



The role of individual-level socioeconomic status measured by the HOUSES index on nursing home placement accounting for neighborhood characteristics

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Background

- While several factors such as physical and cognitive functions are important predictors for nursing home placement (NHP), it is also reported that social determinants of health (SDoH) affect the risk of NHP
- However, detailed SDoH information is typically not readily available in electronic health records (EHRs)

Objective

- By using the HOUSES index, we aim to examine whether an individual-level measure of SES (a key element of SDoH) is associated with the risk of NHP accounting for neighborhood characteristics

Methods

- Study design:** A population-based study based on Olmsted County, MN
 - Self-contained healthcare environment
 - Harmonized EHR data can be extracted via Rochester Epidemiology Project (REP)
- Study cohort**
 - Older Olmsted County residents (65+) as of 4/1/2012 (baseline date)
 - No prior history of NHP
- Outcome**
 - Any NHP identified through EHR until 4/30/2019
 - Used CPT codes for NHP (99304, 99305, 99306, 99307, 99308, 99309, 99310, 99315, 99316, and 99318)
- SES measures**
 - Individual-level SES:** the HOUSES index (in quartiles)
 - Q1: the lowest SES; Q4: the highest SES
 - Neighborhood-level SES:** national-level area deprivation index (ADI; in quartiles)
 - Q1: the highest SES; Q4: the lowest SES
- Statistical analysis**
 - Random effects Cox proportional hazard model used to test association between the HOUSES index and risk of NHP,
 - Adjusting for ADI and other pertinent confounders (e.g., age, and disease burden)
 - Logistic regression models used to test association between known NHP risk factors (living alone and problems for activities in daily living [ADL]),
 - Adjusting for ADI and other confounders

The HOUSES index

- The HOUSES (HOUSing-based index of SocioEconomic Status) index**
 - An individual-level measure reflecting current SES
 - Linking residential address with publicly available real property data
 - Housing value, size, the number of bedrooms and bathrooms
 - Higher HOUSES score, higher SES in a given county
 - Originally developed in Olmsted County, MN (a mixed urban-rural setting) and validated in Jackson County, MO (an urban setting)
 - Utilized to demonstrate health disparities by SES for 40+ health outcomes
- Offered services through the HOUSES Cloud
 - The HOUSES index
 - ADI
 - Rural classification
 - Distance to a reference point (e.g., clinic)
 - Geospatial report

Study cohort

	Overall cohort (N=15031)	Nursing home placement during follow-up duration		HR* (95% CI)
		Yes (N=3341)	No (N=11690)	
Age (years) at index date (4/1/2012)*				
Median (25 th - 75 th percentile)	73 (68-79)	79 (72-84)	71 (68-77)	1.11 (1.11-1.12)
Sex, n (%)				
Female	8215 (54.7%)	1997 (59.8%)	6218 (53.2%)	REF
Male	6816 (45.3%)	1344 (40.2%)	5472 (46.8%)	0.80 (0.74-0.85)
Race/Ethnicity group, n (%)				
Non-Hispanic Whites	13681 (91.4%)	3170 (94.9%)	10511 (90.4%)	REF
Other	1290 (8.6%)	169 (5.1%)	1121 (9.6%)	0.57 (0.49-0.67)
Missing	60 (0.4%)	2 (0.1%)	58 (0.5%)	0.19 (0.05-0.75)
HOUSES, n (%)				
Q1 (lowest SES)	3231 (23.6%)	1055 (34.7%)	2176 (20.4%)	3.09 (2.72-3.50)
Q2	4515 (33.0%)	1017 (33.4%)	3498 (32.8%)	1.83 (1.62-2.08)
Q3	3535 (25.8%)	653 (21.5%)	2882 (27.1%)	1.46 (1.27-1.67)
Q4 (highest SES)	2412 (17.6%)	317 (10.4%)	2095 (19.7%)	REF
Missing	1338 (8.9%)	299 (8.9%)	1039 (8.9%)	1.87 (1.60-2.20)
ADI* (national-level), n (%)				
Q1 (highest SES)	3766 (25.1%)	692 (20.7%)	3074 (26.3%)	REF
Q2	6043 (40.2%)	1272 (38.1%)	4771 (40.8%)	1.11 (0.91-1.34)
Q3	3378 (22.5%)	939 (28.1%)	2439 (20.9%)	1.60 (1.30-1.97)
Q4 (lowest SES)	795 (5.3%)	208 (6.2%)	587 (5.0%)	1.49 (1.12-2.00)
Missing	1049 (7.0%)	230 (6.9%)	819 (7.0%)	1.45 (0.62-3.40)

Association between SES and risk of NHP

- Model 1: Association of HOUSES with risk of NHP
- Model 2: Association of ADI with risk of NHP
- Model 3: Association of HOUSES with risk of NHP, adj for ADI

Characteristics	Model 1, HR (95% CI)	Model 2, HR (95% CI)	Model 3, HR (95% CI)
Age (years)	1.09 (1.09-1.10)	1.09 (1.09-1.10)	1.09 (1.09-1.10)
Gender			
Male	0.87 (0.80-0.93)	0.85 (0.79-0.91)	0.87 (0.81-0.94)
Female	REF	REF	REF
Race/Ethnicity			
Non-Hispanic White	REF	REF	REF
Others	0.63 (0.54-0.74)	0.62 (0.53-0.73)	0.61 (0.52-0.72)
Disease burden score (count)	1.16 (1.15-1.18)	1.16 (1.15-1.18)	1.16 (1.15-1.18)
HOUSES (quartiles)			
Q1 (lowest SES)	1.89 (1.66-2.15)	--	1.81 (1.57-2.10)
Q2	1.36 (1.20-1.55)	--	1.35 (1.17-1.55)
Q3	1.22 (1.07-1.40)	--	1.23 (1.07-1.41)
Q4 (highest SES)	REF	--	REF
ADI (quartiles)			
Q1 (highest SES)	--	REF	REF
Q2	--	1.05 (0.92-1.20)	0.96 (0.84-1.09)
Q3	--	1.30 (1.13-1.50)	1.09 (0.95-1.25)
Q4 (lowest SES)	--	1.40 (1.14-1.72)	1.10 (0.90-1.34)

Association between known NHP risk factors and HOUSES

HOUSES	Living situation			
	Living alone, n (%)	Others, n (%)	OR (95% CI), Model 1 (without ADI adjustment)	OR (95% CI), Model 2 (with ADI adjustment)
Q1 (lowest SES)	938 (43.4%)	1223 (56.6%)	6.35 (5.24-7.68)	5.75 (4.64-7.12)
Q2	717 (21.9%)	2557 (78.1%)	2.58 (2.14-3.12)	2.46 (2.01-3.01)
Q3	362 (13.8%)	2266 (86.2%)	1.57 (1.29-1.92)	1.50 (1.22-1.85)
Q4 (highest SES)	157 (8.5%)	1682 (91.5%)	REF	REF
HOUSES	ADL			
	At least one ADL difficulty, n (%)	No difficulties with ADL, n (%)	Model 1, OR (95% CI)	Model 2, OR (95% CI)
Q1 (lowest SES)	714 (33.7%)	1403 (66.3%)	2.38 (2.00-2.84)	2.17 (1.77-2.66)
Q2	664 (20.9%)	2518 (79.1%)	1.50 (1.26-1.77)	1.40 (1.16-1.69)
Q3	396 (15.5%)	2164 (84.5%)	1.14 (0.95-1.37)	1.08 (0.89-1.31)
Q4 (highest SES)	221 (12.4%)	1555 (87.6%)	REF	REF

Results

- During ~7 years of follow-up, ~22% of study subjects (median age: 73yrs) experienced at least one NHP
- Association of the HOUSES index with risk of NHP was much stronger, compared to the result of ADI, a neighborhood-level SES measure, was used.
- Accounting for pertinent confounders, the HOUSES index was strongly associated with risk of NHP
- Adjusting for neighborhood SES measured by ADI did not influence the association between the HOUSES index and risk of NHP
- Two known NHP risk factors (living alone and ADL) were strongly associated with the HOUSES; adjustment for ADI did not influence the association much

Conclusions

- Older adults with lower SES measured by the HOUSES index had higher risk of NHP, even accounting for neighborhood SES
- Association of the HOUSES index with risk of NHP was independent of ADI
- Older adults with lower SES were more likely to live alone and more problems doing activities of daily living
- This study demonstrates that an individual-level SES measure capturing current subject-specific socioeconomic circumstances play a significant role for predicting NHP independent of neighborhood characteristics where they reside
- This study suggests that older adults who are at risk of higher risk of NHP can be identified by utilizing the HOUSES index and potential individual-level intervention strategies can be applied to reduce the risk for those with higher risk

References

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