

IS FOOD INSECURITY ASSOCIATED WITH CHRONIC DISEASE AND CHRONIC DISEASE CONTROL?

Background: In the United States, chronic diseases represent seven out of the ten chief causes of death and comprise 70% of annual health care costs. Previous studies of chronic diseases have shown that poor access to food influences dietary intake and may lead to worse health in those with these conditions. Specifically, chronic diseases like hypertension, diabetes mellitus, and chronic kidney disease can at times be prevented and/or controlled through dietary measures.

Objective: Our aim was to analyze perceived food security in a nationally representative sample of adults in the United States to examine the association between food security and the risk of having and controlling these chronic diseases.

Methods: We analyzed data from an observational study of respondents to the National Health and Nutrition Examination Survey (NHANES). We used logistic regression to test the association of food insecurity with the development and control of these chronic conditions. Our models will be adjusted for age, sex, race/ethnicity, comorbid conditions, poverty, education, insurance and employment. Our study population included 15,199 persons.

Results: 10% reported some food insecurity; 8% had diabetes; 34% had hypertension and 17% had kidney disease. The average age was 45 years old, 52% were females, 29% were racial or ethnic minorities and 63% of individuals lived above the poverty income ratio. After adjustment for covariates, our findings helped inform the role of food insecurity in chronic disease development and control, as well as the impact of demographics, socioeconomic factors and comorbid conditions on this relationship.

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INTRODUCTION

An estimated 17% of adults in the United States suffer from chronic kidney disease.¹ Chronic kidney disease is a progressive loss of renal function, which can result in transplant, dialysis, or some other form of renal replacement therapy. Diabetes and hypertension are two of the most common causes of chronic kidney disease. Affecting nearly 24 million people in the United States, diabetes is a disease in which the body does not produce or properly use insulin to regulate blood glucose levels. Hypertension or high blood pressure, a disorder that affects one in every five Americans, is commonly caused by inadequate dietary intake, exercise, and stress. Since dietary regulation and meal planning play a fundamental role in disease management, adults who are food insecure may be especially susceptible to developing these chronic conditions. The purpose of this study was to determine whether food insecurity is associated with the development and control of chronic disease, specifically patients with diabetes, hypertension, and chronic kidney disease.

In 2006, 10.1% of US households reported being food insecure at some time.² Food security, as defined by the National Health and Education Survey (NHANES), is one's perceived ability to access healthful food with essential nutrients, fruits and vegetables, and less saturated fats, sugar, and salt as recommended by the National Institutes of Health³ to live a healthful life. Correspondingly, food insecure individuals do not have the proper availability or means to access food and often experi-

ence hunger or inadequate nutrient intake.⁴ According to the Third National Health and Nutrition Examination Survey (NHANES III), approximately 4.1% of the US population consider themselves to be food insufficient, with "an inadequate amount of food intake due to lack of resources."⁵ Studies have shown that adults with chronic illnesses suffer adverse health consequences and risk factors due to food insecurity.⁶ In addition, food insecurity may jeopardize one's physical, mental, and social quality of life.⁴ Food security is an issue of greater concern for individuals with chronic conditions who must maintain certain diets to manage health.

A growing number of articles in the medical literature indicates that health and behavior is affected by social, physical and economic surroundings. In a national sample of adults with diabetes, researchers found that food insufficiency was more common among low-income diabetic patients with poor health status.⁷ Studies examining the spatial availability of food and self-rated health among adults with chronic conditions suggest that socioeconomic surroundings contribute to differences in health.⁸⁻¹⁰ Having a chronic condition was also associated with substantially poorer self-rated health among participants living in low income, underprivileged areas, compared to those in more fortunate areas.¹¹

METHODS AND MATERIALS

We analyzed an observational study of respondents to the National Health

and Nutrition Examination Survey (NHANES), a national source of health and nutrition data that measure the nutritional status and health of the US population. Our study examined respondents during the 1999–2004 interview period. We ran a logistic regression using SUDAAN for a nationally weighted sample. Our predictors were food insecurity/security and defined food secure households as having access to an adequate amount of healthful foods while food insecure households did not and often encountered hunger. We had a total of 6 main outcomes, with our primary outcomes being diabetes mellitus, hypertension, and chronic kidney disease. Of those, we tested for hemoglobin A1c >7%: blood pressure >140/90 mm Hg, and proteinuria to detect poor or adequate control of diabetes, hypertension, and/or chronic kidney disease, respectively. Our models were adjusted for interview period, age, sex, race/ethnicity, education, insurance coverage, marital status, poverty income ratio, body mass index, and smoking status.

RESULTS

Our study population included 15,199 persons, with 10% reporting some food insecurity, either food insecure without hunger or food insecure with hunger. Eight percent reported having diabetes, 34% hypertension and 17% kidney disease. Average age of the study group was 45 years, 52% were females, 29% were racial or ethnic minorities and 63% of individuals lived above the poverty income ratio. (Table 1)

We report the relationship of food security and the three specified chronic conditions before adjusting for covariates in Table 2. 10.79% of respondents with diabetes, 31.70% of respondents with hypertension, and 17.04% of respondents with chronic kidney disease reported some form of food insecurity.

Table 1. Relationship of Food Security to Socio-demographic Characteristics

	Percent %	(1–2) Fully- Marginally Food Secure % (n)	(3–4) Food Insecure w/o Hunger and w/ Hunger % (n)
Interview Period			
1999–2000	31.38%	90.92% (4178)	9.08% (683)
2001–2002	34.47%	89.35% (4490)	10.65% (757)
2003–2004	34.14%	88.63% (4356)	11.37% (735)
Average Age			
Sex			
Male	47.94%	89.85% (6211)	10.15% (1041)
Female	52.06%	89.37% (6813)	10.63% (1134)
Race/Ethnicity			
White	71.06%	92.99% (6727)	7.01% (531)
Hispanic	13.17%	75.05% (3209)	24.95% (1103)
Black	10.93%	83.95% (2578)	16.05% (486)
Other	4.84%	92.08% (510)	7.92% (55)
Education			
Less than High School	21.55%	79.10% (3995)	43.43% (1292)
More than High School	78.45%	92.52% (9006)	7.48% (924)
Poverty Income Ratio			
0–1.999	36.61%	76.58% (5023)	10.42% (1760)
2–5.000+	63.39%	97.09% (6955)	2.91% (233)
Insurance Coverage			
Privates/ Medicare/ Other Government Insurance	77.72%	93.91% (9984)	6.09% (923)
Uninsured/ Medicaid only	22.28%	74.61% (2926)	21.52% (1229)
Marital Status			
Married/ Living with Partner	61.61%	91.67% (7230)	8.33% (999)
Widowed/ Divorced	18.34%	86.83% (2523)	14.17% (459)
Never Married	20.05%	85.77% (2826)	14.23% (664)
Body Mass Index (kg/m²)			
<26	38.98%	89.85% (4837)	10.15% (799)
26–30	33.11%	90.93% (4245)	9.07% (656)
>30	27.91%	87.84% (3513)	12.16% (641)
Smoking Status			
Quit/ Current Smoker	50.04%	87.99% (5644)	12.01% (980)
Never Smoked	49.96%	91.50% (6118)	8.50% (858)
Total Pop. Surveyed (15999)		13024	2975

Table 3 displays the relationship of disease control to food security. 33.17% of respondents with blood pressure \geq 140/90 mm Hg reported food insecurity. 82.59% of respondents with present proteinuria reported food insecurity. 77.23% of respondents with HgA1c >7% reported food insecurity.

Table 4 displays the unadjusted results of our main predictors vs the six outcomes. Those reporting food insecurity were 1.447 times more likely to have diabetes. There was no signif-

icant association between food insecure and food secure respondents for controlling their diabetes. There was no significant association between food secure and food insecure individuals having hypertension. However, food insecure respondents were 1.335 times more likely to better control their hypertension than food secure respondents. There was no significant association between food secure and food insecure respondents having chronic kidney disease. Even though results

Table 2. Food security vs chronic disease

	Diabetes Mellitus % (#)		Hypertension % (#)		Chronic Kidney Disease % (#)	
	Yes	No	Yes	No	Yes	No
Food Secure	8.18% (1365)	91.55% (11006)	34.63% (4670)	65.37% (7465)	17.52% (2504)	82.48% (8375)
Food Insecure	10.79% (246)	89.21% (1819)	31.70% (667)	68.30% (1292)	17.04% (337)	82.96% (1346)

Table 3. Food security vs chronic disease control

	Diabetes Mellitus HgA1c >7% (#)		Hypertension BP > 140/90 mm Hg % (#)		Chronic Kidney Disease Present Proteinuria % (#)	
	Yes	No	Yes	No	Yes	No
Food Secure	71.42% (992)	28.58% (373)	29.70% (1534)	70.30% (3136)	78.50% (1916)	21.50% (523)
Food Insecure	77.23% (194)	22.77% (52)	33.17% (222)	66.83% (445)	82.59% (276)	17.41% (52)

Table 4. Unadjusted outcomes vs main predictors

	Diabetes OR 95% (CI)	Diabetes Control OR 95%(CI)	Hypertension OR 95%(CI)	Hypertension Control OR 95%(CI)	Chronic Kidney Disease OR 95% (CI)	Chronic Kidney Disease Control OR 95% (CI)
Food Security						
1-2. Food Secure	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)
3-4. Food insecure	1.45 (1.13, 1.85)	1.12 (0.73, 1.71)	0.87 (0.73, 1.05)	1.34 (1.06, 1.68)	1.04 (0.85, 1.28)	1.25 (0.77, 2.05)

Table 5. Adjusted outcomes vs main predictors

	Diabetes OR 95% (CI)	Diabetes Control OR 95%(CI)	Hypertension OR 95%(CI)	Hypertension Control OR 95%(CI)	Chronic Kidney Disease OR 95%(CI)	Chronic Kidney Disease Control OR 95%(CI)
Food Security						
1-2. Food Secure	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)
3-4. Food insecure	1.42 (1.04, 1.92)	0.85 (0.53, 1.41)	1.13 (0.91, 1.39)	1.43 (1.11, 1.84)	0.99 (0.80, 1.23)	0.69 (0.39, 1.23)

reported those with chronic kidney disease were 1.253 times more likely to have control of their chronic condition, the odds ratio is not statistically significant (CI=0.765, 2.050).

Table 5 displays the adjusted results of our main predictors and the six outcomes. We used a logistic regression model to adjust for interview period, race/ethnicity, sex, education, marital status, insurance coverage, and age. We also used body mass index and smoking status as a proxy to adjust for other comorbidities like obesity and possibly cancer. Poverty income ratio was also

used as a proxy for income. After adjusting for covariates, our findings found that food insecure respondents were 1.416 times more likely to have diabetes than food secure respondents. However, there was no significant association between the food secure and food insecure respondents controlling their diabetes (CI=0.529, 1.410). There was no significant association between food security and having hypertension. However, food insecure respondents with hypertension were 1.426 times more likely to have control of their condition than food secure

respondents with hypertension. There was no significant association between having chronic kidney disease and food security. We also found no significant association between food secure and food insecure respondents with chronic kidney disease and the control of their condition.

Males with chronic kidney disease were 2.443 times more likely than females to have their condition under control. Males were also 1.394 times more likely than females to have diabetes, but were also 1.501 times more likely to have control of their

diabetes than females. Hispanics were 1.858 times more likely to have diabetes than Whites, and 1.851 times more likely to have control of their chronic kidney disease than Whites. Blacks were 1.791 times more likely to have diabetes, 1.692 times more likely to have hypertension, and 1.231 times more likely to have chronic kidney disease than Whites. However, Blacks were 1.405 times more likely to control their hypertension and 2.150 times more likely to control their chronic kidney disease than Whites. Overweight respondents were 5.304 times more likely to have diabetes and 0.989 times less likely to control their diabetes.

CONCLUSIONS

Food insecurity is associated with a higher likelihood of having diabetes mellitus. Therefore, food insecure individuals are more likely to have diabetes mellitus. Food insecurity is associated with a higher likelihood of poor blood pressure control in those with hyper-

tension. We did not find a significant association with the likelihood of having hypertension, chronic kidney disease, poor diabetes control, or poor chronic kidney disease control.

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