



## Original article

## Functional limitation and chronic diseases are associated with food insecurity among U.S. adults

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## ABSTRACT

**Purpose:** This study examined associations of functional limitation due to any health problems and six chronic diseases (arthritis, diabetes, coronary heart disease, heart attack, hypertension, and stroke) with food security among U.S. adults.

**Methods:** The 2011 National Health Interview Survey data for 30,010 adults ( $\geq 18$  years) were used. Adults were categorized into food secure, low food secure, or very low food secure. Multivariable logistic regressions were used to estimate adjusted odds ratio (OR) and 95% confidence interval (CI) for having functional limitation and chronic diseases while adjusting for sociodemographic and lifestyle factors.

**Results:** The prevalence of functional limitation and the chronic diseases were higher in low–food-secure and very low–food-secure than food-secure adults. The adjusted ORs were significant in both low food secure and very low food secure, respectively, for functional limitation (OR: 1.87; 95% CI: 1.63, 2.14), (OR: 2.20; 95% CI: 1.91, 2.52), inflammatory diseases or joint/muscular pain (OR: 1.42; 95% CI: 1.21, 1.68), (OR: 1.74; 95% CI: 1.49, 2.04), diabetes (OR: 1.26; 95% CI: 1.06, 1.51), (OR: 1.23; 95% CI: 1.02, 1.48), and hypertension (OR: 1.18; 95% CI: 1.04, 1.35), (OR: 1.42; 95% CI: 1.22, 1.65) when compared with food-secure adults.

**Conclusions:** Findings indicate that food insecurity is associated with functional limitation and chronic diseases, whereas directionality is unknown. Besides the traditional food assistance program for food-insecure populations, interventions to prevent or manage chronic diseases may be necessary to help them reduce the risk of the diseases and manage their conditions.

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## Introduction

According to the United States Department of Agriculture Economic Research Report, approximately 12.3% or 15.6 million of U.S. households reported that they were food insecure at some time during 2016 for all household members, which includes children [1]. Food-insecure status includes low food security (7.4%), “reduced quality, variety, or desirability of diet but little or no indication of reduced food intake” and very low food security (4.9%), “multiple indications of disrupted eating patterns and reduced food intake” [1]. Food insecurity has been associated with certain chronic diseases, including hypertension [2,3], diabetes [4–6], heart disease, hypoglycemia [7,8], and metabolic syndrome [9]. In addition, the

prevalence of obesity/overweight, a risk factor for the chronic diseases, was higher among individuals from food-insecure households than among those from food-secure households [8–11].

Food-insecure individuals tend to have inadequate management of chronic diseases because of limited access of health care [12] and/or low-health literacy or education attainment [8,13], when controlling for education and income. Poor disease management can lead to further deterioration of the body and morbidity of diseases and eventually attributes their functional limitation or disability [14]. Previous research has mainly focused on the association of food insecurity to obesity, diabetes, and hypertension. Little research, however, has focused on arthritis, coronary heart disease, heart attack, and stroke, which may increase the risk of disability or functional limitation from inappropriate disease management. Although few studies have investigated the association between functional limitation and food security status, these studies were conducted primarily among older adults [15,16]. Functional limitation or disability due to any health problems can restrain ability to work and further continue food insecurity. Hence,

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the objective of this study was to examine associations of functional limitation and chronic disease with food insecurity among a sample representing the civilian noninstitutionalized U.S. adults.

## Methods

### *Sample and survey administration*

Publicly available data from the 2011 National Health Interview Survey (NHIS) were used [17]. The NHIS is a household survey conducted continuously since 1957 by the Centers for Disease Control and Prevention's National Center for Health Statistics. The Research Ethics Review Board at Centers for Disease Control and Prevention's National Center for Health Statistics approved conducting NHIS. It uses a multistage sampling design with face-to-face interviews in a sample of household representatives of the civilian noninstitutionalized U.S. population. Information on the health and other characteristics of each family member is obtained. Some data were collected about all members of the family and more detailed data were collected from one randomly selected child (the "sample child") or one randomly selected adult (the "sample adult"). In the present study, data from the sample adult file were analyzed. The final sample adult response rate was 66.3%. A total of 33,014 sample adults aged 18 years or older completed the Sample Adult Module in 2011.

For these analyses, 3004 adults were excluded due to missing data on any variables included in the study, leaving a final analytic sample of 30,010 adults. The analytic sample had a higher proportion of younger adults, males, and those with higher income, but there were no differences in race/ethnicity, marital status, and education level between the analytic sample and those who were excluded from the study.

### *Variables*

#### *Functional limitation and chronic diseases*

According to the Summary Health Statistics for the U.S. Population National Health Interview Survey (2011), functional limitation and chronic diseases were self-reported data. For functional limitation, the degree of difficulty of performing certain task(s) (functional limitation) and the conditions(s) or health problem(s) associated with the functional limitation and the length of having the condition or health problem were identified. The scope of functional limitation included specific physical tasks and engaging in social activities and recreation without assistance from another person or special equipment. The examples of specific physical tasks were "walking a quarter of a mile," "walking up ten steps," "standing for 2 hours," "carrying a ten-pound object." Engaging in social activities and recreation included "going shopping," "attending club meetings," "visiting friends," "sewing, reading," and so forth. Each individual was asked to identify the condition(s) or health problem(s) related to their functional limitation using 18 categories, such as "vision/problem seeing," "hearing problem," "arthritis/rheumatism," "back or neck problem," "fracture, bone/joint injury," "other injury," "heart problem," "stroke problem," "hypertension/high blood pressure," "diabetes," "lung/breathing problem," "cancer," "birth defect," "intellectual disability, also known as mental retardation," "other developmental problem (e.g., cerebral palsy)," "senility," "depression/anxiety/emotional problem," and "weight problem." If any condition or health problem was not included in the list, the interviewer used an additional 17-second screen category or typed the condition or health problem. In this study, a summary measure that indicated individuals who reported one or more functional limitation(s) was used for the data analysis. The summary variable (the recorded variable—FLA1AR)

includes three response levels including 1 (limited), 2 (not limited), and 3 (unknown).

For chronic conditions/diseases status, individuals were asked the following questions to assess each of the six chronic diseases including inflammatory diseases or joint/muscular pain, coronary heart disease, diabetes, heart attack, hypertension, and stroke: "Have you ever been told by a doctor or other health professional that you have some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?" and "Have you ever been told by a doctor or other health professional that you had ... ?" Prevalence of coronary heart disease, diabetes (also called sugar-diabetes), heart attacks, hypertension (also called high blood pressure), and strokes were assessed separately. Response options for each chronic disease were categorized as Yes or No, except for diabetes, which was categorized as Yes, Borderline, or No.

### *Food security*

Household food security status in the past 30 days was assessed using the 10-item U.S. Adult Food Security Survey Module. The module was developed and validated based on 2 decades of research identifying the particular set of conditions, experience, and behavior patterns that consistently characterize the phenomenon of food insecurity and hunger [18]. Statements included "we worried whether our food would run out before we got money to buy more" and "the food that we bought just didn't last and we didn't have money to get more", with answer prompts being "was that often, sometimes, or never true for you in the last 12 months?" A household's food security status is determined by the number of questions answered affirmatively. The adults with zero to two affirmative responses were categorized as being food secure. The participants were categorized as having low food security if they had 3–5 affirmative responses, and the participants were categorized as having very low food security if they had 6–10 affirmative responses [19].

### *Sociodemographics and body mass index (BMI)*

Mutually exclusive response categories were created for each variable. Sociodemographic variables included were age (18–24, 25–39, 40–59, and ≥60 years), sex, race/ethnicity (Hispanic white, non-Hispanic black, Hispanic, or other/multiracial), and marital status (married/domestic partnership or not married). Not married included widowed, divorced, separated, or never married. Education level was categorized as < high school, high-school graduate or recipient of a General Education Development certificate, some college, or college graduate. Annual family income was categorized as <\$35,000, \$35,000–\$74,999, \$75,000–\$99,999, or ≥\$100,000. Regions of residence were categorized as Northeast, Midwest, South, and West. BMI was calculated from weight and height (kg/m<sup>2</sup>) reported by respondents during a face-to-face interview and categorized as underweight (BMI < 18.5), normal weight (BMI 18.5–<25), overweight (BMI 25–<30), or obese (BMI ≥ 30) [20]. Employment status was self-reported, then categorized as employed, unemployed, retired, student/homemaker, or unable to work (disabled). Number of children in household was categorized as 0, 1, 2, or ≥3. Smoking status categorized as never, former, or current smokers.

### *Statistical analysis*

Chi-square tests were used to examine the bivariate relationship between food security status and aforementioned variables. A *P* value of < .05 was the cut point for statistical significance. Multivariable logistic regression modeling was used to estimate adjusted odds ratios (aOR) and 95% confidence intervals (CIs) for the relationship between food security status and the likelihood of having any functional limitation and chronic diseases. Reference category

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