

Food Insecurity and Healthcare Expenditures

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Disclosures

- **I have no actual or potential conflict of interest in relation to this program/presentation.**

Confidential

- **Data presented in this talk are part of a manuscript currently under review. Please do not distribute.**

Goals

- **Recap what is known re: food insecurity and healthcare costs**
- **Review methods for analysis of healthcare expenditures**
- **Discuss new data on association between food insecurity and healthcare costs**

What is known

- **Food insecurity well known to be associated with illness in adults and children**
 - **Should → increased costs**
- **Little evidence on cost specifically until recently**

Appendix 2:

Estimating the Health-Related Costs of Food Insecurity and Hunger

*John T. Cook, PhD, MAEd, Principal Investigator, Associate Professor of Pediatrics, Boston University School of Medicine
Ana Paula Poblacion, MSc, Project Manager & Research Assistant, Universidade Federal de São Paulo*

- Estimates \$155 Billion in food insecurity-related healthcare costs
- Uses population level estimates
 - No direct assessment of food insecurity
 - Makes some causal assumptions that are difficult to independently confirm

Association between household food insecurity and annual health care costs

Variable	Odds of health care expenditure* <i>n</i> = 67 033		Total health care costs per person† <i>n</i> = 59 817	
	Unadjusted OR (95% CI)	Adjusted‡ OR (95% CI)	Unadjusted mean, \$ (95% CI)	Adjusted‡ mean, \$ (95% CI)
Food insecurity status				
Food secure	1.00 (ref)	1.00 (ref)	1 516 (1498–1534)	1 438 (1421–1455)
Marginally food insecure	1.03 (0.90–1.17)	1.13 (0.99–1.29)	1 748 (1647–1849)	1 673 (1579–1767)
Moderately food insecure	1.21 (1.08–1.36)	1.33 (1.18–1.50)	2 143 (2037–2249)	1 892 (1800–1985)
Severely food insecure	1.54 (1.30–1.81)	1.71 (1.44–2.04)	3 078 (2883–3273)	2 529 (2370–2688)

- Found food insecurity association with \$500 to \$1500 greater healthcare costs per person per year
- Could not evaluate which came first: food insecurity or poor health

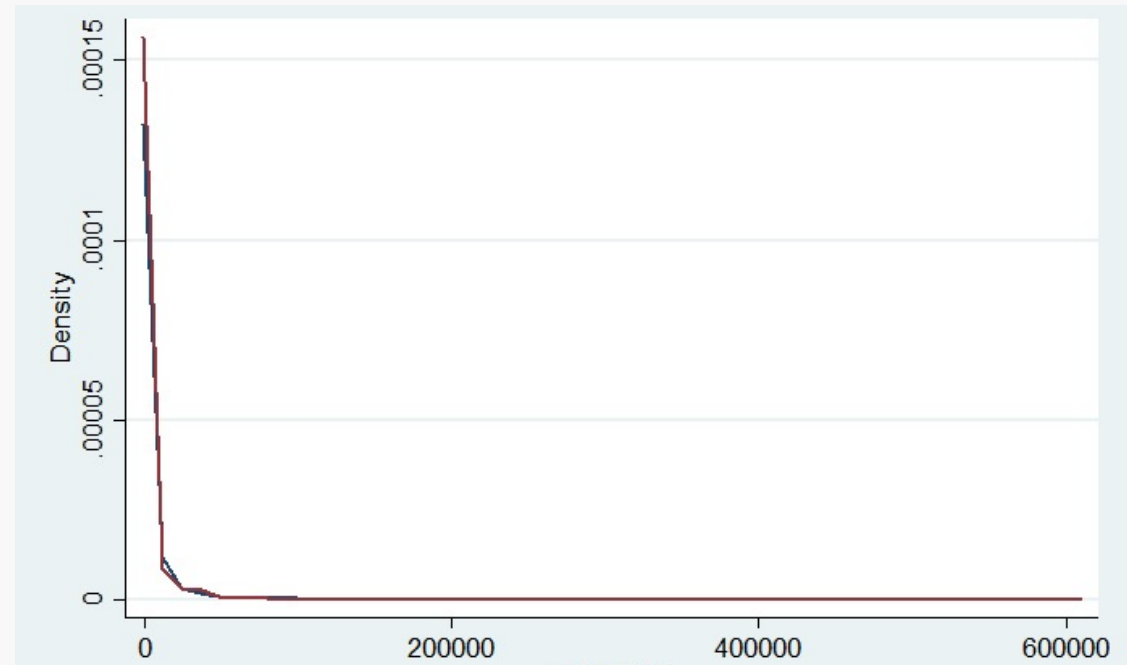
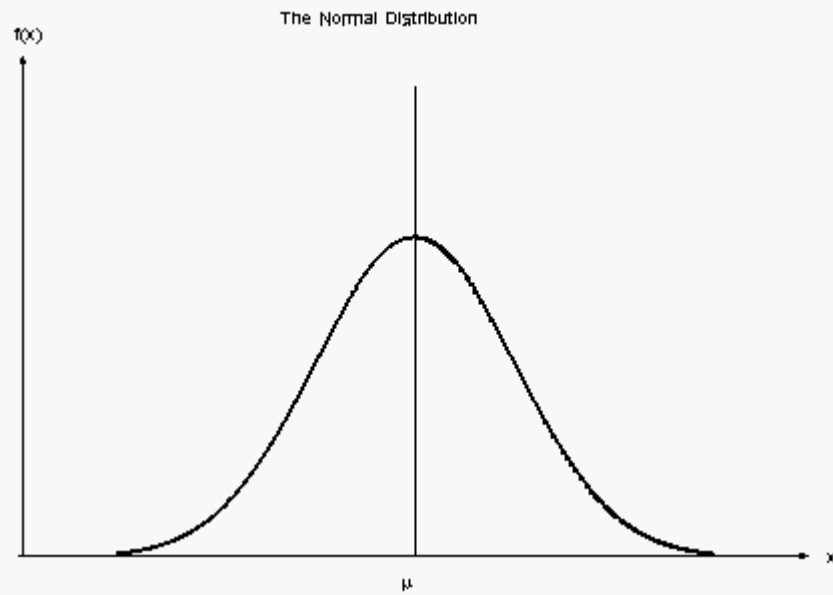
Enhancing Knowledge Base

- Would like to have:
 - Longitudinal data (food insecurity assessment prior to cost assessment)
 - Nationally-representative data
 - Adults and children

Analyzing costs

- Healthcare costs notoriously difficult to analyze
 - Large number of folks without healthcare expenditures in given year
 - “zero mass”
 - Small number of folks with very high expenditures
 - Skewed distribution or “right tail”

Analyzing costs



Analyzing costs

- Additional issue with food insecurity
 - “excess zero” vs. “true zero”
 - Imagine a pizza shop
 - Sometimes you might not want pizza (“true zero”)
 - Sometimes the pizza shop may be closed, so you can’t buy pizza even if you want it (“excess zero”)



Analyzing costs

- Options:
 - Ignore these issues!
 - Ordinary least squares (OLS)/Linear regression
 - Surprisingly common!

Analyzing costs

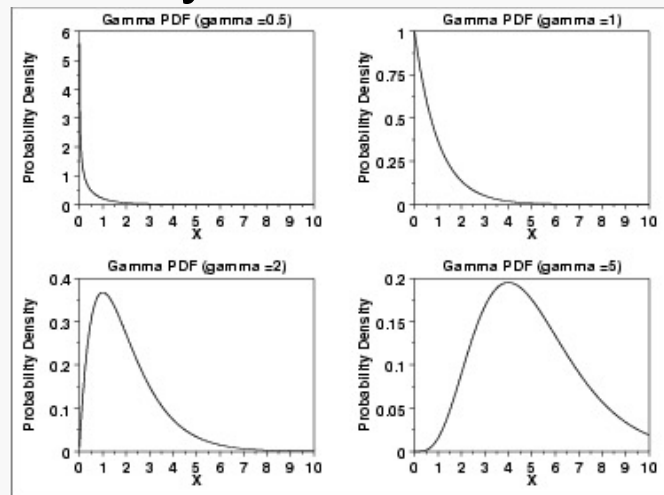
- Options:
 - “log transform”: takes the natural logarithm of expenditures, and then analyzes that with OLS
 - Will bring in the ‘tail’
 - Problems:
 - Excludes zeros
 - Can’t distinguish excess zeros
 - Log costs not interesting per se

Analyzing costs

- Better 'log transform' option: Two part model
 - Fit model for any expenditures vs. no expenditures (logistic regression)
 - Then fit OLS model for those with expenditures
- Problems:
 - Log costs still not parameter of interest
 - Still can't distinguish excess zeros from true zeros

Analyzing costs

- Options:
 - Generalized linear regression (gamma distribution)
 - Uses a link function to transform the exposures and covariates, rather than the outcome
 - Gamma distribution usually fits costs better than normal distribution



Analyzing costs

- Generalized linear regression with gamma distribution
- Benefits:
 - Outcome is real costs
 - Can handle zeros
- Downside:
 - Still can't distinguish excess zeros

Analyzing costs

- Zero inflated negative binomial distribution
 - Another type of generalized linear regression
 - Uses 'negative binomial' distribution rather than gamma
 - Also models whether zeros are greater than expected in an 'inflation' model

Analyzing costs

- Zero inflated negative binomial distribution
 - Assumptions work with cost distributions ✓
 - Outcome in real costs ✓
 - Handles zeros ✓
 - Can distinguish excess zeros ✓

Ok, onto the actual study

- Coauthors: Sanjay Basu, James Meigs, Hilary Seligman
- Data source:
 - 2011 National Health Interview Survey (NHIS)
 - Linked to 2012-2013 Medical Expenditure Panel Survey (MEPS)
- Sample:
 - All MEPS participants who completed household food insecurity assessment in 2011

Food Insecurity and Healthcare Expenditures in the United States

- Exposure:
 - Household food insecurity
 - Used a 10-item modification of standard food security survey module with 30 day look back in 2011
- Outcome:
 - Total expenditures in 2012-2013
 - Sub-categories:
 - Inpatient
 - Outpatient
 - ED
 - Pharmacy

Food Insecurity and Healthcare Expenditures in the United States

- Covariates:
 - Age
 - Gender
 - Race/ethnicity
 - Education
 - Income
 - Health Insurance
 - Rural vs. Urban
- Analysis method: Zero-inflated negative binomial regression

Selected Demographics

	Food Secure % (n)	Food Insecure % (n)
Age Categories		
0 - 17	22.9 (3611)	27.6 (991)
18-64	63.2 (8335)	66.9 (1896)
65 and greater	13.9 (1390)	5.5 (160)
Female	51.3 (7068)	52.7 (1695)
Race/Ethnicity		
Non-Hispanic White	66.1 (5095)	51.7 (719)
Non-Hispanic Black	11.3 (2665)	18.9 (875)
Hispanic	15.4 (4286)	26.1 (1374)
Asian/multi-/other	7.3 (1482)	3.3 (130)
Income		
<100% FPL ^a	11.5 (2327)	36.9 (1362)
100-199% FPL	16.5 (2564)	34.0 (898)
≥200% FPL	72.1 (7235)	29.1 (587)
Insurance		
Private	67.6 (7226)	34.1 (692)
Medicare	7.7 (880)	8.1 (228)
Other Public	11.6 (2592)	29.5 (1131)
Uninsured	13.2 (2404)	28.3 (911)

Total Costs

Table 2: Total Expenditures							
	Odds of 'Excess Zero' Expenditures		Incidence Rate of Expenditures		Expenditure Estimates		
	OR	95% Confidence Interval	IRR (95% CI)	p-value	Annualized Estimated Expenditures	95% Confidence Interval	Annualized Difference
Food Insecure	0.93	0.72 – 1.21	1.44 (1.24 to 1.67)	P<0.0001	\$6,071.60	\$5,144.92 to \$6,998.28	\$1,863.17
Food Secure	ref	--	ref	--	\$4,208.43	\$3,976.07 to \$4,437.79	--

Estimates adjusted for: age, age squared, gender, race/ethnicity, education, income, rural residence, and insurance. Estimated expenditures in 2015 dollars.

Interpretation note: an odds ratio greater than 1 represents evidence of a process that prevents expenditures (e.g. inability to access healthcare). An incidence rate ratio greater than 1 represents evidence of greater expenditures in a group, compared with a referent group. Information from both models is used to estimate annual expenditures.

Ref=Reference category

Costs by Category

Table 3: Estimated Expenditures by Spending Category

	Outpatient			Emergency Department			Inpatient			Prescription medication		
	Annualized Estimated Expenditure (95% CI), \$	Annualized Difference, \$	p-value	Annualized Estimated Expenditure (95% CI), \$	Annualized Difference, \$	p-value	Annualized Estimated Expenditure (95% CI), \$	Annualized Difference, \$	p-value	Annualized Estimated Expenditure (95% CI), \$	Annualized Difference, \$	p-value
Food Insecure	576.60 (417.22 to 735.99)	154.34	0.07	271.96 (201.74 to 342.18)	91.46	0.512	1587.49 (1149.85 to 2025.14)	493.41	.03	1776.59 (1472.03 to 2081.15)	779.36	<0.0001
Food Secure	422.26 (377.42 to 467.10)	--		180.50 (164.58 to 196.42)	--		1094.09 (958.73 to 1229.44)	--		997.23 (897.52 to 1096.95)	--	

Estimates adjusted for: age, age squared, gender, race/ethnicity, education, income, rural residence, and insurance. Estimated expenditures expressed in 2015 dollars.

Bold indicates significant at p<0.05

Total Excess Expenditures

- \$182 Billion in healthcare expenditures in those with food insecurity
- If spending patterns could be changed to resemble those who are demographically and clinically similar but food secure:
 - \$77 Billion in savings
- Thank you to co-authors!
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