Food Insecurity as a Social Determinant of 30-Day Congestive Heart Failure Readmissions

Alison Blodgett, Jonathan Guerrero PharmD, Baraka Muvuka PhD

Indiana University School of Medicine- Northwest (IUSM-NW)

Introduction

- Around 6.7 million American adults have heart failure, costing the healthcare system over $30 billion annually.[1]
- Around 20-25% of heart failure hospitalizations result in a readmission within 30 days,[2] and readmissions are a primary contributor to heart failure care costs.[3]
- The Hospital Readmissions Reduction Program (HRRP) aims to reduce readmission rates for conditions such as heart failure by monitoring and giving financial penalties to hospitals exceeding expected readmission rates.[1]
- Heart failure readmission rates have been the primary driver of penalties in the HRRP.[4]

Research Question

- Previous research on factors contributing to heart failure readmissions has focused along three broad domains: demographic characteristics (e.g., race, ethnicity),[5] social risk factors (e.g., living arrangement, social support),[6] and/or health behaviors and characteristics (e.g., medical history, self-care, lifestyle choices).[7]
- While many studies focus on a few variables from one or two domains, the current study integrates many social determinants from all three domains to explore the following question:

What are the impacts of social determinants of health on 30-day readmissions for congestive heart failure?

Materials & Methods

- Research framework: Participatory Research
- Study Design: Retrospective
- Data Collection: Routine SDOH screenings in Epic using the Protocol for Responding to and Assessing Patients' Assets, Risks, and Experiences (PRAPARE)[8] for all inpatient admissions in 3 urban hospitals in Northwest Indiana between January 2021 – April 2024
- Data Analysis:
  - IBM SPSS V. 29.0
  - Descriptive statistics: frequencies, measures of central tendency
  - Bivariate analysis (p<.05): Chi-Square
  - Multivariate Analysis (p<.05): Binary Logistic Regression
- IRB #14040 (Exempted 1/28/2022)

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Results

Tables 1.1-1.3 Descriptive Statistics and Bivariate Analysis (N=5,489)

Table 1.1 Demographic Characteristics

		30-Day Readmission		
		Yes (N = 1,232)	No (N = 4,257)	
Variables	**Count (%)/Median (IQR)**	**Count (%)**		***p*-value**
Age	73.0 (18.0)	73.0 (18.0)	73.0 (18.0)	.298
18-24	5 (0.1%)	0 (0.0%)	5 (0.1%)	
25-39	120 (2.2%)	24 (1.9%)	96 (2.3%)	
40-49	220 (4.0%)	38 (3.1%)	182 (4.3%)	
50-64	961 (17.5%)	222 (18.0%)	739 (17.4%)	
65-74	1434 (26.1%)	316 (25.6%)	1118 (26.3%)	
75+	2749 (50.1%)	632 (51.3%)	2117 (49.7%)	
Ethnicity				**.003**
Not Hispanic	4941 (90.0%)	1082 (87.8%)	3859 (90.7%)	
Hispanic	546 (10.0%)	150 (12.2%)	396 (9.3%)	
Race				.183
American Indian and Alaska Native	10 (0.2%)	2 (0.2%)	8 (0.2%)	
Asian	10 (0.2%)	3 (0.2%)	7 (0.2%)	
Black or African American	1,453 (26.5%)	331 (26.9%)	1122 (26.4%)	
Native Hawaiian				
Other Pacific Islander	3 (0.1%)	2 (0.2%)	1 (0.0%)	
White or Caucasian	3,504 (63.8%)	764 (62.0%)	2740 (64.4%)	
Other	508 (9.3%)	130 (10.6%)	378 (8.9%)	
Sex				**.046**
Male	2695 (49.1%)	574 (46.6%)	2,121 (49.8%)	
Female	2795 (50.9%)	658 (53.4%)	2,136 (50.2)	
Sexual Orientation				.290
Straight	563 (92.6%)	117 (90.0%)	446 (93.3%)	
Lesbian or Gay	33 (5.4%)	11 (8.5%)	22 (4.6%)	
Bisexual	3 (0.5%)	1 (0.8%)	2 (0.4%)	
Other	9 (1.5%)	1 (0.8%)	8 (1.7%)	
State				
Indiana	791 (14.4%)			
Out of State	4698 (85.6%)			
Language				**.017**
English	5279 (96.2%)	1168 (94.8%)	4111 (96.6%)	
Spanish	145 (2.6%)	45 (3.7%)	100 (2.3%)	
Other	65 (1.2%)	19 (1.5%)	46 (1.1%)	
Veteran Status				.413
No	4675 (86.1%)	1041 (85.4%)	3634 (86.3%)	
Yes	754 (13.9%)	178 (14.6%)	576 (13.7%)	
Hospital				**.009**
Hospital A*	3091 (56.3%)	694 (56.3%)	2397 (56.3%)	
Hospital B*	782 (14.2%)	205 (16.6%)	577 (13.6%)	
Hospital C*	1616 (29.4%)	333 (27.0%)	1283 (30.1%)	
Insurance Type				**.003**
None	18 (3%)	1 (0.1%)	17 (0.4%)	
Public	5041 (91.8%)	1162 (94.3%)	3879 (91.1%)	
Private	424 (7.7%)	68 (5.5%)	356 (8.4%)	
Other	6 (0.1%)	1 (0.1%)	5 (0.1%)	

* Hospital A: large hospital, higher SES; Hospital B: medium hospital, diverse SES; Hospital C: small-medium hospital, lower SES

Table 1.2 Social Determinants of Health

		30-Day CHF Readmission		
		Yes (N = 1,232)	No (N = 4,257)	
Variables	**Count (%)/Median (IQR)**	**Count (%)**		***p*-value**
Family Income	$35,500 ($14,750)	$32,500 ($16,000)	$33,500 ($17,000)	.102
< $14,999	71 (2.0%)	18 (2.3%)	53 (1.9%)	
$15,000-$24,999	664 (18.5%)	135 (17.0%)	529 (19.0%)	
$25,000-$34,999	1201 (33.5%)	296 (37.2%)	905 (32.5%)	
$35,000-$49,999	1155 (32.2%)	252 (31.7%)	903 (32.4%)	
$50,000-$74,999	377 (10.5%)	81 (10.2%)	296 (10.6%)	
$75,000-$99,999	72 (2.0%)	9 (1.1%)	63 (2.3%)	
$100,000-$124,999	15 (0.4%)	2 (0.3%)	13 (0.5%)	
$125,000-$149,999	16 (0.4%)	1 (0.1%)	15 (0.5%)	
$150,000-$199,999	12 (0.3%)	2 (0.3%)	10 (0.4%)	
Financial Resource Risk				.385
Low	235 (84.5%)	49 (79.0%)	186 (86.1%)	
Medium	22 (7.9%)	7 (11.3%)	15 (6.9%)	
High	21 (7.6%)	6 (9.7%)	15 (6.9%)	
Housing Risk				.463
Low	457 (83.9%)	103 (81.7%)	354 (84.5%)	
High	88 (16.1%)	23 (18.3%)	65 (15.5%)	
Social Connections Risk				.574
Socially Isolated	129 (58.1%)	26 (55.3%)	103 (58.9%)	
Moderately Isolated	91 (41.0%)	20 (42.6%)	71 (40.6%)	
Social Integrated	2 (0.9%)	1 (2.1%)	1 (0.6%)	
Intimate Partner Violence Risk				.884
Not at risk	554 (99.1%)	126 (99.2%)	428 (99.1%)	
At risk	5 (0.9%)	1 (0.8%)	4 (0.9%)	
Food Insecurity				**.048**
No food insecurity	513 (92.6%)	107 (88.4%)	406 (93.8%)	
Food insecurity	41 (7.4%)	14 (11.6%)	27 (6.2%)	
Stress Presence				.427
No stress concern present	196 (74.0%)	42 (70.0%)	154 (75.1%)	
Stress concern present	69% (26.0%)	18 (30.0%)	51 (24.9%)	
Transportation Needs				.285
No transportation needs	517 (92.5%)	111 (90.2%)	406 (93.1%)	
Unmet transportation needs	42 (7.5%)	12 (9.8%)	30 (6.9%)	
Cumulative Social Risk	4.0 (2.0)			.804
Low	118 (71.1%)	24 (66.7%)	94 (72.3%)	
Moderate	44 (26.5%)	11 (30.6%)	33 (25.4%)	
High	4 (2.4%)	1 (2.8%)	3 (2.3%)	

Table 1.3 Behavioral and Health Characteristics

		30-day CHF Readmission		
		Yes (N = 1,232)	No (N = 4,257)	
Variables	**Count (%) / Median (IQR)**	**Count (%)**		***p*-value**
Physical Activity Level				.579
Inactive	183 (71.2%)	43 (74.1%)	140 (70.4%)	
Insufficiently Active	47 (18.3%)	8 (13.8%)	39 (19.6%)	
Sufficiently Active	27 (10.5%)	7 (12.1%)	20 (10.1%)	
Smoking Tobacco Use				.267
Never	2146 (39.7%)	489 (40.2%)	1657 (39.6%)	
Former	2546 (47.5%)	587 (48.3%)	1977 (47.2%)	
Current	692 (12.8%)	139 (11.4%)	553 (13.2%)	
Alcohol Risk-Men				.311
Not at risk	90 (89.1%)	20 (95.2%)	70 (87.5%)	
Heavy drinking	11 (10.9%)	1 (4.8%)	10 (12.5%)	
Alcohol Risk-Women				.239
Not at risk	82 (94.3%)	18 (100.0%)	64 (92.8%)	
Heavy drinking	5 (5.7%)	0 (0.0%)	5 (7.2%)	
Depression Risk				**.003**
Not at risk	234 (98.3%)	40 (93.0%)	194 (99.5%)	
At risk	4 (1.7%)	3 (7.0%)	1 (0.5%)	
Postpartum Depression Risk				*
No risk	1 (100.0%)	1 (100.0%)	0 (0.0%)	
Risk	0 (0.0%)	0 (0.0%)	0 (0.0%)	
BMI Category				.284
Underweight	123 (2.3%)	34 (2.8%)	89 (2.1%)	
Healthy weight	1138 (20.9%)	262 (21.7%)	876 (20.7%)	
Overweight	1370 (25.2%)	313 (25.9%)	1057 (25.0%)	
Obesity	2803 (51.6%)	601 (49.7%)	2202 (52.1%)	
Length of Stay	6.0 (7.0)	5.0 (5.0)	4.0 (4.0)	**<.001**
Top 3 secondary diagnoses				.222
Circulatory Diseases	1062 (19.3%)	852 (20.0%)	210 (17.0%)	
Endocrine, Nutritional, and Metabolic Diseases	847 (15.4%)	664 (15.6%)	183 (14.9%)	
Respiratory	443 (8.1%)	338 (7.9%)	105 (8.5%)	

*unable to calculate; counts for postpartum depression risk and 30-day readmission are constants

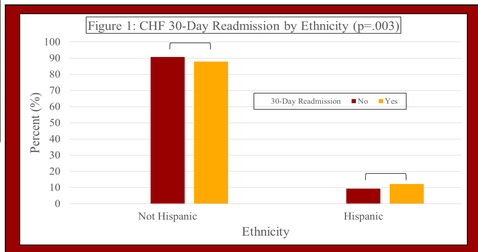
Table 2. Logistic regression model predicting 30-day CHF readmissions

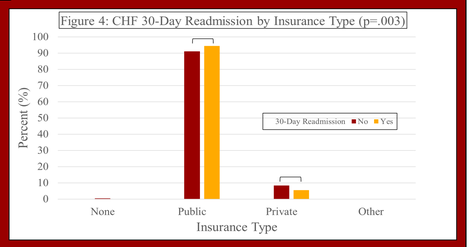
Variables	Log Odds	Odds Ratio	95% Confidence Interval for Odds Ratio	*p*-Value
Constant	-1.639	.194	—	.001
Sex (Reference = Male)				
Female	-0.010	.990	.657, 1.493	.963
Ethnicity (Reference = Non-Hispanic)				
Hispanic	.059	1.061	.461, 2.445	.963
Food Insecurity Presence (Reference = No Food Insecurity)				
Food Insecurity Presence	.755	2.128	1.062, 4.264	**.033**
Language (Reference = English)				
Spanish Language	1.455	4.285	.949, 19.361	.059
Other Language	.261	1.298	.133, 12.674	.823
Insurance Type (Reference = Private Insurance)				
No Insurance	-19.715	[2]	[2]	.999
Public Insurance	.155	1.168	.465, 2.934	.742
Other Insurance	.919	2.507	.182, 34.531	.492
Hospital Location (Reference = Hospital A)[3]				
Hospital B	.175	1.192	.772, 1.838	.428
Hospital C	-.215	.806	.365, 1.783	.595
Length of Stay	.008	1.008	.962, 1.057	.730

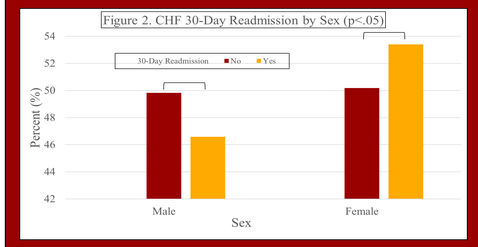
[1] Based on n = 553 respondents after removing cases with missing values on the variables included in the regression
[2] Sample population (n = 2) was insufficient to calculate these values
[3] Hospital A: large hospital, higher SES; Hospital B: medium hospital, diverse SES; Hospital C: small-medium hospital, lower SES

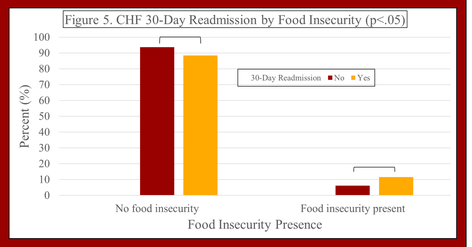
Cox & Snell R^2 = .019; Nagelkerke R^2 = .029

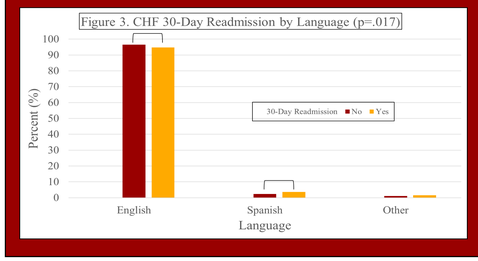
Figures 1-6 Select Significant Variables
*brackets indicate a significant difference at the .05 level

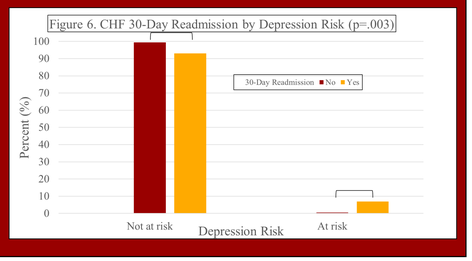












Discussion

- Bivariate analysis revealed significant associations between 30-day CHF Readmissions and Ethnicity (p=.003), Sex (p=.046), Language (p=.017), Hospital (p=.009), Insurance Type (p=.003), Food Insecurity (p=.048), and Depression Risk (p=.003).
- After accounting for all factors in the multivariate regression:
  - Food insecurity remained significant (OR=2.128; p=.033).
  - Spanish language was approaching significance (OR=4.285; p=.059).
- The model demonstrated high predictive accuracy (77.9%) despite a low goodness of fit (R^2 = 0.029). While food insecurity was a significant predictor of CHF readmissions, it explained only a small proportion of the variance in readmission rates.
- Overall, the results support previous research on impacts of SDOH on 30-day CHF readmission. In a departure from previous research:
  - There was a significantly higher proportion of female patients in the readmitted population in this study, while previous research has found a higher proportion of males.[9]
  - Significant associations were found with depression risk, language spoken (Spanish), and food insecurity—variables that have generally not been explored.
- **Limitations:** Small sample sizes of some variables led to their exclusion on advanced analysis (e.g., see depression risk bivariate analysis).

Conclusion

- Food insecurity was identified as a *modifiable* variable associated with 30-day CHF readmission after accounting for all factors in the multivariate regression:
  - Further research is needed to create interventions that address food insecurity in the context of CHF readmission.
  - There is room for increased food insecurity screenings among CHF patients, as there were low response rates despite being significantly associated with readmission.
  - While food insecurity is a useful predictor of CHF readmissions, the model suggests that additional unmeasured or omitted variables contribute to the outcome.
- **Implication**: Addressing food insecurity may be an important aspect of reducing 30-day hospital readmissions for CHF.
- **Future research** should conduct analysis on Spanish language and depression risk with a larger sample, investigate the efficacy of different multi-level food insecurity interventions on CHF readmissions, and continue exploring multi-domain factors to inform interventions.

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