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

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**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.

**INTRODUCTION**

An estimated 17% of adults in the United States suffer from chronic kidney disease. 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. 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 Health to live a healthful life. Correspondingly, food insecure individuals do not have the proper availability or means to access food and often experience hunger or inadequate nutrient intake.

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.” Studies have shown that adults with chronic illnesses suffer adverse health consequences and risk factors due to food insecurity. In addition, food insecurity may jeopardize one’s physical, mental, and social quality of life. 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 indicate 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. 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. 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.

**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 3 displays the relationship of disease control to food security. 33.17% of respondents with blood pressure ≥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 significant 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

<table>
<thead>
<tr>
<th></th>
<th>Diabetes Mellitus % (#)</th>
<th>Hypertension % (#)</th>
<th>Chronic Kidney Disease % (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Food Secure</td>
<td>8.18% (1365)</td>
<td>91.55% (11006)</td>
<td>34.63% (4670)</td>
</tr>
<tr>
<td>Food Insecure</td>
<td>10.79% (246)</td>
<td>89.21% (1819)</td>
<td>31.70% (667)</td>
</tr>
</tbody>
</table>

Table 3. Food security vs chronic disease control

<table>
<thead>
<tr>
<th></th>
<th>Diabetes Mellitus HgA1c &gt;7% (#)</th>
<th>Hypertension BP &gt; 140/90 mm Hg % (#)</th>
<th>Chronic Kidney Disease Present Proteinuria % (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Food Secure</td>
<td>71.42% (992)</td>
<td>28.58% (373)</td>
<td>29.70% (1534)</td>
</tr>
<tr>
<td>Food Insecure</td>
<td>77.23% (194)</td>
<td>22.77% (52)</td>
<td>33.17% (222)</td>
</tr>
</tbody>
</table>

Table 4. Unadjusted outcomes vs main predictors

<table>
<thead>
<tr>
<th></th>
<th>Diabetes OR 95% (CI)</th>
<th>Diabetes Control OR 95% (CI)</th>
<th>Hypertension OR 95% (CI)</th>
<th>Hypertension Control OR 95% (CI)</th>
<th>Chronic Kidney Disease OR 95% (CI)</th>
<th>Chronic Kidney Disease Control OR 95% (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Security</td>
<td>1.00 (1.00, 1.00)</td>
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<td>1.00 (1.00, 1.00)</td>
<td>1.00 (1.00, 1.00)</td>
<td>1.00 (1.00, 1.00)</td>
<td>1.00 (1.00, 1.00)</td>
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<tr>
<td>1-2. Food Secure</td>
<td>1.00 (1.00, 1.00)</td>
<td>1.00 (1.00, 1.00)</td>
<td>1.00 (1.00, 1.00)</td>
<td>1.00 (1.00, 1.00)</td>
<td>1.00 (1.00, 1.00)</td>
<td>1.00 (1.00, 1.00)</td>
</tr>
<tr>
<td>3-4. Food insecure</td>
<td>1.45 (1.13, 1.85)</td>
<td>1.12 (0.73, 1.71)</td>
<td>0.87 (0.73, 1.05)</td>
<td>1.34 (1.06, 1.68)</td>
<td>1.04 (0.85, 1.28)</td>
<td>1.25 (0.77, 2.05)</td>
</tr>
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Table 5. Adjusted outcomes vs main predictors

<table>
<thead>
<tr>
<th></th>
<th>Diabetes OR 95% (CI)</th>
<th>Diabetes Control OR 95% (CI)</th>
<th>Hypertension OR 95% (CI)</th>
<th>Hypertension Control OR 95% (CI)</th>
<th>Chronic Kidney Disease OR 95% (CI)</th>
<th>Chronic Kidney Disease Control OR 95% (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Security</td>
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<td>1.00 (1.00, 1.00)</td>
</tr>
<tr>
<td>3-4. Food insecure</td>
<td>1.42 (1.04, 1.92)</td>
<td>0.85 (0.53, 1.41)</td>
<td>1.13 (0.91, 1.39)</td>
<td>1.43 (1.11, 1.84)</td>
<td>0.99 (0.80, 1.23)</td>
<td>0.69 (0.39, 1.23)</td>
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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 control-
ing 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 hypertension. 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.

ACKNOWLEDGMENTS

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REFERENCES