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Food insecurity and dyslipidemia among adults in the United States

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ABSTRACT

Objective. The objective of this study is to estimate the likelihood of dyslipidemia among food insecure men and women.

Method. Men, $n=2572$ and women, $n=2977$, in the National Health and Nutrition Examination Survey 1999–2002 cholesterol screening sample were included in this study. Gender-stratified descriptive comparisons and logistic regression models were used to study associations between food insecurity and dyslipidemia indicated by abnormal levels of fasting serum triglyceride (TRG), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C) and their ratios.

Results. Food insecurity did not associate with dyslipidemia among men. Among women, the associations between food insecurity and dyslipidemia were not consistent. Compared with the fully food secure, women who were marginally food secure were more likely to have abnormal levels of LDL-C (adjusted OR, 1.85; $P=0.045$) and TRG/HDL-C ratio (adjusted OR, 1.91; $P=0.046$). Women who were food insecure without hunger were more likely to have abnormal levels of TRG (adjusted OR, 1.90; $P=0.041$).

Conclusion. Intermediate-level food insecurity associated with some indicators of dyslipidemia among women but not among men. This observation shows food insecure women may be at risk of dyslipidemia.

Introduction

Recent reports from food security surveys indicate that approximately 11% of adults in the United States are food insecure (Nord et al., 2007). That is, they have limited or uncertain availability of nutritionally adequate and safe food or limited or uncertain ability to acquire acceptable foods in socially acceptable ways (LSRO, 1989). Among the characteristics of food insecure persons are socio-economic deprivation and lack of access to resources, including inadequate access to health care (Seligman et al., 2007). Thus, many food insecure persons may not be aware of underlying disease conditions (Seligman et al., 2007; Kushel et al., 2006). An important risk factor for cardiovascular disease (CVD) is abnormal levels of serum lipids, termed dyslipidemia (NCEP, 2007; AHA, 2004; Patt et al., 2003; Aronne and Segal, 2002). Dyslipidemia indicated by abnormal levels of serum triglyceride (TRG), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C) and high-density lipoprotein cholesterol (HDL-C) are known risk factors for CVD (NCEP, 2007).

Studies on the associations between food insecurity and factors predisposing to CVD, including dyslipidemia are scarce. Significant associations between food insufficiency and physician-diagnosed self-reported chronic conditions, including heart disease, have been reported among Canadians (Vozoris and Tarasuk, 2003). In one study, food insufficiency did not associate with TC concentration but associated with decreased concentration of HDL-C among older adults (Dixon et al., 1994). A study of the associations between food insecurity and risk of CVD using objective measures and multiple indicators such as concentrations of many related serum lipids will help elucidate associations. It is estimated that coronary heart disease morbidity and mortality could be decreased by 25–35% by treating and alleviating the effects of dyslipidemia (Ballantyne et al., 2000; Jacobson et al., 1998).

Food insecurity associates with poor diet (Dixon et al., 1994; Rose, 2000) and overweight and obesity (Wilde and Peterman, 2006; Adams et al., 2003) which are independent risk factors for CVD (AHA, 2004; Eckel and Krauss, 1998). Due to its associations with overweight and obesity, and poor dietary habits, it is tempting to assume that food insecurity would associate with risk factors of CVD such as dyslipidemia. This study estimated the likelihood of dyslipidemia among food insecure men and women by examining levels of fasting serum HDL-C, LDL-C, TC and TRG as well as LDL/HDL-C, TC/HDL-C and TRG/HDL-C ratios.

Methods

Data sources and study sample

Data for this study were from the National Health and Nutrition Examination Survey (NHANES) 1999–2002 cholesterol screening sample. The NHANES is a nationally representative survey of non-

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institutionalized United States civilian population. It is conducted by the National Center for Health Statistics of the Centers for Disease Control (CDC, 2007a). The NHANES 1999–2002 uses a stratified, multistage probability cluster sampling method. Data from participants in the NHANES 1999–2002 mobile examination center (MEC) cholesterol screening who met the following inclusion criteria were selected for the study. The inclusion criteria were: ages 18–50 years, complete food security status, serum lipids and gender data. Among the cholesterol screening sample, 6260 participants were aged 18–50 years. Of these, 5549 comprising 2572 men and 2977 women met inclusion criteria and thus were included in this study. Data from participants aged 18–50 years were included to obviate the complex influence of aging on blood lipids levels (NCEP, 2007; Edelstein et al., 2005). In the NHANES 1999–2002, a sub-sample comprising 2695 provided data on LDL-C and TRG. This LDL-C and TRG sub-sample comprised 1268 men and 1427 women.

The NHANES demographic questionnaire contained socio-demographic information including age, gender, income, race/ethnicity and level of education. Smoking status and physical activity level were obtained from the smoking status and tobacco use, and physical activity and physical fitness questionnaires, respectively. Height, body weight and BMI data were from the MEC body measures data files (CDC, 2007b). NCHS Ethics Review Board approved the survey protocols and informed consent was obtained from all participants (CDC, 2007b). The procedures for this study were approved locally by the Institutional Review Board, Office of Human Subjects Research.

Food security status

In the NHANES 1999–2002, food related circumstances over the past 12 months were used to assign adults into food security categories as fully food secure, marginal food security, food insecure without hunger and food insecure with hunger. The 10-item adult food security scale from the U.S. 18-item Food Security Survey Module (FSSM) was used for the food security status assignment (USDA, 2004). In this study, adult food security status was used because the influences of food insecurity could vary across household members (Kaiser et al., 2002; Dixon et al., 1994) and also adults are the first to adopt coping behaviors to food insecurity including limiting the quantity and quality of foods consumed or skipping of meals (Kaiser et al., 2002).

Serum lipids data

The NHANES MEC laboratory data files contained participants' data on serum triglycerides, total cholesterol, high-density lipoprotein cholesterol and low-density lipoprotein cholesterol which were used for this study (CDC, 2007d). Details of the procedures for the serum lipids determinations have been published elsewhere (CDC, 2007e).

Table 1
Reference clinical guidelines used for the identification of dyslipidemia.

Serum component	Interpretative guide	
	Normal	High
HDL-cholesterol (HDL-C)[a]		
Men	≥40 mg/dl	<40 mg/dl
Women	≥50 mg/dl	<50 mg/dl
LDL-cholesterol (LDL-C)[b]	<130 mg/dl	≥130 mg/dl
Total cholesterol (TC)[c]	<240 mg/dl	≥240 mg/dl
Triglycerides (TRG)[a]	<150 mg/dl	≥150 mg/dl
LDL-C/HDL-C ratio[d]	<2.5	≥2.5
TC/HDL-C ratio[e]	<3.5	≥3.5
TRG/HDL-C ratio[f]	<3.0	≥3.0

[a] Kompoti et al., 2006; Patt et al., 2003.
[b] NCEP Expert Panel, 2001.
[c] NCEP, 2007; Brown, 1990.
[d] Herron et al., 2002; McNamara and Min, 2002.
[e] Lemieux et al., 2001; Anderson et al., 1991.
[f] McLaughlin et al., 2003.

Identification of dyslipidemia

The National Cholesterol Education Program and other clinical guidelines were used to categorize participants into normal and dyslipidemic groups (Table 1). Participants were deemed to be dyslipidemic if the measured serum component of interest did not satisfy the reference guideline. Because the proportion of the sample which associated with hypolipidemia (total cholesterol<120 mg/dl) (Glueck et al., 1997; Lévesque et al., 1991) was small, 2.04%, our analysis focused mainly on hyperlipidemia, with the exception of HDL-C which associates inversely with CVD. There is unclear consensus on the cutoff for hypolipidemia, stated as 100, 120 or 150 mg/dl (Glueck et al., 1997; Lévesque et al., 1991) which discourages its assessment.

Confounding variables

Confounding variables included in the study were age, education, income, physical activity, race/ethnicity and smoking status, within the limitations of available data sets (Armour et al., 2001; Davison et al., 2002). Level of education was collapsed into less than high school degree and high school degree or higher. Because sample sizes were small for some race\ethnic groups, it was collapsed into three categories: Black (non-Hispanic), Mexican-American and other Hispanics, and White (non-Hispanic) and other white ethnicity. A dichotomous variable was created for income as income<185% and ≥185% of the Federal poverty threshold. Physical activity was self-reported as less than average, same as average and greater than average American. Although self-reported physical activity is prone to reporting biases, it has been found applicable in many studies (Jones and Frongillo, 2007; van Dam et al., 2006; Neumark-Sztainer et al., 2004). Participants who reported use of 100 cigarettes, pipes 20 times, and cigars 20 times in their life time and currently use tobacco were classified as current smokers. Those who reported previous smoking were classified as ex-smokers. Those who reported they never smoke were classified as non-smokers. The U.S. Census 2000 age grouping format was used (U.S. Census Bureau, 2007).

Statistical analysis

Statistical analyses were done using STATA 10.0 (STATA Corporation, College Station, Texas) and SAS 9.1.3 (SAS Institute Inc., Cary, NC) statistical software. To correct for MEC sampling design and to apply MEC sampling weights, STATA 10.0 (College Station, TX) was used to estimate all descriptive and inferential statistics (CDC, 2005). The NHANES 1999–2002 MEC four-year full sample weights were applied to HDL-C and TC data while the sub-sample weights were applied to the TRG and LDL-C data (CDC, 2007e; Alaimo et al., 2001).

Gender-stratified descriptive comparisons of proportions with dyslipidemia by food security status were performed. Significant associations were tested using Pearson's χ^2 test of independence with Rao and Scott correction whereas for continuous variables, the overall F-test was used to test for significant differences across levels of food security (Flores et al., 2005; Rao and Scott, 1981). Logistic regression models were performed to estimate odds ratios (OR) for dyslipidemia in relation to food insecurity stratified by gender. Odds ratios were adjusted for age, education, ethnicity, income and smoking. The referent group for the main exposure variable, food insecurity, was the fully food secure category. The referent groups for the confounding variables were age 18–24 year group, high school degree or higher, non-smoker and White (non-Hispanic). All confounding variables were examined as indicator variables. Statistical significance was tested at $P<0.05$.