

Supplemental Online Content

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This supplemental material has been provided by the authors to give readers additional information about their work.

eTable 1. Kaiser Permanente National Social Needs Survey: Social risk factors, survey questions, and level of social risk exposure determination.

Social Risk Factor Indicators	Social Risk Exposure Categories (Levels of Severity)	
	No Risk	Social Risk
<u>HOUSING INSTABILITY</u>¹		
Unable to pay the mortgage or rent on time	'No'	'Yes'
Yes		
No		
	AND	AND/OR
Number of places lived	'one' OR 'two'	'Three or more'
One		
Two		
Three or more		
	AND	AND/OR
Unsteady Place to Sleep	'No'	'Yes'
Yes		
No		
	AND	AND/OR
Living Situation	'Have a steady place to live'	'Have a steady place to live but are worried about losing it in the future'
Have a steady place to live		OR
Have a steady place to live but are worried about losing it in the future		'Do not have a steady place to live'
Do not have a steady place to live		

<u>FOOD INSECURITY</u> ²		
Worried food would run out	'Never true'	'Somewhat true'
Never true		OR
Sometime true		'Often true'
Often true		
	AND	AND/OR
Food did not last	'Never true'	'Somewhat true'
Never true		OR
Sometime true		'Often true'
Often true		
	AND	AND/OR
Hard to get enough healthy food	'Never true'	'Somewhat true'
Never true		OR
Sometime true		'Often true'
Often true		
<u>FINANCIAL STRAIN</u> ³		
Difficulty paying for basic needs	'Not very hard' OR 'Not hard at all'	'Somewhat hard'
Very hard		OR
Hard		'Hard'
Somewhat hard		OR
Not very hard		'Very hard'
Not hard at all		
	AND	AND/OR
Money left at end of each month to make ends meet	'More than enough'	'Just enough'

More than enough	OR 'Some left over'	OR 'Almost enough' OR 'Not enough'
Some left over		
Just enough		
Almost enough		
Not enough		
<u>SOCIAL RISK EXPOSURE (Composite Measure)</u>		
Housing Instability	'No Risk' for all social risk factors	'Social Risk' for at least one social risk factor
Food Insecurity		
Financial Strain		

¹ Housing Instability Questions (Response Options): #1: In the past 12 months, was there a time when you were not able to pay the mortgage or rent on time? (Yes, No); #2: In the past 12 months, how many places have you lived? (One, Two, Three or more); #3: In the past 12 months, was there a time when you did not have a steady place to sleep or slept in a shelter? (Yes, No); #4: What is your living situation today? (You have a steady place to live; you have a steady place to live but are worried about losing it in the future; you do not have a steady place to live)

² Food Insecurity Questions (Response Options): #1: Within the past 12 months, you worried whether your food would run out before you got money to buy more. (Never true; Sometimes true; Often true); #2: Within the past 12 months, the food you bought just didn't last and you didn't have money to get more. (Never true; Sometimes true; Often true); #3: Within the past 12 months, it was hard for you to get enough healthy food. (Never true; Sometimes true; Often true)

³ Financial Strain Questions (Response Options): #1: How hard is it for you to pay for the very basics like food, housing, medical care, and heating? (Very hard, hard, somewhat hard, not very hard, not hard at all); #2: Thinking about the past 12 months, would you say that at the end of each month you generally ended up with...(More than enough to make ends meet, Some left over to make ends meet, Just enough to make ends meet, Almost enough to make ends meet, Not enough to make ends meet)

eTable 2. Weighted baseline cohort descriptives among the analytic study cohort and those excluded.

	Response Options	Analytic Cohort ¹	Excluded ²	Significance
Sociodemographic Characteristics		% (95% CI) or Mean (SD)	% (95% CI) or Mean (SD)	Rao-Scott Chi-Square P-value
Age Group	18-34 years	26.6% (25.0-28.2)	44.3% (36.5-52.2)	<.0001
	35-49 years	26.7% (25.0-28.4)	15.3% (10.2-21.7)	
	50-64 years	26.3% (24.8-27.9)	23.4% (17.6-30.2)	
	65 + years	20.4% (19.1-21.8)	17.0% (12.0-23.0)	
Sex	Female	54.1% (52.3-55.9)	52.1% (44.3-59.9)	0.6211
	Male	45.9% (44.1-47.7)	47.9% (40.1-55.7)	
Race and Ethnicity	Hispanic, Latino/a or Spanish origin	27.1% (25.5-28.8)	27.2% (20.5-34.8)	0.2510
	White/Caucasian (non-Hispanic)	43.6% (41.9-45.3)	38.4% (31.1-46.1)	
	African American or Black (non-Hispanic)	8.2% (7.3-9.1)	11.7% (7.5-17.1)	
	Asian (non-Hispanic)	15.9% (14.5-17.3)	18.2% (12.5-25.2)	
	Pacific Islander (non-Hispanic)	1.8% (1.3-2.4)	1.6% (0.5-3.6)	
	American Indian or Alaska Native (non-Hispanic)	0.4% (0.2-0.8)	1.2% (0.0-6.2)	
	Another race / Unknown (non-Hispanic)	0.2% (0.1-0.3)	0.4% (0.0-1.4)	
	Two or more race groups selected (non-Hispanic)	2.9% (2.3-3.5)	1.3% (0.4-3.3)	
Education Level	Less than High School	6.0% (5.2-6.9)	4.8% (2.3-8.8)	0.0344
	High school graduate or GED	15.9% (14.7-17.3)	20.6% (14.4-27.9)	
	Some college or 2-year degree	31.0% (29.4-32.7)	38.1% (30.6-46.1)	
	4-year college graduate or more	47.0% (45.3-48.8)	36.6% (29.1-44.5)	
Insurance Type	Medicare, Medicaid, Special Program	30.9% (29.4-32.5)	38.6% (31.3-46.3)	0.0342
	Commercial	69.1% (67.5-70.6)	61.4% (53.7-68.7)	
Income Level	< \$35,000	20.2% (18.7-21.6)	27.9% (20.3-36.5)	0.0007
	\$35,000 - \$75,000	31.6% (29.8-33.4)	41.4% (32.5-50.7)	
	≥ \$75,000	48.3% (46.4-50.2)	30.7% (22.6-39.8)	

Marital Status	Married / Living w/ Partner	65.8% (64.1-67.5)	46.5% (38.7-54.4)	<.0001
	Previously Married	13.8% (12.7-15.0)	17.3% (11.9-23.8)	
	Never Married	20.4% (18.9-21.8)	36.2% (28.5-44.6)	
Social Risk Factors				
Food Insecurity				0.0006
	No Risk	70.0% (68.3-71.6)	56.8% (48.5-64.8)	
	Risk	30.0% (28.4-31.7)	43.2% (35.2-51.5)	
Housing Instability				0.0020
	No Risk	83.8% (82.4-85.0)	74.0% (66.0-80.9)	
	Risk	16.2% (15.0-17.6)	26.0% (19.1-34.0)	
Financial Strain				<.0001
	No Risk	56.8% (55.1-58.6)	37.4% (29.5-45.7)	
	Risk	43.2% (41.4-44.9)	62.6% (54.3-70.5)	
Any Financial strain, Housing instability, and/or food insecurity ³				0.0211
	No Risk	49.7% (47.9-51.5)	40.7% (33.3-48.4)	
	Risk	50.3% (48.5-52.1)	59.3% (51.6-66.7)	
Health Status				
Self-rated physical health	Excellent / Very Good	48.3% (46.5-50.1)	43.2% (35.7-50.9)	0.1109
	Good	37.8% (36.0-39.5)	37.2% (29.8-45.2)	
	Fair / Poor	13.9% (12.7-15.2)	19.6% (13.8-26.6)	
Self-rated mental health	Excellent / Very Good	55.9% (54.1-57.7)	48.3% (40.5-56.1)	0.1232
	Good	29.6% (28.0-31.3)	32.6% (25.3-40.6)	
	Fair / Poor	14.5% (13.3-15.8)	19.1% (13.2-26.3)	
Charlson Comorbidity Index	None, 0	60.8% (59.0-62.5)	63.4% (55.7-70.6)	0.8950
	Mild, 1-2	28.5% (26.9-30.1)	26.0% (19.7-33.2)	
	Moderate, 3-4	7.6% (6.7-8.5)	7.8% (4.3-12.7)	
	Severe >=5	3.2% (2.7-3.7)	2.8% (0.8-6.8)	
Health Service Utilization				

Emergency Department Encounter, Count <small>*12 months prior to survey completion</small>	None, 0	87.2% (85.9-88.3)	81.8% (74.5-87.8)	0.0098
	1	9.6% (8.5-10.7)	12.6% (7.6-19.2)	
	2-5	3.1% (2.6-3.7)	4.2% (1.7-8.5)	
	6 or more	0.2% (0.1-0.3)	1.4% (0.1-6.1)	
Inpatient Hospitalization Encounter, Count <small>*12 months prior to survey completion</small>	None, 0	95.7% (94.9-96.4)	93.5% (87.8-97.1)	0.1184
	1	3.2% (2.6-3.8)	5.8% (2.4-11.6)	
	2-5	1.1% (0.7-1.5)	0.7% (0.1-2.0)	
	6 or more	0.0% (0.0-0.1)	0.0% (0.0-0.8)	

%, percent; CI, confidence interval; SD, standard deviation

¹ Unweighted n = 9,785 patients; Survey respondents that completed the initial survey were eligible (n=10,226). NSNS data were merged with electronic health records (EHR) using a unique member ID (100% match). EHR data from January 2019 through July 2023 were extracted and included the following domains: acute care utilization, membership enrollment periods, health outcomes, and demographics. After exclusions, the final analytic study cohort included 9,785 adults with complete data. Exclusions ranged from 3.1% – 6.2% of the regional samples.

² Unweighted n = 489 patients; Exclusion criteria included: 1) those not enrolled in health plan at time of the first survey completion (allowing time for utilization to occur; 30-day lapse in coverage permitted) (n=338); and 2) those with incomplete data for social risk variables or covariates (n=151). Exclusions ranged from 3.1% – 6.2% of the regional samples.

³ Any social risk defined as screening positive for one or more social risk factors including housing instability, food insecurity, and/or financial strain (Supplemental Table 1).

eTable 3. Rate of Acute Care Utilization (ED Visits and Hospitalizations) by level of social risk exposure among weighted analytic cohort (supporting Figure 1).²

Social Risk Factors	Social Risk Level	Hospitalizations	ED Visits
		Rate (95% CI) ¹	Rate (95% CI) ¹
Any Financial Strain, Housing Instability, Food Insecurity	Social Risk	40.6 (35.2 – 46.9)	115.0 (104.3 – 126.8)
	None (ref)	33.8 (29.2 – 39.1)	86.9 (78.6 – 96.1)
Housing Instability	Social Risk	47.2 (36.4 – 61.1)	134.6 (115.4 – 157.0)
	None (ref)	35.4 (31.7 – 39.4)	94.5 (87.3 – 102.3)
Food Insecurity	Social Risk	44.4 (36.6 – 53.9)	124.6 (110.2 – 140.8)
	None (ref)	34.2 (30.3 – 38.7)	91.0 (83.7 – 99.0)
Financial Strain	Social Risk	40.2 (34.2 – 47.1)	118.5 (107.2 – 131.0)
	None (ref)	35.0 (30.5 – 40.1)	87.9 (80.0 – 96.7)

¹ Rate per 1,000 person years

² Unweighted n = 9,785 adults

eTable 4. Sensitivity Analysis: Adjusted hazard ratios (HR) of emergency department (ED) visits by social risk factors; with and without race and ethnicity included in final adjusted model.¹

Social Risk Factors	Social Risk Level	ED Visits	
		Adjusted Model (presented in manuscript)	Adjusted Model - Race and Ethnicity Removed
		HR (95% CI)	HR (95% CI)
Any Financial Strain, Housing Instability, Food Insecurity	Social Risk	1.21 (1.03 – 1.41)	1.21 (1.04 – 1.41)
	None	1.00 (Ref)	1.00 (Ref)
Financial Strain	Social Risk	1.20 (1.03 – 1.39)	1.20 (1.03 – 1.40)
	None	1.00 (Ref)	1.00 (Ref)
Housing Instability	Social Risk	1.31 (1.09 – 1.57)	1.30 (1.09 – 1.56)
	None	1.00 (Ref)	1.00 (Ref)
Food Insecurity	Social Risk	1.20 (1.02 – 1.40)	1.20 (1.03 – 1.40)
	None	1.00 (Ref)	1.00 (Ref)

¹ Model adjusted for individual-level sociodemographic factors (age group, sex, race and ethnicity, education, marital status) and health status factors (self-rated physical health, comorbidities). Covariates excluded from final analytic model after collinearity testing include insurance type, income level, employment status, self-reported mental health status.

CI, confidence intervals; HR, hazard ratios; ED emergency department

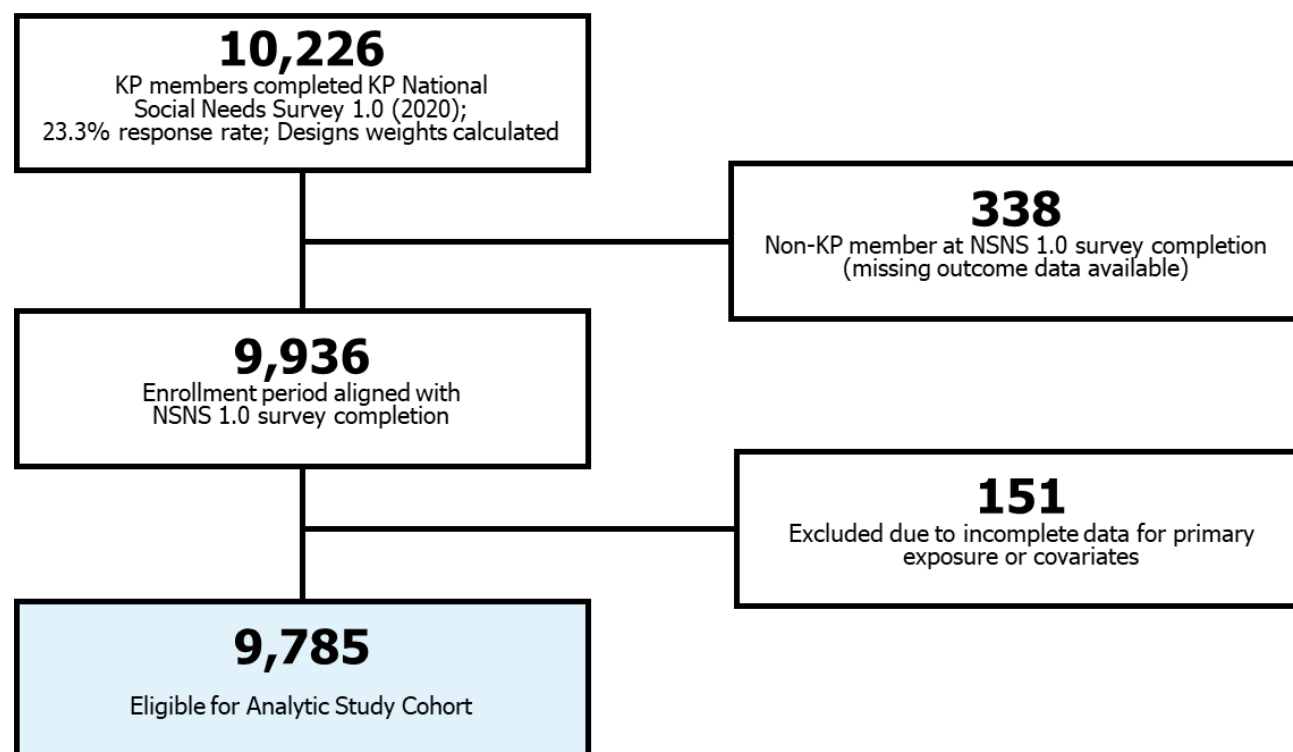
eTable 5. Sensitivity Analysis: Adjusted hazard ratios (HR) of hospitalizations by social risk factors; with and without race and ethnicity included in final adjusted model.¹

Social Risk Factors	Social Risk Level	Hospitalizations	
		Adjusted (presented in manuscript)	Adjusted Model - Race and Ethnicity Removed
		HR (95% CI)	
Any Financial Strain, Housing Instability, Food Insecurity	Social Risk	1.05 (0.84 – 1.32)	1.02 (0.82 – 1.28)
	None (ref)	1.00 (Ref)	1.00 (Ref)
Financial Strain	Social Risk	1.01 (0.81 – 1.26)	0.99 (0.79 – 1.23)
	None (ref)	1.00 (Ref)	1.00 (Ref)
Housing Instability	Social Risk	1.28 (0.94 – 1.74)	1.24 (0.91 – 1.68)
	None (ref)	1.00 (Ref)	1.00 (Ref)
		1.00 (Ref)	1.00 (Ref)
Food Insecurity	Social Risk	1.05 (0.81 – 1.35)	1.02 (0.79 – 1.30)
	None (ref)	1.00 (Ref)	1.00 (Ref)

¹ Model adjusted for individual-level sociodemographic factors (age group, sex, race and ethnicity, education, marital status) and health status factors (self-rated physical health, comorbidities). Covariates excluded from final analytic model after collinearity testing include insurance type, income level, employment status, self-reported mental health status.

CI, confidence intervals; HR, hazard ratios;

eFigure 1. CONSRT Diagram, unweighted cohort¹



Notes.

¹ 1.0 survey wave administered between January-September 2020, 9,785 respondents met inclusion criteria and were included in the analytic study cohort (unweighted sample). Approximately two years later, 2.0 survey wave was administered between June 2022-February 2023. Of the 9,785 survey respondent meeting eligibility criteria, 6,003 (61.3%) respondents completed the 2.0 survey (unweighted sample).