



Association between family history of diabetes and cardiovascular disease and lifestyle risk factors in the United States population: The 2009–2012 National Health and Nutrition Examination Survey



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ABSTRACT

Family history is a well-known risk factor for diabetes and cardiovascular disease (CVD) and modification of lifestyle risk factors can significantly lessen such risk.

Our aim was to assess the association between family history of diabetes and/or CVD and lifestyle behaviors and risk factors (smoking, low physical activity, excessive dietary sodium and cholesterol intake and obesity) in a nationally representative sample of U.S. adults.

We conducted a cross-sectional analysis of the National Health and Nutrition Examination Survey (NHANES) 2009–2012. Family history, lifestyle behaviors and risk factors were defined using self-reported and physical examination data.

The study sample included 10,988 participants with a mean age of 47 years. Among the U.S. adult population, 29.5%, 5.7% and 6.5% had a family history of diabetes, CVD and both diseases respectively. Compared to participants with no family history, participants with a family history of diabetes, CVD and both diabetes and CVD were more likely to be current smokers (OR = 1.18[95% CI, 1.03–1.35], OR = 1.68[95% CI, 1.31–2.17] and OR = 1.71[95% CI, 1.30–2.26] respectively). Participants with a family history of diabetes (OR = 1.42[95% CI, 1.26–1.61]) and both diabetes and CVD were more likely to be overweight/obese (OR = 2.06[95% CI, 1.57–2.69]). There was no association between family history and dietary factors or physical activity.

In the U.S., there is a high prevalence of modifiable risk factors among persons with a family history of diabetes and/or CVD. Healthcare providers have a significant role to play in targeting these individuals for lifestyle changes.

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1. Introduction

Diabetes and cardiovascular disease (CVD) are two of the leading causes of mortality in the United States (U.S.) and in the world. Both diabetes and cardiovascular disease have known genetic susceptibility among progeny. However, evidence suggests that lifestyle behaviors play a major role in influencing the risk of disease, particularly among susceptible individuals (Lauer, 1999; Williams et al., 2001; Harrison et al., 2003; Colditz et al., 1991; Kardia et al., 2003; Hunt et al., 2003). Therefore, the significance of family history as a way of identifying

individuals who should receive more intensive lifestyle modification counseling by health care providers should be a priority.

Case-control studies comparing offspring of parents with and without diabetes showed that offspring of parents with diabetes were more likely to be obese, have higher waist circumference and higher blood pressure (p -value < 0.01) (Higgins et al., 2005; Sheikh Rashid et al., 2008). Insulin resistance was also found to be higher among children of diabetic parents compared to controls (Higgins et al., 2005). The combination of these risk factors contribute to an increased predisposition for the development of diabetes and cardiovascular disease.

The American Heart Association (AHA) and American Diabetes Association (ADA) have developed guidelines for the prevention of cardiovascular disease and diabetes; these guidelines identify several modifiable risk factors that are known to increase the probability of developing diabetes and/or cardiovascular disease such as diet, physical activity, weight, blood pressure, smoking, lipid metabolism and blood glucose (Harrison et al., 2003; Dorman et al., 2012; Pearson et al., 2002; Eckel et al., 2006; Eckel et al., 2013; Wenger, 2013). There is sufficient literature supporting the

Abbreviations: ADA, American Diabetes Association; AHA, American Heart Association; CVD, Cardiovascular disease; NHANES, National Health and Nutrition Examination Survey; U.S., United States.

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numerous benefits associated with modifying these lifestyle factors, most significantly a decrease in the incidence of both diabetes and heart disease among high risk individuals (Harrison et al., 2003; Pearson et al., 2002; Eckel et al., 2006; Eckel et al., 2013; Wenger, 2013; Go et al., 2014; Wing et al., 1998; Haffner et al., 1989; Knowler et al., 2002; Folsom et al., 2011; Sheppard et al., 2014).

Despite these guidelines, and despite widespread advocacy for healthy lifestyle behaviors, there is a huge disparity between these recommendations and the level of adoption in the general population (Pearson et al., 2002; Folsom et al., 2011). Moreover, little is known about the lifestyle patterns among individuals with family history of diabetes and/or CVD. It can be hypothesized that given their awareness of their family history, they have been motivated individually, or by their health provider to modify certain lifestyle risk factors for disease. The purpose of this study was to assess the association between family history of diabetes and/or CVD and lifestyle behaviors and risk factors (smoking, low physical activity, excessive dietary sodium and cholesterol intake and obesity) using a nationally representative sample of U.S. adults.

2. Methods

2.1. Study design and participants

We used data from the 2009–2012 cycles of the National Health and Nutrition Examination Survey (NHANES). NHANES is a national survey designed to assess the health and nutrition of the United States (U.S.) population (Johnson et al., 2013). It is conducted annually by the Centers for Disease Control and Prevention and National Center for Health Statistics (NCHS) using a complex multistage probability sampling method to achieve a representative sample of the civilian, non-institutionalized U.S. population. NHANES was approved by the NCHS Institutional Review Board and all participants signed an informed consent. Consenting participants provide questionnaire data during home interviews and then undergo physical examinations in mobile examination centers (MEC) (Johnson et al., 2013).

In the 4-year cycle used in this study, there were 20,293 individuals who were interviewed, and 19,591 individuals who had MEC data available. The eligible study population was comprised of participants who were 18 years and older and provided information pertaining to family history status of either diabetes and/or cardiovascular disease ($n = 10,988$) (Fig. 1). All physical examinations and survey questionnaires were administered by trained NHANES staff.

2.2. Exposure definition

To determine family history of diabetes, we used the response to the following NHANES question: “Including living and deceased, were any of your close biological that is, blood relatives including father, mother, sisters or brothers, ever told by a health professional that they had diabetes?”. Similarly, to determine family history of cardiovascular disease, we used the response to the following NHANES question: “Including living and deceased, were any of your close biological that is, blood relatives including father, mother, sisters or brothers, ever told by health professional that they had a heart attack or angina before the age of 50?”. Based on the responses to these two questions, we created four mutually exclusive categories: a) no history, which represents participants who indicated that they do not have a family history of diabetes or cardiovascular disease; b) family history of diabetes; c) family history of cardiovascular disease; d) family history of both diabetes and cardiovascular disease.

2.3. Outcome measures

The following lifestyle behaviors and risk factors were included in the analyses:

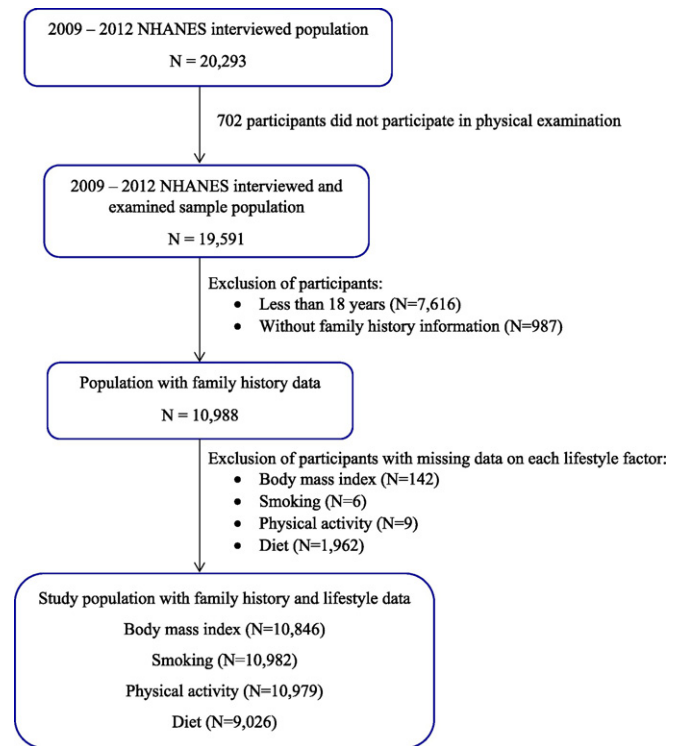


Fig. 1. Flow chart showing study inclusion in the United States population: the 2009–2012 National Health and Nutrition Examination Survey.

2.3.1. Body Mass Index (BMI)

BMI was calculated from body measurements done by trained health technicians in the mobile examination center (MEC). In our analyses, we categorized BMI as: normal ($BMI \leq 24.99 \text{ kg/m}^2$) and overweight/obese ($BMI \geq 25 \text{ kg/m}^2$).

2.3.2. Smoking

Categorized as current, former or never.

2.3.3. Physical activity

Data on this lifestyle behavior was collected using a global physical activity questionnaire administered during the home interview. Based on the reported level of physical activity, participants were initially subdivided into two groups: any activity and absence of physical activity. Participants in the ‘any activity group’ were further sub-divided into two categories according to the 2008 physical activity guidelines (U.S. Department of Health and Human Services, 2008): not recommended ($< 150 \text{ min per week}$) and recommended ($\geq 150 \text{ min per week}$) physical activity. This was achieved by calculating the amount of activity performed per week in minutes using the formula: Moderate activity in minutes per week $+ 2 \times$ Vigorous activity in minutes per week (Centers for Disease Control and Prevention, National Center for Health Statistics, Health Indicators Warehouse, 2013). This equivalent combination formula is centered on the assumption that 1 min of vigorous activity is equivalent to 2 min of moderate activity (U.S. Department of Health and Human Services, 2008; Centers for Disease Control and Prevention, National Center for Health Statistics, Health Indicators Warehouse, 2013).

2.3.4. Dietary sodium and cholesterol

Estimated from the 24-hour dietary recall interview administered to all NHANES participants. Daily average dietary cholesterol was divided into two categories based on the recommended daily intake by AHA of $< 300 \text{ mg}$ and $\geq 300 \text{ mg}$. Similarly, based on AHA guidelines, average

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