

Food Insecurity, Neighborhood, and Health Care Utilization in Health System Adults

Karen Distelhorst, PhD, APRN; Kristine Adams, MSN, CNP; and Rocio Lopez, MS, MPH

The burden of food insecurity is not equal across all populations and communities.¹⁻³ In 2020, 10.5% of American households (13.8 million) did not have the availability of or access to nutritionally adequate food due to lack of money or resources. However, food insecurity rates for states and counties vary widely, ranging from 5.7% to 15.3% for states and 6.3% to 36.8% for counties.⁴ Food insecurity has been associated with measures of socioeconomic status (household income, education)^{2,5} and population-level characteristics (race/ethnicity, primary language, food access).^{2,3,6} From a population health management perspective, the prevalence of food insecurity has implications for both individual and population health outcomes. However, limited research exists examining the relationships among food insecurity, neighborhood, and health care utilization (HCU).

Food Insecurity and HCU

Based on national databases, food-insecure adults have higher HCU as measured by hospitalizations, emergency department (ED) visits, and outpatient visits⁷⁻⁹ and are more likely to become high-cost users of health care.¹⁰ In one national study, health care spending was associated with food insecurity across states and counties, but results varied by location.¹ In contrast, an analysis of state-level data linked to Medicare claims revealed no significant differences in HCU (provider visits, inpatient visits, ED visits, and home health visits) based on food insecurity status among older adults in Georgia.¹¹ It is important to understand how these trends related to food insecurity and HCU in the general population translate to the local patient population within a health system.

Neighborhood Disadvantage

Neighborhood disadvantage has been associated with higher HCU and costs from encounters such as hospitalizations and ED visits at the national, state, and county levels.^{12,13} Researchers in Canada reported that neighborhood deprivation and instability, together with food insecurity as a household-level factor, had the greatest effect on the odds of future high-cost use of health care over time.¹⁰ Evidence supports an association among food insecurity,

ABSTRACT

OBJECTIVES: To (1) explore relationships among food insecurity, neighborhood disadvantage, and health care utilization in adults from a single health system and (2) determine whether food insecurity and neighborhood disadvantage predict acute health care utilization within 90 days of hospital discharge.

STUDY DESIGN: A retrospective, correlational design with a single cohort.

METHODS: Data were analyzed from health system administrative billing databases, electronic health records, and publicly available population databases. Multivariable negative binomial regression was performed to assess the association between factors of interest and acute health care utilization within 90 days of index hospital discharge.

RESULTS: In 41,566 records, 1.45% (n=601) of patients reported food insecurity. The mean (SD) Area Deprivation Index score was 54.4 (26), indicating that the majority of patients lived in disadvantaged neighborhoods. Patients with food insecurity were less likely to have a provider office visit ($P < .001$) but were expected to have 2.1 times greater acute health care utilization within 90 days [incidence rate ratio [IRR], 2.12; 95% CI, 1.90-2.37; $P < .001$] compared with those without food insecurity. Living in a disadvantaged neighborhood had a small effect on acute health care utilization (IRR, 1.12; 95% CI, 1.08-1.17; $P < .001$).

CONCLUSIONS: When considering social determinants of health for health system patients, food insecurity was a stronger predictor of acute health care utilization than was neighborhood disadvantage. Identifying patients with food insecurity and targeting appropriate interventions to high-risk populations may improve provider follow-up and acute health care utilization.

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neighborhood disadvantage, and HCU, but additional research is needed to understand these phenomena for local populations served by a health system.

Purpose and Aims

The purpose of this study was to understand if the presence of neighborhood disadvantage and food insecurity were associated with greater rate of acute HCU for health system patients. The aims of this study were to (1) explore the relationships among food insecurity, neighborhood disadvantage, and HCU in an adult cohort that received care within a single health system and (2) determine whether food insecurity and neighborhood disadvantage predict acute HCU within 90 days of hospital discharge.

METHODS

The study used a retrospective, correlational design with a single cohort. The setting was 9 hospitals (1 quaternary care medical center, 8 regional hospitals) serving 6 counties as part of a large health system within Northeast Ohio. The health system institutional review board approved the study as exempt research, using protected health information as regulated by the Health Insurance Portability and Accountability Act only for the identification of records and to link publicly available data.

Sample

The sample included records of adult patients (18 years and older) residing in Ohio who were hospitalized and received primary care within the health system from October 1, 2017, to September 1, 2019. Because the data spanned 2 years, patient records were included based on the first index hospitalization in which they were discharged to the home setting. Sources of data included health system administrative billing databases, electronic health records, and publicly available population databases.

Variables

The primary outcome variable was *acute HCU*, defined as a patient's total number of inpatient admissions, ED visits not resulting in admission, and outpatient observation admissions within 90 days after the index hospital discharge. *Ambulatory care encounters* included the number of outpatient office visits with a licensed independent provider (LIP) and the number of telephone encounters with a nurse that occurred after index hospital discharge; these were considered as covariables and not calculated as part of acute HCU. Data for HCU and ambulatory care encounters were obtained from health system administrative billing databases.

We analyzed food insecurity and neighborhood disadvantage as key predictor variables. *Food insecurity* was defined as a self-report of having food insecurity at any admission during the study period

TAKEAWAY POINTS

Health system patients with food insecurity need targeted assessment and interventions related to food insecurity and access to health care.

- ▶ Patients with food insecurity were less likely to have a provider visit after hospitalization than those without food insecurity.
- ▶ Patients with food insecurity were expected to have 2.1 times greater acute health care utilization within 90 days of hospital discharge than those without food insecurity.
- ▶ Food insecurity was a stronger predictor of acute health care utilization than was neighborhood disadvantage.

based on an answer of yes to at least 1 of 2 screening questions: (1) In the last month, have you had trouble getting food? and (2) During the last month, have you worried whether your food would run out before you had enough money to buy more? The validated 2-item food insecurity screen¹⁴ was used by care managers as part of their admission assessment. Additional text responses documented as part of the assessment were considered when coding responses as yes, no, or unable to determine (**eAppendix** [available at ajmc.com]). All food insecurity data were extracted from the electronic health record.

Neighborhood disadvantage was defined as residence in an area of high socioeconomic deprivation, based on the address of record at the time of the index admission. Neighborhood disadvantage was measured using the 2015 Area Deprivation Index (ADI) version 2.0,¹⁵ which is a factor-based deprivation index of 17 indicators of poverty, education, housing, and employment from US Census data. The ADI has been validated at the Census block group level¹⁶ and reported as predictive for hospital readmission and observation admissions.¹⁶⁻¹⁸

Additional population-level measures assessed included household income and food access. *Median household income* in the past 12 months was extracted from the American Community Survey using 2017 5-year estimates at the Census block group tabulation area level.¹⁹ *Low food access area* indicators were downloaded from the Food Access Research Atlas. A low food access area was defined as a Census tract that is low income and in which at least 100 households are more than half a mile from a supermarket and have no access to a vehicle, or at least 500 people or 33% of the population live more than 20 miles from a supermarket, regardless of vehicle.²⁰

Demographic variables included age, sex, race, insurance, primary diagnosis at index admission, length of stay, and discharge disposition. *Comorbidity* was measured using the Elixhauser comorbidity index for readmission based on the *International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM)* codes at the time of admission. The index program transforms the 29 Elixhauser comorbidity variables from the original measures into a single comorbidity index score calculated as a weighted sum of each of the binary comorbidity variables in the administrative data.²¹

Data Collection

We screened 121,693 patient records for inclusion. Patients who did not reside in Ohio (n=13,158), were receiving total parenteral nutrition or enteral feedings (n=41), were not assessed for food

TABLE 1. Index Admission Characteristics^a

	Total (N = 41,566)	No FI reported (n = 40,965)	FI reported (n = 601)	P
Age in years at admission, mean (SD)	64.4 (16.0)	64.5 (16.0)	57.7 (14.2)	<.001^b
Age group in years, n (column %)				<.001^c
18-64	18,906 (45.5)	18,490 (45.1)	416 (69.2)	
≥ 65	22,660 (54.5)	22,475 (54.9)	185 (30.8)	
Female gender, n (column %)	22,350 (53.8)	21,997 (53.7)	353 (58.7)	.014^c
Race, n (column %)				<.001^c
White	30,354 (73.0)	30,052 (73.4)	302 (50.2)	
Black	8903 (21.4)	8643 (21.1)	260 (43.3)	
Other/multiracial	1089 (2.6)	1063 (2.6)	26 (4.3)	
Unknown	1220 (2.9)	1207 (2.9)	13 (2.2)	
Expected payer, n (column %)				<.001^c
Medicaid	4577 (11.0)	4366 (10.7)	211 (35.1)	
Medicare	23,901 (57.5)	23,587 (57.6)	313 (52.1)	
Private	12,016 (28.9)	11,961 (29.2)	55 (9.2)	
Self-pay	733 (1.8)	714 (1.7)	19 (3.2)	
Other	339 (0.82)	336 (0.82)	3 (0.50)	
Readmission comorbidity index, median (IQR)	14.0 (4.0-28.0)	14.0 (4.0-28.0)	24.0 (13.0-36.0)	<.001^d
Length of stay in days, median (IQR)	3.0 (2.0-5.0)	3.0 (2.0-5.0)	3.0 (2.0-5.0)	<.001^d
Discharge disposition, n (column %)				.032^e
Home	30,208 (72.7)	29,748 (72.6)	460 (76.5)	
Home health	11,358 (27.3)	11,217 (27.4)	141 (23.5)	
Primary diagnosis, n (column %)				
Asthma	331 (0.80)	327 (0.80)	4 (0.67)	.99 ^e
COPD	1241 (3.0)	1191 (2.9)	50 (8.3)	<.001^c
Diabetes	888 (2.1)	866 (2.1)	22 (3.7)	.009^c
Hypertension	2365 (5.7)	2322 (5.7)	43 (7.2)	.12 ^c
Heart failure	2012 (4.8)	1980 (4.8)	32 (5.3)	.58 ^c
Chronic kidney disease	213 (0.51)	210 (0.51)	3 (0.50)	.99 ^e

COPD, chronic obstructive pulmonary disease; FI, food insecurity.

^aP values in bold are < .05.

^bSatterthwaite *t* test.

^cPearson χ^2 test.

^dWilcoxon rank sum test.

^eFisher exact test.

insecurity by a care manager (n = 24,173), or did not receive routine care within the health system (n = 42,755) were excluded.

Patient addresses at the time of index admission were geocoded to Census block groups using PROC GEOCODE in SAS version 9.4 (SAS Institute), which links to the US 2018 street lookup data from the Census Bureau. Measures of geographic risk were downloaded from the population databases and linked to each record by geographic identifiers. ICD-10-CM codes at the time of the index admission were used to identify primary diagnoses of asthma, chronic obstructive pulmonary disease (COPD), diabetes, hypertension, heart failure, and chronic kidney disease. Primary diagnoses were also grouped into clinical categories; all categories with less than 5% of patients were combined into a single “other conditions” category.

Statistical Analysis

Normally distributed continuous measures were summarized using means and SDs and compared between patients with and without food insecurity using *t* tests. Nonnormally distributed continuous and ordinal measures were summarized using medians with 25th and 75th percentiles and compared using Wilcoxon rank sum tests. Categorical factors were summarized using frequencies and percentages and compared using Pearson's χ^2 tests.

Negative binomial regression was performed to assess the association between factors of interest and HCU within 90 days of index hospital discharge. Separate models were built for food insecurity, neighborhood disadvantage, and low food access area because these factors were highly correlated with each other. Other variables included in each model were sex, age, race, primary payer, asthma, COPD, diabetes, hypertension, heart failure, chronic kidney disease, readmission comorbidity index, and length of stay during index admission. Because transitional care management after hospital discharge is an established practice to decrease readmission rates,²² we also controlled for LIP office visits and telephone encounters with a nurse within 90 days after the index hospital discharge.

Data were missing for the following variables: race (3%), median household income (8.4%), ADI (7.9%), and low food access area (7.5%). We used multiple imputation with the fully conditional specification method to impute 5 complete data sets. The multiple imputation included the following variables: sex, age, race, primary payer, asthma, COPD, diabetes, hypertension, heart failure, chronic kidney disease, readmission comorbidity index, length

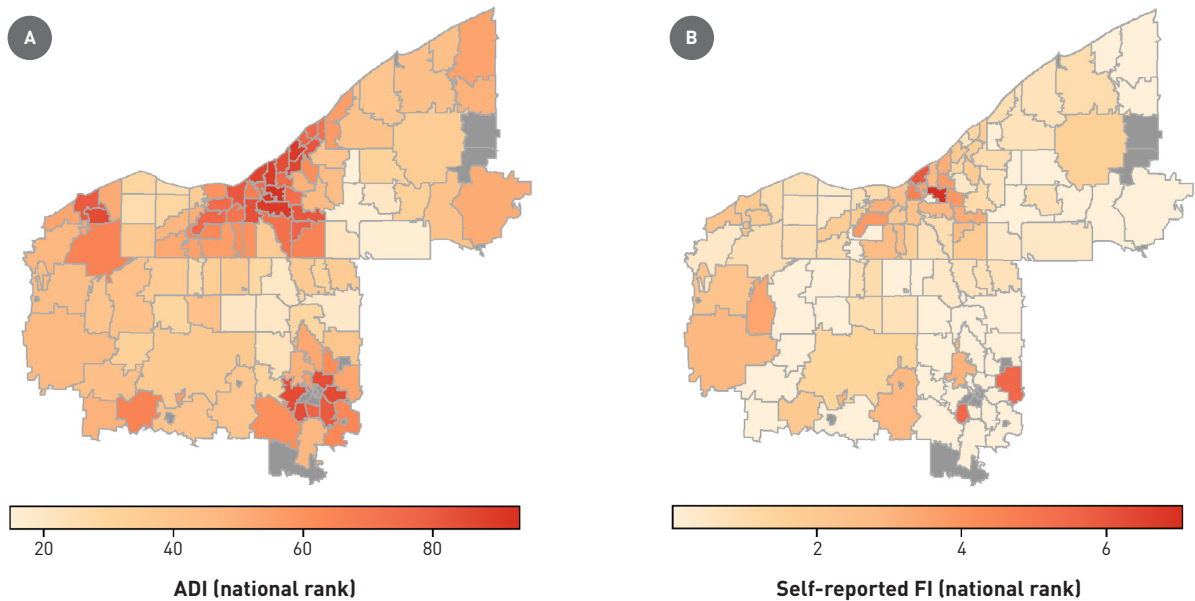
of stay, and report of food insecurity. Multivariable models were fitted on each of the imputed data sets, and parameter estimates were aggregated. Analyses were performed using SAS version 9.4, and a significance level of .05 was used.

RESULTS

Sample Characteristics

Records from a total of 41,566 patients who met inclusion criteria were included in the analysis. The mean (SD) age was 64.4 (16.0) years, with more than half (54.5%) in the 65 years or older category. Overall, 53.8% were female, 24% were of non-White race, and 27.3% were discharged with home health care (Table 1).

FIGURE. ADI and FI Maps for Study Sample*



ADI, Area Deprivation Index; FI, food insecurity.

*Maps are at the zip code level. Gray areas represent zip codes with fewer than 10 patients.

TABLE 2. Use of Food Stamps, ADI, and Residence in Low Food Access Area*

Factor	Overall (N = 41,566)		No FI reported (n = 40,965)		FI reported (n = 601)		P
	N missing	Statistics	N missing	Statistics	N missing	Statistics	
Report of food stamp use (during study period), n (column %)	0	123 (0.30)	0	75 (0.18)	0	48 (8.0)	<.001^b
Median household income in 2017 US\$, median (IQR)	3491	58,036.0 [39,669.0-79,896.0]	3416	58,333.0 [39,813.0-80,208.0]	75	37,691.0 [26,296.0-54,886.0]	<.001^c
ADI (national rank), mean (SD)	3303	54.4 (26.0)	3231	54.2 (26.0)	72	72.0 (22.7)	<.001^d
ADI (national rank) ≥ 85, n (column %)	3303	6823 (17.8)	3231	6614 (17.5)	72	209 (39.5)	<.001^e
ADI (national rank) ≥ 50, n (column %)	3303	21,020 (54.9)	3231	20,593 (54.6)	72	427 (80.7)	<.001^e
Resides in low food access Census tract, n (column %)	3113	5188 (13.5)	3047	5038 (13.3)	66	150 (28.0)	<.001^e

ADI, Area Deprivation Index; FI, food insecurity.

*P values in bold are < .05.

^bFisher exact test.

^cWilcoxon rank sum test.

^dSatterthwaite t test.

^ePearson χ^2 test.

Only 1.45% (n = 601) of the sample reported food insecurity and the mean (SD) ADI was 54.4 (26), indicating that most patients lived in disadvantaged neighborhoods (Figure and Table 2). Further, 17.8% (n = 6823) of patients lived in highly disadvantaged neighborhoods (the top 15th percentile). For total acute HCU, 32.2% (n = 13,404) of the sample had 1 or more encounters within 90 days of the index hospital discharge (Table 3).

Characteristics of Patients With Food Insecurity

Overall, patients with food insecurity were more likely to be younger, female, and non-White and to receive Medicaid compared with food-secure patients (Table 1). Although 21.4% of the sample was non-White, which mirrors the local population, this group accounted for 43.3% of those with food insecurity. Food-insecure patients also had higher comorbidity and lived in areas of greater neighborhood

TABLE 3. HCU Within 90 Days of Index Hospital Discharge^a

	Total (N = 41,566)	No FI (n = 40,965)	FI reported (n = 601)	P
Acute HCU, n (column %)				
Inpatient admissions				<.001^b
0	34,634 (83.3)	34,248 (83.6)	386 (64.2)	
1	5446 (13.1)	5297 (12.9)	149 (24.8)	
2	1138 (2.7)	1099 (2.7)	39 (6.5)	
3	259 (0.62)	239 (0.58)	20 (3.3)	
≥4	89 (0.21)	82 (0.20)	7 (1.2)	
Observation admissions				<.001^b
0	38,660 (93.0)	38,152 (93.1)	508 (84.5)	
1	2583 (6.2)	2511 (6.1)	72 (12.0)	
2	260 (0.63)	244 (0.60)	16 (2.7)	
3	49 (0.12)	45 (0.11)	4 (0.67)	
≥4	14 (0.03)	13 (0.03)	1 (0.17)	
ED visits				<.001^b
0	34,599 (83.2)	34,191 (83.5)	408 (67.9)	
1	5326 (12.8)	5216 (12.7)	110 (18.3)	
2	1137 (2.7)	1093 (2.7)	44 (7.3)	
3	281 (0.68)	268 (0.65)	13 (2.2)	
≥4	223 (0.54)	197 (0.48)	26 (4.3)	
Total HCU				<.001^b
0	28,162 (67.8)	27,917 (68.1)	245 (40.8)	
1	8560 (20.6)	8395 (20.5)	165 (27.5)	
2	2972 (7.2)	2887 (7.0)	85 (14.1)	
3	1074 (2.6)	1034 (2.5)	40 (6.7)	
≥4	798 (1.9)	732 (1.8)	66 (11.0)	
Ambulatory encounters, n (column %)				
Office visits with LIP				<.001^b
0	6761 (16.3)	6571 (16.0)	190 (31.6)	
1	6948 (16.7)	6862 (16.8)	86 (14.3)	
2	7409 (17.8)	7329 (17.9)	80 (13.3)	
3	6463 (15.5)	6385 (15.6)	78 (13.0)	
≥4	13,985 (33.6)	13,818 (33.7)	167 (27.8)	
Telephone encounters with nurse				.022 ^b
0	28,004 (67.4)	27,612 (67.4)	392 (65.2)	
1	7682 (18.5)	7602 (18.6)	80 (13.3)	
2	2685 (6.5)	2635 (6.4)	50 (8.3)	
3	1097 (2.6)	1071 (2.6)	26 (4.3)	
≥4	2098 (5.0)	2045 (5.0)	53 (8.8)	

ED, emergency department; FI, food insecurity; HCU, health care utilization; LIP, licensed independent provider.

^aP values in bold are < .05. Total HCU is defined as patient's total number of inpatient admissions, outpatient observation admissions, and ED visits not resulting in admission within 90 days after index hospital discharge.

^bWilcoxon rank sum test.

disadvantage. For 90-day postdischarge HCU (Table 3), food-insecure patients had significantly higher rates of inpatient readmissions, observation admissions, and ED visits than food-secure patients. For ambulatory care encounters, patients with food insecurity had a higher rate of telephone encounters with a nurse, but lower rate of office visits with a LIP within 90 days; 31% had no outpatient LIP visit, compared with 16% of those without food insecurity ($P < .001$).

Predictors of HCU

In 3 separate multivariable negative binomial regression models (controlling for demographic variables, transitional care, and comorbidity), food insecurity and neighborhood disadvantage were associated with increased HCU (Table 4), but residence in a low-access Census tract was not (results not shown). Patients with food insecurity had a rate of HCU within 90 days that was 2.1 times greater than that of patients without food insecurity. Living in a disadvantaged neighborhood ($ADI \geq 50$ vs < 50) had only a small effect on HCU.

Other variables in the food insecurity model (Table 4: model 1) associated with increased HCU included non-White race, type of insurance, COPD as a primary diagnosis, and readmission comorbidity index. For each 10-year increment in age at index admission, HCU was expected to decrease by 12%. Additionally, having 1 or 2 office visits with a LIP within 90 days of discharge, compared with none, was associated with decreased HCU (10% and 9% for 1 and 2 visits, respectively). Having 1 telephone encounter with a nurse, compared with none, also decreased HCU by 7%. However, having more LIP visits and telephone encounters was associated with a greater rate of HCU than having no encounters.

DISCUSSION

The rate of food insecurity (1.6%) in this study was much lower than reported rates of food insecurity in the general community of Northeast Ohio. The 2018 rate of food insecurity for the counties included in our sample ranged from 9.0% to 15.9%.²³ However, local population estimates utilize the US Department of Agriculture Core Food Security Module, which reflects food insecurity in the past 12 months²⁴; we measured food insecurity based on the past 30 days. Few studies have examined food insecurity prevalence within a health system population. In one study, 5.7% of health system older adults reported food insecurity when asked a single question: "Do you always have enough money to buy the food you need?"²⁵

Food insecurity has been reported to significantly increase risk of health care access hardship in a national sample.²⁶ For health system patients, food insecurity can affect both ambulatory and acute HCU. We found that patients with food insecurity had more acute HCU while having less provider follow-up in the 90 days post hospital discharge. These findings are similar to those of studies in the general adult population. Food insecurity has been reported as being significantly associated with more ED visits, hospitalizations, and days hospitalized after adjusting for demographics, education,

income, health insurance, region, and rural residence.¹ Additionally, in a sample of lower-income adults, food insecurity was associated with both increased hospitalization and having no usual source of care.²⁷

Even in the presence of chronic disease and comorbidity, food insecurity is an important indicator in the risk of increased acute HCU after hospitalization. Because our sample was composed of patients who were active with a primary care provider, we included common ambulatory care-sensitive conditions as primary admission diagnoses in our analysis (asthma, COPD, diabetes, hypertension, heart failure, and chronic kidney disease). We found that COPD, hypertension, heart failure, and chronic kidney disease were associated, along with food insecurity, with increased risk of HCU. In the final adjusted model, only COPD was significant, and food insecurity remained a strong predictor of utilization. These results differ slightly from those of a national study in which researchers reported that ED utilization was positively associated with food insecurity when chronic conditions were considered, but outpatient and inpatient utilization were not.⁹

We found that neighborhood disadvantage was significantly associated with increased acute HCU after hospital discharge, but the effect was small. Our predictor variable was living in a disadvantaged neighborhood (ADI ≥ 50). Higher levels of neighborhood disadvantage might have a greater effect on HCU. In a study of Medicare beneficiaries in Maryland, HCU rates were greatest for those in the most disadvantaged (fifth quintile) neighborhoods compared with those in the least disadvantaged (first quintile).²⁸ Additionally, in a national study, those in the most disadvantaged neighborhoods had lower health care cost but higher HCU (ED visits and hospitalizations).¹³

Currently, population-level data are not available to most health system providers, and screening for social determinants of health is not yet a standard of practice. More research is needed to determine the value of adding population-level data to patients' medical records, as these types of updates may be costly and complex. Assessment for food insecurity, on the other hand, can be relatively easy to incorporate into medical record documentation.

Practice Implications

Our findings have important implications for the transitional care of hospitalized health system patients. Conditions that contribute to food insecurity can rapidly change, so screening should be a standard part of inpatient documentation and addressed in the discharge plan

of care for all patients. However, one health system reported lack of knowledge and experience, along with time constraints, as barriers to food insecurity screening in acute care/ED settings.²⁹ An effective program for food insecurity screening and intervention should include training for nurses, LIPs, and hospitalists in collaboration with social workers. A standardized protocol and screening tool, along with training, can help to normalize the assessment for patients and decrease hidden bias for caregivers.

In a national survey of health care entities with formal programs for food insecurity screening and intervention, the most common actions implemented were to provide a list of food resources, referral to case management, referrals to food resources, and assistance with application for federal health benefits.³⁰ For transitional care to be effective when addressing food insecurity for health system patients, community partnerships need to be established with procedures for efficient referrals. Hospitalized patients with food insecurity face challenges in access to care after discharge, so patient education and active handoff to resources is essential. Navigation during the

TABLE 4. Factors Associated With Health Care Utilization: Multivariable Negative Binomial Regression^a

Factor	Model 1 ^b		Model 2 ^b	
	IRR (95% CI)	P	IRR (95% CI)	P
Age at admission (per 10 years)	0.88 (0.87-0.89)	<.001	0.88 (0.86-0.89)	<.001
Male vs female	1.01 (0.98-1.05)	.4	1.00 (0.97-1.04)	.89
Race: Black vs White	1.24 (1.19-1.29)	<.001	1.21 (1.15-1.26)	<.001
Race: other/multiracial vs White	1.13 (1.02-1.25)	.022	1.12 (1.01-1.25)	.036
Expected payer: Medicaid vs private	1.65 (1.56-1.75)	<.001	1.67 (1.57-1.78)	<.001
Expected payer: Medicare vs private	1.47 (1.39-1.54)	<.001	1.45 (1.38-1.53)	<.001
Expected payer: other vs private	1.41 (1.25-1.60)	<.001	1.43 (1.26-1.63)	<.001
Expected payer: self-pay vs private	1.28 (1.05-1.57)	.015	1.20 (0.97-1.49)	.092
COPD ^c	1.14 (1.04-1.25)	.007	1.14 (1.03-1.26)	.01
Comorbidity index (per 5 units)	1.06 (1.05-1.06)	<.001	1.06 (1.05-1.06)	<.001
Length of stay (days)	1.01 (1.01-1.02)	<.001	1.01 (1.01-1.02)	<.001
Office visits with LIP				
1 vs 0	0.90 (0.85-0.96)	.001	0.90 (0.84-0.96)	.001
2 vs 0	0.91 (0.85-0.96)	.002	0.89 (0.84-0.96)	<.001
3 vs 0	1.09 (1.02-1.16)	.01	1.07 (1.00-1.15)	.039
≥ 4 vs 0	1.61 (1.53-1.70)	<.001	1.62 (1.53-1.71)	<.001
Telephone encounters with nurse				
1 vs 0	0.93 (0.89-0.98)	.005	0.94 (0.90-0.99)	.018
2 vs 0	1.54 (1.45-1.64)	<.001	1.56 (1.46-1.67)	<.001
3 vs 0	1.86 (1.70-2.04)	<.001	1.92 (1.75-2.11)	<.001
≥ 4 vs 0	2.06 (1.93-2.20)	<.001	2.08 (1.94-2.23)	<.001
Self-reported food insecurity	2.12 (1.90-2.37)	<.001	—	—
ADI (national rank) ≥ 50 vs < 50	—	—	1.12 (1.08-1.17)	<.001

ADI, Area Deprivation Index; COPD, chronic obstructive pulmonary disease; IRR, incidence rate ratio; LIP, licensed independent provider.

^aP values in bold are < .05.

^bAlso controlled for first diagnosis of asthma, diabetes, hypertension, heart failure, and chronic kidney disease but not shown.

^cFirst diagnosis.

immediate postdischarge period should facilitate communication among patients, community services, and providers to ensure that food needs are addressed and appropriate follow-up care is received.

Limitations

A limitation of this study is the use of retrospective data from the medical record to determine food insecurity because the intent of the screening was for clinical use, not research. To account for this, additional text responses documented as part of the screening were considered to determine appropriate coding of the food insecurity variable (eAppendix). From all eligible patient records (n = 108,494), 77.7% had an assessment for food insecurity. In our analysis, we included only those patients who were assessed for food insecurity during hospitalization. We did not account for differences between hospitalized patients who were assessed for food insecurity and those who were not. Also, it is possible the “no food insecurity” group might contain food-insecure patients who did not feel comfortable with the questions, which may attenuate our findings.

All admission data and dates of health services for the study were obtained from health system administrative billing databases. A limitation of this method is potentially missing HCU in hospitals outside of the health system. This risk was minimized by including only those patients attributed to a health system primary care provider. Otherwise, administrative data for dates of health services and inpatient medical claims have been considered accurate due to financial implications for organizations and are a robust research tool.³¹

CONCLUSIONS

When considering social determinants of health that may affect HCU for health system patients, food insecurity was a stronger predictor of acute HCU in the 90 days after hospital discharge than was neighborhood disadvantage. Most health care professionals within a health system do not have easy access to neighborhood or population data. However, food insecurity can be easily screened for in the acute care setting. A standardized protocol for food insecurity screening, community referrals, and navigation to ensure that food needs are met may improve provider follow-up and acute HCU for hospitalized health system patients. ■

Author Affiliations: Office of Nursing Research & Innovation (KD), Care Management & Ambulatory Services (KA), and Center for Populations Health Research/Quantitative Health Science (RL), Cleveland Clinic, Cleveland, OH.

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Address Correspondence to: Karen Distelhorst, PhD, APRN, Office of Nursing Research & Innovation, Cleveland Clinic, 9500 Euclid Ave/T4-48, Cleveland, OH 44164. Email: distelk@ccf.org.

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eAppendix. Food Insecurity Definition

Food insecurity status was determined as yes or not based on patient response to the following questions: a) in the last month, have you had trouble getting food? and b) during the last month, have you worried whether your food would run out before you had enough money to buy more? Additional text responses documented as part of the assessment were considered when coding food insecurity responses as yes, no, or unable to determine.

1. No category

- a. If phrase starts with “No trouble getting food” or “No” for runs out. This is regardless of comment that follows which can sometimes be contradictor.
- b. Food provided at nursing facility, group home, etc. (unless they say it’s not enough or group home does not follow health restrictions for diet)
- c. Declined resources.

2. Yes category

- a. If the phrase started with “Yes”. This is regardless of comment that follows which can sometimes be contradictory.
- b. If they state they are applying for food stamps or are interested in applying
- c. If they state going to food banks to supplement supply
- d. Receive food stamps but state it is not enough or amount recently reduced
- e. Phrases as “gets food here and there”
- f. Said no but expressed worry because of job loss
- g. Referred to/has info for resources, 211.
- h. Reported being homeless.

3. On tube feeding – Subjects excluded

- a. Report being on TPN, formula, PEG tube, etc.

4. Unable to determine – Subjects excluded

- a. Either explicitly stated or phrase is not clear
- b. Say they get food stamps but no clear mention of whether that is enough