



ORIGINAL PAPER

Cardiovascular disease risk among subjects with impaired fasting glucose in the United States: Results from NHANES 1999–2004

Carol E. Koro^{a,b,*}, Steven J. Bowlin^a, Vincent Rabatin^a,
Donald O. Fedder^b

^a Glaxo Smith Kline, 1250 S. Collegeville Road, UP4305, Collegeville, PA 19426, United States

^b University of Maryland, United States

KEYWORDS

Impaired fasting
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Dysglycemia;
Coronary heart disease;
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Summary

Background: Type 2 diabetes is a major independent risk factor for cardiovascular disease. Accumulating evidence suggests that there is an association between cardiovascular risk and impaired fasting glucose. This study describes the prevalence of cardiovascular risk factors and examines the coronary heart disease (CHD) risk among US adults with impaired fasting glucose (IFG).

Methods: This study is a cross-sectional analysis of NHANES 1999–2004. The study included 1925 individuals with normoglycemia, 838 with IFG, and 275 subjects with diabetes. Individuals 20–79 years old and free of CHD were included in this analysis. Ten-year CHD risk was assessed by Framingham Risk Score sheets.

Results: Compared to normoglycemic individuals, subjects with IFG had higher rates of obesity, hypertension, high LDL-C, low HDL-C, and high triglycerides. Among male and female adults, respectively, the 10-year absolute risk of developing CHD increased from 8.78% (95% CI, 7.54–10.03%) and 3.13% (95% CI, 2.86–3.40%) for normoglycemic subjects to 9.11% (95% CI, 8.01–10.22%) and 6.09% (95% CI, 5.62–6.56%) for subjects with IFG, and further to 14.84% (95% CI, 12.95–16.72%) and 13.04% (95% CI, 11.15–14.94%) for subjects with diabetes. Compared to normoglycemic individuals, the 10-year odds ratio for CHD was 1.83 (95% CI, 1.62–2.08) for females and 1.09 (95% CI, 0.88–1.34) for males with impaired fasting glucose.

Conclusions: Females with IFG had a significant 83% increased 10-year risk of developing CHD compared to subjects with normal glucose levels. While our results need replication, controlling IFG in females may reduce their CHD risk.

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* Corresponding author at: Glaxo Smith Kline, 1250 S. Collegeville Road, UP4305, Collegeville, PA 19426, United States.
Tel.: +1 610 917 6422; fax: +1 610 917 4818.

E-mail address: carol.e.koro@gsk.com (C.E. Koro).

Subclinical hyperglycemia, at which people are not clinically diagnosed with diabetes, has been linked to an increased risk for cardiovascular disease including myocardial infarction, stroke, heart failure, and damage to cardiac structure and function [1–3]. Impaired fasting glucose

Table 1 World Health Organization (WHO) and the American Diabetes Association (ADA) values for diagnosis of impaired fasting glucose

	ADA	WHO
Impaired fasting glucose (IFG)	Fasting plasma glucose 100 mg/dL (5.6 mmol/L) to 125 mg/dL (6.9 mmol/L)	Fasting plasma glucose 110 mg/dL (6.1 mmol/L) to 125 mg/dL (6.9 mmol/L)

(IFG) can be considered an intermediate stage of the diabetes disease process. Table 1 summarizes the criteria for IFG diagnosis defined by the World Health Organization (WHO) and the American Diabetes Association (ADA) [4,5]. The prevalence of IFG among US adults is approximately 26.0% [6].

It is well established that type 2 diabetes is a major independent risk factor for cardiovascular disease [7]. Accumulating evidence suggests that there is a progressive relationship between cardiovascular risk and varying glucose levels, ranging from normal values of 70–110 mg/dL to diabetic levels of ≥ 200 mg/dL [1,8,9]. For example, Scheidt-Nave et al. observed a linear relationship between the fasting plasma glucose level and mortality from coronary heart disease among non-diabetic individuals [10]. Further, a meta-analysis of large scale cohort studies observed that IFG increased the cardiovascular risk by 33% (RR = 1.33; 95% CI, 1.06–1.67) over 12.4 years [1]. Similarly, other epidemiologic studies have reported that people with IFG have a higher cardiovascular mortality rate compared to those with normoglycemia [11].

In spite of growing evidence of the relationship, a limited number of studies have systematically examined the CHD risk profiles among people with IFG [11]. In addition, previous studies have observed poor control of cardiovascular risk factors among people with type 2 diabetes in the US [12]. This may indicate that people with IFG may also lack adequate control of cardiovascular risk factors. Hence, the objectives of this study are to describe the prevalence of cardiovascular risk factors among a US sample of normoglycemic individuals, those with impaired fasting glucose, and those with diabetes. In addition, we compared the 10-year CHD risk using the Framingham Risk Score among US adults with IFG to that of subjects with normoglycemia. We used NHANES data that were collected during the years 1999–2004 from a nationally representative sample of the U.S. population.

Research design and methods

Data from the National Health and Nutrition Examination Survey, NHANES, 1999–2004 were used in this analysis. NHANES is a series of surveys conducted by the National Center for Health Statistics,

which is part of the Centers for Disease Control and Prevention. NHANES data were collected from multiple stage stratified cluster samples of the US population, and can be projected to US non-institutionalized individuals.

From the NHANES 1999–2004, adults who were between 20 and 79 years of age at the time of interview and free of self-reported CHD were included in this analysis. In addition to home interviews, laboratory tests such as blood pressure measurements and blood samples were taken at mobile exam units for data collection.

Self-reported demographic information included age, gender and race. To describe the demographic characteristics of the study population, subjects were categorized into 3 age groups: 20–44 years old, 45–64 years old, and 65 years and older. Race was classified into the following four categories: “non-Hispanic white”, “non-Hispanic black”, “Mexican American”, and “Other race”. The “Other race” included the remaining individuals who indicated a race other than “non-Hispanic white”, “non-Hispanic black” or “Mexican American”. Other self-reported data included history of CHD and cigarette smoking. Subjects were identified as having CHD and were excluded from the analysis if they answered ‘yes’ to either one of the following two household interview questions: “Has your doctor ever told you that you have had a heart attack?”; and “Has a doctor or other health professional ever told you that you had coronary heart disease?”. The cigarette smoking status was classified into “current smokers” and “non-smokers” based on the following question: “Do you smoke cigarettes now?” Body Mass Index (BMI) was calculated as weight in kilograms/height in meters squared and was categorized into the following three groups: ≤ 24.9 ; 25.0–29.9; and ≥ 30.0 kg/m² [14].

Subjects were classified into the following three study groups: Impaired fasting glucose (IFG), diabetes mellitus (DM), and normoglycemia. IFG was defined as an 8-h fasting plasma glucose level of 100–125 mg/dL. The DM group consisted of adults with an 8-h fasting plasma glucose levels of >125 mg/dL or those who reported a diagnosis of diabetes. The normoglycemia group consisted of adults who were not classified into either the DM or the IFG group (Table 1).

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