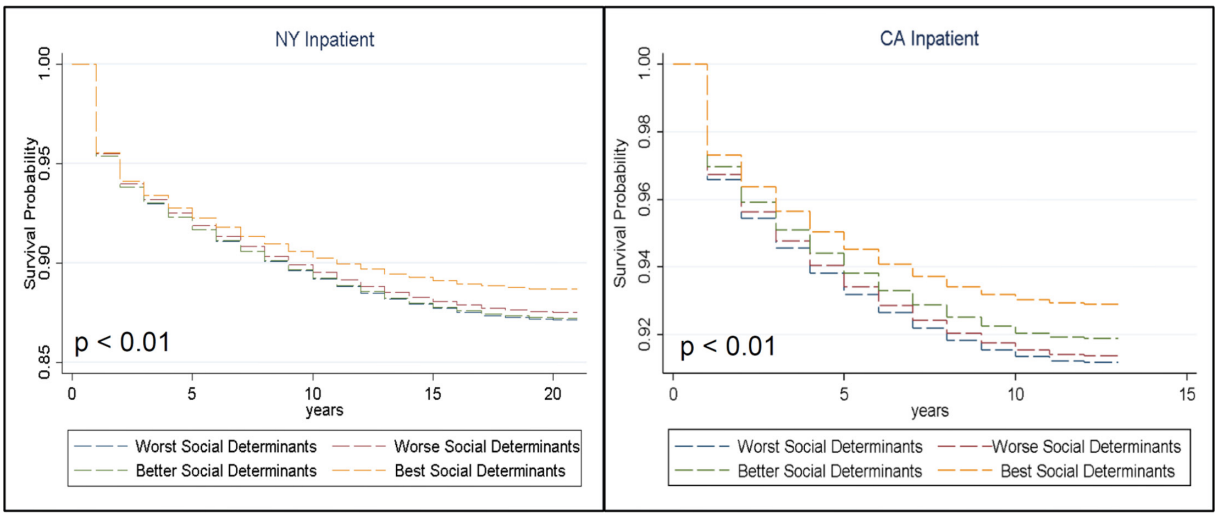

Figure 1 Age-adjusted Kaplan-Meier survival curves by social determinants of health categories in New York (NY) and California (CA).

Social determinants of health

To measure SDOH, we employed a recently developed index measure comprising six domains based on frameworks established by Healthy People 2030 and the Kaiser Family Foundation sharing common elements of the PhenX Toolkit.[5 23] This index represents community-level SDOH characteristics using data from the US Census (2000 and 2010), American Community Survey (2010–2017), US Department of Agriculture Food Access Research Atlas (2006 and 2010) and Dartmouth Atlas (1996, 2006 and 2011).[24–28] The SDOH index encompasses six domains, specifically Economic Stability (employment; poverty), Neighbourhood and Physical environment (home occupancy; modern house heating fuel; mortgage), Education (high school education level), Access to Food (supplemental nutrition assistance programme or SNAP; nearest grocery stores within 1 mile in urban and 10 miles in rural areas), Community and Social Context (travel time to work of an hour or more; urban density) and Healthcare and Health Outcomes (primary care availability; health insurance; disability status). The SDOH index measure is quantitatively measured from 0 to 1, where higher scores close to 1 indicate better SDOH characteristics and close to 0 indicate worse SDOH characteristics. Each patient's SDOH characteristics were linked using a neighbourhood-level measure based on their residential ZIP code linked to ZIP code tabulation area (ZCTA). The SDOH index measure was categorised by quartile, ranking from worst (Q1) to best (Q4).

Study population

Patients with pregnancy-related diagnoses (2 480 094 patients in NY and 3 631 134 patients in CA) or a listed residential ZIP code outside NY or CA were excluded. We identified initial hospitalisations in the study cohort with at least one hospitalisation during the lookback periods of 2000–2009 in NY and 2000–2006 in CA (online supplemental appendix A). Patients with hospital admissions 5 years before and after these periods were excluded. We also established two subcohorts of patients hospitalised with either chronic or acute diseases identified using the International Classification of Diseases, Ninth Revision, Clinical Modification codes (ICD-9-CM). Chronic diseases were defined as preventable conditions using a primary diagnosis of a cardiovascular condition or cerebrovascular disease. Patients identified with cardiovascular conditions had the following conditions: acute myocardial infarction, angina, cardiomyopathy, congestive heart failure, coronary atherosclerosis, heart disease, hypertension or ischaemic heart disease with ICD-9-CM codes of 401.0–402.0, 410.0–411.0, 413.0–414.0, 425.0 and 428.0. Patients identified with cerebrovascular disease had the following conditions: cerebral embolism, ischaemia, thrombosis or haemorrhage with ICD-9-CM codes of 430.0–432.0 and 434.0–436.0. We defined acute disease as a treatable condition using a primary diagnosis of pneumonia. Patients identified with pneumonia had ICD-9-CM codes of 479.0–487.0.

Measures

The primary outcome measure was defined as 1-year all-cause mortality post-hospitalisation on discharge. The mortality status was based on data from the US Vital Statistics Reports using records only in NY and CA. Mortality status was observed within a 1-year timeframe and linked to each patient with unique record numbers. Baseline patient characteristics were included as covariates for age, gender, race, ethnicity and comorbidity status as estimated by the Charlson Comorbidity Index.[29] The Charlson Comorbidity Index accounts for multiple conditions, including myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, rheumatological disease, peptic ulcer disease, liver disease, diabetes, hemiplegia, paraplegia, renal disease, malignancy, leukaemia, lymphoma and AIDS.

Statistical analysis

We categorised SDOH (combined index and component domain scores) into quartiles with four categories, worst

(Q1) to best (Q4) from the overall range of the SDOH index. Using these predefined cut points, we linked the SDOH characteristics to each patient in the cohort using the patient's residential ZIP code.

Survival probability was estimated using age-adjusted Kaplan-Meier survival analysis, with comparison tests using log-rank across SDOH quartiles. The association between mortality and SDOH was estimated using multivariable Cox proportional-hazard models, reporting adjusted HRs (aHRs) and 95% CIs. Mortality comparisons were made across SDOH categories with Q1 (worst) category as the reference group. We also examined the association between all-cause mortality and SDOH for hospitalised patients with chronic diseases versus acute diseases. The primary model for the overall population in NY and CA was adjusted for age (continuous measure), gender, race, ethnicity and comorbidity status. The secondary model for subcohorts in NY and CA was adjusted for age, gender, race and ethnicity. We assessed the proportional hazards assumption for all models and set the statistical significance threshold at p<0.001. All statistical analyses were conducted using Stata (V.16, Stata Corp).

Patient and public involvement

The design, conduct and reporting of this research did not directly involve patients or the public. The research team designed and developed this study and determined the objectives, methodology and analysis without direct input from patients or members of the public. We did not include patient advisory groups or public consultations to guide the research process. As a result, patients were not formally involved in the research design or dissemination process.

RESULTS

Table 1 presents data on hospitalisations in NY and CA. In NY, there were 10 650 846 hospitalisations, of which 1 191 758 of them had a chronic disease and 251 413 had an acute disease. Among these hospitalisations, 5 076 939 were identified as incident cases (534 813 chronic disease and 113 711 acute disease). Similarly, in CA, there were 10 196 635 hospitalisations, of which 1 060 522 of them had a chronic disease and 289 843 had an acute disease. Among these hospitalisations, 5 924 864 were identified as incident cases (567 127 chronic disease and 136 950 acute disease). Among these hospitalisations in CA, 5 924 864 were identified as incident cases (567 127 chronic disease and 136 950 acute disease). The mean age among patients was 57 years (SD=18) in NY and 61 years (SD=20) in CA. A large proportion of patients in both states were white, non-Hispanic, with private insurance or Medicare, and exhibited a higher prevalence of cardiovascular disease compared with cerebrovascular disease or pneumonia. Mortality rates were higher for patients with acute disease than for those with chronic disease or overall. Table 1 also shows the mean value of the SDOH index measure in NY as 0.76 (SD=0.12) with the SDOH index measure ranging from 0.73 (SD=0.046) to 0.922 (SD=0.230) in the quartiles and in CA as 0.84 (SD=0.07) ranging from 0.653 (SD=0.085) to 0.911 (SD=0.022) in the quartiles.

Figure 1 shows an estimate of survival by the four groups of the SDOH index by quartile, comparing worst (Q1) to best (Q4) in both NY and CA using age-adjusted Kaplan-Meier survival curves. In both NY and CA, patients in the best category (Q4) had the lowest mortality (p value <0.01), whereas those in the worst category (Q1) had the highest mortality (p value <0.01).

Table 2 presents the adjusted associations between the six SDOH domains and 1-year mortality. In NY, better SDOH quartiles in four of the six domains (excluding Neighbourhood and Food Access) were associated with lower mortality risks. Similarly, in CA, five of six SDOH domains (excluding Community and Social Context) were associated with lower mortality risks (table 2). Notably, the Economic and Education domains showed substantially lower mortality risks compared with the domains of Neighbourhood, Food Access, Community and Social Context, and Healthcare. As reported in online supplemental appendix B, starting with Q1 in NY, there were consistent relationships where better SDOH was associated with decreasing mortality risk, although this was not observed in the domains of Neighbourhood, Food Access, Community and Social Context, and Healthcare. In CA, starting with Q1, there were more consistent relationships between increasing (better) SDOH categories and decreasing mortality risk, but such a pattern was not observed for the domains of Community and Social Context and Healthcare.

Table 3 presents the adjusted association between the overall SDOH index among all hospitalised patients or subcohorts and 1-year mortality. Patients in the best SDOH category (Q4) had significantly lower mortality risks than those in the worst SDOH category (Q1). This was consistent among all hospitalised in the NY and CA cohorts. In addition, this trend was also observed among those hospitalised for chronic disease and among those hospitalised for acute disease in the CA cohort.

Table 4 examines the relationship between six SDOH domains and 1-year mortality among patients with chronic or acute diseases. In NY, patients with chronic disease had lower mortality risk in three SDOH domains, namely, Economic, Neighbourhood, and Community and Social Context. In CA, patients with chronic disease had consistently lower mortality risks in five domains, namely, Economic, Neighbourhood, Education, Food Access and Healthcare which were at statistical significance. Among NY patients with acute diseases, lower mortality risks were associated with three SDOH domains: Economic, Neighbourhood, and Community and Social Context. In CA, among patients with an acute disease, lower mortality risks were associated with all six SDOH domains across many quartiles at statistical significance. Although some of these observed associations did not meet our threshold of statistical significance especially in NY (p value <0.001), patterns indicated that some SDOH domains predicted lower 1-year mortality risk among

Table 2 1-year mortality with aHRs by social determinants of health domains in NY and CA

	NY inpatient		CA inpatient	
	aHR	95% CI	aHR	95% CI
Economic				
Q1=Worst	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)
Q2=Worse	0.985*	(0.972 to 0.998)	0.952*	(0.942 to 0.961)
Q3=Better	0.961*	(0.948 to 0.970)	0.892*	(0.883 to 0.900)
Q4=Best	0.882*	(0.870 to 0.894)	0.821*	(0.813 to 0.829)
Neighbourhood				
Q1=Worst	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)
Q2=Worse	0.991	(0.978 to 1.004)	0.972*	(0.963 to 0.981)
Q3=Better	1.008	(0.995 to 1.021)	0.949*	(0.940 to 0.958)
Q4=Best	0.960*	(0.948 to 0.972)	0.927*	(0.919 to 0.936)
Education				
Q1=Worst	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)
Q2=Worse	1.010	(0.997 to 1.024)	0.970*	(0.960 to 0.979)
Q3=Better	0.987	(0.973 to 1.001)	0.921*	(0.912 to 0.931)
Q4=Best	0.920*	(0.907 to 0.934)	0.850*	(0.841 to 0.859)
Food access				
Q1=Worst	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)
Q2=Worse	1.149*	(1.060 to 1.247)	0.972*	(0.963 to 0.981)
Q3=Better	1.023*	(1.011 to 1.035)	0.949*	(0.940 to 0.958)
Q4=Best	0.999	(0.987 to 1.011)	0.927*	(0.919 to 0.936)
Community and social context				
Q1=Worst	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)
Q2=Worse	0.991	(0.960 to 1.024)	1.001	(0.992 to 1.011)
Q3=Better	1.001	(0.980 to 1.022)	0.994	(0.984 to 1.003)
Q4=Best	0.974*	(0.955 to 0.994)	1.033*	(1.023 to 1.043)
Healthcare				
Q1=Worst	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)
Q2=Worse	1.054*	(1.040 to 1.069)	1.012*	(1.002 to 1.022)
Q3=Better	1.025*	(1.010 to 1.039)	0.961*	(0.952 to 0.970)
Q4=Best	0.962*	(0.949 to 0.975)	0.939*	(0.930 to 0.948)

*aHR significant at p<0.001.
aHR, adjusted HR; CA, California; NY, New York.

chronic and acute disease subgroups (online supplemental appendix C) while in CA, most SDOH domains predicted lower 1-year mortality risk among chronic and acute disease subgroups (online supplemental appendix D).

DISCUSSION

This study investigated the crucial role of SDOH as a potential driver of health disparities, specifically regarding mortality among hospitalised individuals, including subgroups with chronic or acute diseases. Our findings showed that mortality was significantly associated with the overall SDOH index measure and its six component domains, underscoring the influence of community-level SDOH on health outcomes.

The impact of specific SDOH domains on mortality varied between the states of NY and CA. In both states, patients in communities with better economic characteristics faced lower risks of mortality. In CA, higher educational attainment was also associated with lower mortality. Notably, the risks of mortality were lower in CA among patients with chronic disease or acute disease. These results highlight the need for future policies to dedicate the consideration of a comprehensive SDOH index measure and targeted evaluations of individual SDOH domains to improve post-hospitalisation outcomes and mitigate disparities in inpatient mortality.

While previous research has established a relationship between higher mortality risks and worse SDOH, few studies have conducted a large-scale investigation of post-hospitalisation mortality.[30 31] Limited prior studies have

Table 3 1-year mortality with aHRs by social determinants of health categories among hospitalised patients with chronic and acute diseases in NY and CA

	NY inpatient		CA inpatient	
	aHR	95% CI	aHR	95% CI
All adults				
Worst (Q1)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)
Worse (Q2)	1.056*	1.042 to 1.071	0.964*	0.954 to 0.973
Better (Q3)	1.026*	1.011 to 1.040	0.919*	0.910 to 0.928
Best (Q4)	0.964*	0.950 to 0.978	0.834*	0.825 to 0.842
Chronic disease				
Worst (Q1)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)
Worse (Q2)	1.032	0.926 to 1.149	0.893*	0.858 to 0.930
Better (Q3)	0.891	0.789 to 1.005	0.784*	0.751 to 0.819
Best (Q4)	0.886	0.782 to 1.005	0.628*	0.599 to 0.658
Acute disease				
Worst (Q1)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)
Worse (Q2)	1.050	0.824 to 1.339	0.941	0.857 to 1.034
Better (Q3)	0.999	0.769 to 1.296	0.955	0.867 to 1.053
Best (Q4)	0.886	0.667 to 1.177	0.890*	0.801 to 0.989

*aHR significant at p<0.001.
aHR, adjusted HR; CA, California; NY, New York.

explored the association of SDOH with health outcomes at a multi-state level, often focusing on smaller populations at the county level.[32 33] Our study incorporated nearly two decades of data to analyse mortality. While prior research has examined the association between SDOH and health outcomes among chronic conditions such as cardiovascular disease, diabetes and other chronic diseases, a limited number of studies have investigated the impact of SDOH on patients with chronic or acute diseases.[13 34 35] This study addresses this gap, emphasising the importance of individual SDOH domains in understanding mortality risks among different population groups.

Several limitations should be acknowledged. Our analysis of health outcomes was confined to a 1-year mortality on discharge from an inpatient setting limiting our understanding of a longer-term association. The SDOH measures were derived from frameworks of Healthy People 2030, Kaiser Family Foundation and PhenX, incorporating five to six of their domains with some measures within each domain excluded to minimise issues of collinearity. Residual confounding factors may affect our interpretations, as these SDOH factors are not completely understood and may potentially bias interpretations of their association with mortality. Additionally, using ZIP code-level data linked to ZCTA as a community-level SDOH measure limits the analysis to area-level characteristics as a substitute for individual factors and introduces ecological fallacy. Given that our data came from various timepoints, changes in the SDOH measure over time may not match the year of hospitalisation. Other critical factors such as health behaviour and lifestyle habits as well as discrimination were not included.[36] Finally, relying on administrative datasets limits our understanding of individual health statuses, as they primarily consisted of diagnosis codes, basic demographics, residential ZIP codes and billing information. Although our study design aimed to examine associations rather than causality, the extensive multi-state datasets strengthen the findings, although geographical variations may affect generalisability.

The implications of our findings on SDOH for health policy are significant, particularly concerning risk-adjustment of factors and outcomes, reimbursement models and overall medical care. Worse SDOH have been associated with increased short-term healthcare costs.[37] This underscores the importance of incorporating these factors into the appropriate adjustment of health policies.[38 39] Furthermore, community-level characteristics and patient demographics have influenced readmission penalties, underscoring the importance of addressing SDOH in these contexts.[40] Dual enrolment status has also been used as a proxy for SDOH characteristics, advocating for more appropriate risk adjustment strategies in health outcomes and readmissions.[39] With the increase in the availability of personal health data such as genetic risk factors through administrative datasets or electronic health records, researchers will be better equipped to analyse the impact of individual SDOH characteristics on costs, risks and health outcomes.[41] The integration of claims and personal health data could facilitate a more comprehensive understanding of SDOH characteristics and their impact on health outcomes.

Table 4 1-year mortality with aHRs by social determinants of health domains among hospitalised patients with chronic and acute diseases in NY and CA

	Chronic disease		Acute disease	
	NY inpatient	CA inpatient	NY inpatient	CA inpatient
	aHR (95% CI)	aHR (95% CI)	aHR (95% CI)	aHR (95% CI)
Economic				
Q1=Worst	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)
Q2=Worse	1.004 (0.779 to 1.295)	0.846* (0.821 to 0.872)	1.048 (0.636 to 1.726)	0.906* (0.861 to 0.954)
Q3=Better	1.082 (0.843 to 1.388)	0.730* (0.707 to 0.754)	0.987 (0.594 to 1.640)	0.856* (0.811 to 0.903)
Q4=Best	0.893 (0.685 to 1.163)	0.604* (0.584 to 0.625)	0.931 (0.547 to 1.585)	0.782* (0.739 to 0.827)
Neighbourhood				
Q1=Worst	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)
Q2=Worse	0.900 (0.708 to 1.144)	0.975 (0.943 to 1.007)	0.749 (0.471 to 1.191)	0.924* (0.875 to 0.976)
Q3=Better	0.940 (0.740 to 1.193)	0.934* (0.904 to 0.965)	0.647 (0.393 to 1.067)	0.937* (0.887 to 0.989)
Q4=Best	0.818 (0.652 to 1.041)	0.883* (0.855 to 0.912)	0.878 (0.562 to 1.373)	0.919* (0.871 to 0.969)
Education				
Q1=Worst	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)
Q2=Worse	1.129 (0.864 to 1.474)	0.875* (0.848 to 0.902)	1.506 (0.853 to 2.660)	0.948* (0.900 to 0.998)
Q3=Better	1.267 (0.968 to 1.658)	0.764* (0.739 to 0.790)	1.566 (0.876 to 2.780)	0.892* (0.844 to 0.943)
Q4=Best	1.116 (0.861 to 1.464)	0.641* (0.619 to 0.664)	1.533 (0.862 to 2.727)	0.786* (0.740 to 0.834)
Food access				
Q1=Worst	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)
Q2=Worse	0.919 (0.659 to 1.281)	0.976 (0.943 to 1.007)	1.034 (0.531 to 2.010)	0.924* (0.871 to 0.976)
Q3=Better	1.124 (0.898 to 1.408)	0.934* (0.904 to 0.965)	1.029 (0.642 to 1.647)	0.937* (0.887 to 0.989)
Q4=Best	1.089 (0.846 to 1.402)	0.883* (0.855 to 0.912)	1.403 (0.872 to 2.258)	0.919* (0.871 to 0.969)
Community social context				
Q1=Worst	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)
Q2=Worse	1.103 (0.647 to 1.879)	1.011 (0.979 to 1.043)	2.005 (0.835 to 4.819)	1.028 (0.975 to 1.084)
Q3=Better	0.893 (0.624 to 1.278)	0.962* (0.932 to 0.994)	1.065 (0.533 to 2.126)	0.922* (0.892 to 0.974)
Q4=Best	0.719 (0.510 to 1.016)	0.994 (0.963 to 1.027)	0.726 (0.360 to 1.442)	0.999 (0.947 to 1.054)
Healthcare				
Q1=Worst	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)	1.000 (Ref)
Q2=Worse	1.218 (0.944 to 1.571)	1.022 (0.990 to 1.054)	1.110 (0.659 to 1.863)	0.980 (0.930 to 1.033)
Q3=Better	1.172 (0.899 to 1.529)	0.956* (0.926 to 0.987)	1.176 (0.689 to 2.006)	0.935* (0.886 to 0.987)
Q4=Best	1.031 (0.789 to 1.345)	0.877* (0.848 to 0.906)	1.104 (0.650 to 1.876)	0.887* (0.840 to 0.937)

*aHR significant at p<0.001.
aHR, adjusted HR; CA, California; NY, New York.

CONCLUSIONS

Future research should prioritise the integration of SDOH in studies examining disparities especially in hospitalisation outcomes, aiming to inform policies on the value of SDOH interventions. Collaboration with community partners and government entities is essential to ensure that SDOH is addressed and clinical care is effectively provided to ensure improved health outcomes. Our findings suggest that policies targeting specific SDOH areas could significantly improve long-term outcomes for hospitalised patients, particularly among those with preventable chronic and treatable acute diseases.

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