Diabetes, Asymptomatic Hyperglycemia, and 22-Year Mortality in Black and White Men

The Chicago Heart Association Detection Project in Industry Study

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OBJECTIVE — To assess relationships of diabetes and asymptomatic hyperglycemia at baseline to the risk of cardiovascular disease (CVD) and all-cause (ALL) mortality in employed, white and black middle-aged men.

RESEARCH DESIGN AND METHODS — A prospective cohort study of 11,554 white men and 666 black men between the ages 35 and 64 from 1967 to 1973 was conducted using data from the Chicago Heart Association (CHA) Detection Project in Industry 22-year mortality follow-up. Cox proportional hazards models, adjusted for age and other CVD risk factors, were used to estimate the relative risk (RR) and the 95% CI of mortality associated with baseline glycemic status.

RESULTS — Age-adjusted baseline prevalence of clinical diabetes was similar in white (3.7%) and black (4.3%) men; asymptomatic hyperglycemia (glucose post–50-g load ≥11.1 mmol/l) was present in 11.1% of whites and 7.8% of blacks. After controlling for age, lifestyle, and other CVD risk factors, mortality risk was increased among white men with clinical diabetes (CVD: RR 2.51, CI 2.08–3.02; ALL: RR 1.88, CI 1.63–2.17) and asymptomatic hyperglycemia (CVD: RR 1.18, CI 1.01–1.37; ALL: RR 1.24, CI 1.11–1.37), compared with men with postload glucose <8.9 mmol/l. Risks were similarly, though nonsignificantly (owing to low statistical power), increased among black men with clinical diabetes (CVD: RR 1.60, CI 0.60–4.29; ALL: RR 1.78, CI 0.97–3.25) and asymptomatic hyperglycemia (CVD: RR 1.29, CI 0.61–2.72; ALL: RR 1.37, CI 0.85–2.20).

CONCLUSIONS — Asymptomatic hyperglycemia and clinical diabetes appear to confer increased mortality risk in both white and black men. In addition, mortality risk is increased with increased severity of glycemia. These findings indicate the importance of applying efforts to reduce risk factors and prevent diabetes in both blacks and whites.

Age-standardized prevalences of diagnosed and undiagnosed diabetes are higher among black adults compared with white adults in the United States (1). In addition, the mortality rate for cardiovascular diseases (CVD) is higher among blacks than among whites (2). Diabetes is an important independent risk factor for CVD mortality (3–12). Findings from a study based on death certificates suggest that mortality caused by diabetes is much higher among blacks than whites (13). Hyperglycemia, in the absence of clinically diagnosed diabetes, has also been associated with an increased risk of diabetes-related complications (14–18) and of CVD and all-cause (ALL) mortality in some, but not all, white populations (6,7,9,12,19–27) and in Japanese men (28) and Puerto Rican men (8). The contribution of hyperglycemia to mortality, in the absence of clinically diagnosed diabetes, has not been previously assessed among blacks. The Chicago Heart Association (CHA) Detection Project in Industry is one of the largest prospective studies in the United States that contains CVD and all-cause mortality data for blacks and whites. Initial mortality data for men, after an average of 9 years of follow-up, suggested that blacks and whites with diabetes or asymptomatic hyperglycemia had higher death rates than those with normoglycemia (29). We now extend those observations to 22 years of follow-up. In addition, the baseline prevalence and independent effect of asymptomatic hyperglycemia on mortality are also assessed.

RESEARCH DESIGN AND METHODS

—The background and methodology of the CHA study have been described in reports on this and related population surveys (7,30,31). Briefly, 39,573 individuals aged 18 years and older and employed at 84 companies and institutions in the Chicago area were surveyed from November 1967 to January 1973. The response rate was 53%.

Demographic data, history of diabetes, history of drug treatment for diabetes and hypertension, and history of cigarette smoking were ascertained by a self-administered questionnaire. A 50-g glucose load was administered without regard to fasting status or time of day to those individuals not currently receiving treatment for diabetes. Blood for plasma glucose measurement was drawn ~1 h after loading and measured with the auto-analyzer adaptation of Hoffman's method (32). Total serum cholesterol was measured from a venous blood sample using standardized methods

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ALL, all-cause; CVD, cardiovascular disease; CHA, Chicago Heart Association; ECG, electrocardiograms; ICD, International Classification of Diseases; NDDG, National Diabetes Data Group; NHANES, Nutrition Examination Survey; RR, relative risk; WHO, World Health Organization.

described previously (30). Height and weight were measured to calculate BMI (weight [kilograms]/height [meters] squared). A single casual supine blood pressure was obtained using a standard mercury sphygmomanometer. Electrocardiograms (ECGs) were obtained as previously described (33); ECG abnormalities were classified as major or minor based on criteria of the Hypertension Detection and Follow-Up Program, which are slight modifications of those used by the national cooperative Pooling Project (34).

Vital status through 1992 was ascertained by periodic follow-up of participants through local contact and the Social Security Administration before 1979 and by the use of the National Death Index since 1979. Death certificates were obtained for known decedents. The underlying cause of death was determined from the death certificate and classified according to the eighth revision of the International Classification of Diseases (adapted for use in the U.S.) (ICDA-8) (35). Deaths from cardiovascular diseases were those assigned to ICD codes 400.0–445.9.

The cohort selected for these analyses consisted of white and black men aged 35–64 years at baseline. Men who already had ECG evidence of a previous myocardial infarction at baseline, who had no follow-up information, or who had missing data for any of the variables considered were excluded (1.3%). A total of 104 (0.8%) men were excluded because they did not have a postload glucose level and also did not have a history of diabetes. In addition, in order to standardize interpretation of the postload levels, men whose glucose level was drawn before 30 min or more than 65 min after loading were excluded (4.3% of white and 4.7% of black men). Hereafter, the glucose level will be referred to as a "1-h post–50-g plasma glucose." Included in this analysis were 11,554 white and 666 black men. After an average follow-up of 22 years, there were 1,411 (whites) and 75 (blacks) deaths owing to CVD and 3,014 (whites) and 189 (blacks) deaths owing to all causes, respectively.

Data analysis

Glycemic status at baseline was classified within race. For purposes of these analyses, glycemic status was classified as clinical diabetes, asymptomatic hyperglycemia, or neither. Clinical diabetes was defined as a self-report of previous diagnosis by a physician whether the participant was currently receiving treatment or not. Asymptomatic hyperglycemia was defined as a plasma glucose level ≥11.1 mmol/l after a 50-g oral glucose load. This definition was used to maintain consistency with previous reports from the CHA study (7,29). Subjects not classified as clinically diabetic or asymptomatic hyperglycemic were dichotomized according to 1-h post–50-g load plasma glucose level as <8.9 mmol/l or 8.9–11.0 mmol/l. The latter category represents the top 25% of the nondiabetic, nonasymptomatic hyperglycemic distribution of glucose in white men and the top 15% in black men. Data to apply the current criteria for classification and diagnosis of diabetes and other categories of glucose intolerance delineated by the National Diabetes Data Group (NDDG) (17) and the World Health Organization (WHO) (18) were not available from the baseline examination.

Baseline prevalence and distribution of other CVD risk factors were assessed by race and glycemic status. Cholesterol ≥6.20 mmol/l was classified as high blood cholesterol (36). Subjects with systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg or on antihypertensive medication were classified as having high blood pressure (37). Overweight was defined based on National Health and Nutrition Examination Survey (NHANES) II criteria for men as BMI ≥27.8 kg/m^2 (38). Age-adjusted mortality rates per 10,000 person-years of observation were calculated using direct standardization for black and white men according to glycemic status for deaths owing to CVD and all causes. Person-years of exposure were calculated as time from date of baseline examination to time of death or 31 December 1992. To test for differences in CVD and all-cause mortality rates between black and white men by glycemic status, Cox proportional hazards analysis was used. The same analysis was also used to determine age-adjusted relative risk (RR) and corresponding 95% CI of CVD and all-cause mortality by glycemic status for black and white men separately. Men with a 1-h post–50-g load plasma glucose level <8.9 mmol/l were used as the reference group. To determine whether clinical diabetes or asymptomatic hyperglycemia was an independent risk factor for mortality, these analyses were repeated in one model with adjustment for potential lifestyle confounders (years of education, number of cigarettes smoked per day, BMI, BMI^2) in addition to age, and the analyses were repeated in a second model that adjusted for lifestyle factors plus other known CVD risk factors (baseline serum total cholesterol, systolic blood pressure, antihypertensive treatment, any ECG abnormality) in addition to age. The purpose of adjusting for lifestyle and other CVD risk factors in a stepwise manner was to avoid potential overadjustment. To test for mortality trend by glycemic status, a model was run with glucose as a continuous variable, excluding persons with clinical diabetes. To determine whether the association between glycemic status and mortality differed by race, these analyses were repeated in models with both races combined with interaction terms for race and glycemic status, adjusted for age, potential lifestyle confounders, and other CVD risk factors.

RESULTS

Baseline characteristics of whites and blacks

Table 1 presents baseline characteristics for white and black men. Age-adjusted prevalence of clinical diabetes was similar in white (3.7%) and black (4.3%) men. Asymptomatic hyperglycemia was present in 11.1% of white men, compared with 7.8% of black men. For multiple characteristics, average values were lowest for men (both white and black) with lowest 1-h post–50-g load glycemia level (<8.9 mmol/l), including age, BMI, serum cholesterol, systolic blood pressure, diastolic blood pressure, and prevalence of overweight, high blood cholesterol (cholesterol ≥6.20 mmol/l), high blood pressure, antihypertensive drug treatment, and ECG abnormalities. These values tended to be progressively higher for subjects in the strata with postload glucose 8.9–11.0 mmol/l and asymptomatic hyperglycemia, and the values were also higher in men with clinical diabetes, compared with men with postload glucose <8.9 mmol/l. For several of these characteristics (cholesterol, systolic blood pressure, diastolic blood pressure), levels were highest for men with asymptomatic hyperglycemia, not for men with clinical diabetes.

Adjusted CVD and all-cause mortality by glycemic status

CVD mortality. The rates of CVD mortality according to glycemic status did not differ significantly between white and black men (Table 2). Among white men,

Table 1—*Characteristics by glycemic status at baseline, CHA Detection Project in Industry, black and white men ages 35–64 at entry*

	White men				Black men			
Risk factor	<8.9 mmol/l	8.9–11.0 mmol/l	Asymptomatic hyperglycemia ≥11.1 mmol/l	Diabetes	<8.9 mmol/l	8.9–11.0 mmol/l	Asymptomatic hyperglycemia ≥11.1 mmol/l	Diabetes
n	7,476	2,354	1,297	427	499	95	46	26
Plasma glucose (mmol/l)	6.7 ± 1.2	9.8 ± 0.6	13.1 ± 2.6	—	6.6 ± 1.3	9.7 ± 0.7	13.9 ± 4.1	—
Age (years)	46.6 ± 7.8	49.2 ± 7.9	50.8 ± 7.8	51.8 ± 7.7	45.1 ± 7.8	48.3 ± 7.6	50.0 ± 6.9	47.3 ± 7.1
Education (years)	13.1 ± 2.8	13.0 ± 2.8	12.7 ± 2.8	12.7 ± 2.8	11.8 ± 2.8	11.2 ± 2.1	11.3 ± 2.6	12.4 ± 3.7
Current smoking	39.8	40.4	43.2	40.3	55.7	55.8	45.7	50.0
Number of cigarettes	24.0 ± 11.1	23.8 ± 11.0	25.0 ± 11.8	23.7 ± 12.1	16.9 ± 8.8	16.3 ± 8.3	17.2 ± 11.4	19.8 ± 12.1
BMI (kg/m^2)	26.8 ± 3.4	27.5 ± 3.6	28.0 ± 4.0	27.6 ± 4.3	26.8 ± 4.0	28.2 ± 3.7	29.0 ± 4.6	29.5 ± 5.0
Overweight	34.7	43.7	49.1	43.8	37.1	55.8	50.0	65.4
Cholesterol (mmol/l)	5.41 ± 0.95	5.55 ± 0.94	5.56 ± 0.93	5.51 ± 1.00	5.28 ± 0.95	5.37 ± 0.96	5.55 ± 1.05	5.31 ± 1.08
High blood cholesterol	18.9	22.9	23.5	21.6	16.6	21.1	28.3	34.6
sBP (mmHg)	138.4 ± 18.0	143.9 ± 20.0	151.0 ± 22.7	145.7 ± 22.4	141.1 ± 23.1	154.0 ± 23.6	151.7 ± 21.0	145.8 ± 19.3
dBP (mmHg)	82.2 ± 11.1	85.2 ± 11.6	88.5 ± 12.9	84.8 ± 11.4	84.8 ± 14.1	91.5 ± 13.5	92.3 ± 12.7	90.6 ± 10.2
Antihypertensive Rx	4.2	7.2	10.3	10.3	3.8	6.3	6.5	11.5
High blood pressure	56.2	67.1	77.0	68.2	58.3	80.0	87.0	84.6
Any ECG abnormality	13.4	15.8	22.4	19.9	17.6	32.6	30.4	11.5

Data are means ± SD or %. Diabetes was determined by subject's self-reported medical history. Overweight was defined as BMI ≥27.8 kg/m^2. High blood cholesterol is serum cholesterol ≥6.20 mmol/l and high blood pressure is sBP ≥140 mmHg or dBP ≥90 mmHg or antihypertensive treatment. Number of cigarettes is amount per day among current smokers only. sBP, systolic blood pressure; dBP, diastolic blood pressure.

the age-adjusted CVD mortality rate increased from 53.1 per 10,000 patient-years of observation for those with a baseline post–50-g load plasma glucose concentration <8.9 to 80.4 and 154.1 per 10,000 person-years for those with asymptomatic hyperglycemia and clinical diabetes, respectively. A similar trend was observed among black men where the age-adjusted rate was 56.8 per 10,000 person-years for those with the lowest postload glucose level, and increased to 79.9 and 129.7 per 10,000 person-years among those with asymptomatic hyperglycemia and clinical diabetes, respectively.

Age-adjusted RR of CVD mortality associated with hyperglycemia after a 50-g load was similar in white and black men. The risk increased with higher postload glucose level, and both white and black men with clinical diabetes had the highest RR of CVD mortality. With adjustment for age and lifestyle factors, the relative risk in each category was slightly reduced; the pattern of findings remained. With additional adjustment for other CVD risk factors, there was a further slight reduction in relative risk in each category of glycemic status. Among white men, asymptomatic hyperglycemia at baseline was positively

Table 2—*22-year adjusted CVD mortality by baseline glycemic status, CHA Detection Project in Industry, black and white men ages 35–64 at entry*

	White men				Black men			
Risk factor	<8.9 mmol/l	8.9–11.0 mmol/l	Asymptomatic hyperglycemia ≥11.1 mmol/l	Diabetes	<8.9 mmol/l	8.9–11.0 mmol/l	Asymptomatic hyperglycemia ≥11.1 mmol/l	Diabetes
n	7,476	2354	1,297	427	499	95	46	26
Number of deaths	733	310	232	136	45	16	9	5
Rate*†	53.1	61.1	80.4	154.1	56.8	86.7	79.9	129.7
RR‡	1.00	1.13	1.49	2.76	1.00	1.46	1.61	2.14
95% CI‡		(0.99–1.29)	(1.28–1.73)	(2.29–3.32)		(0.83–2.60)	(0.78–3.31)	(0.85–5.38)
RR§	1.00	1.10	1.36	2.65	1.00	1.32	1.47	1.72
95% CI§		(0.96–1.26)	(1.17–1.58)	(2.20–3.19)		(0.74–2.35)	(0.70–3.07)	(0.67–4.42)
RR‖¶	1.00	1.04	1.18	2.51	1.00	1.17	1.29	1.60
95% CI‖		(0.91–1.19)	(1.01–1.37)	(2.08–3.02)		(0.66–2.10)	(0.61–2.72)	(0.60–4.29)

Diabetes was determined by subject's self-reported medical history. RR, Cox proportional hazards analysis relative risk. *Per 10,000 person-years adjusted for age (years), and estimate may be unstable for black men due to small number of individuals. †There was no statistically significant difference between races by glycemic status. ‡Adjusted for age (years). §Adjusted for age (years), education (years), cigarettes (number per day), BMI, and BMI^2. ‖Adjusted for age (years), education (years), cigarettes (number per day), BMI, BMI^2, cholesterol (mg/dl), systolic blood pressure (mmHg), antihypertensive medication use, and any ECG abnormality. ¶Test of trend for glucose based on Cox regression using glucose as a continuous variable (excluding diabetic men): white men $P = 0.0004$, black men $P = 0.13$. There was no statistically significant race–by–diabetes status interaction for RR.

Table 3—*22-year adjusted all-cause mortality by baseline glycemic status, CHA Detection Project in Industry, black and white men ages 35–64 at entry*

	White men				Black men			
Risk factor	<8.9 mmol/l	8.9–11.0 mmol/l	Asymptomatic hyperglycemia ≥11.1 mmol/l	Diabetes	<8.9 mmol/l	8.9–11.0 mmol/l	Asymptomatic hyperglycemia ≥11.1 mmol/l	Diabetes
n	7,476	2,354	427	427	499	95	46	26
Number of deaths	1,640	657	500	217	121	33	22	13
Rate*†	118.2	131.5	177.2	240.2	146.4	175.9	214.9	342.3
RR‡	1.00	1.09	1.47	2.03	1.00	1.18	1.59	2.10
95% CI‡		(0.99–1.19)	(1.33–1.63)	(1.76–2.34)		(0.80–1.74)	(1.00–2.51)	(1.19–3.72)
RR§	1.00	1.07	1.37	1.97	1.00	1.18	1.51	1.89
95% CI§		(0.98–1.17)	(1.24–1.52)	(1.70–2.27)		(0.80–1.74)	(0.95–2.42)	(1.05–3.39)
RR‖¶	1.00	1.03	1.24	1.88	1.00	1.10	1.37	1.78
95% CI‖		(0.94–1.12)	(1.11–1.37)	(1.63–2.17)		(0.74–1.64)	(0.85–2.20)	(0.97–3.25)

Diabetes was determined by subject's self-reported medical history. RR, Cox proportional hazards analysis relative risk. *Per 10,000 person-years adjusted for age (years), and estimate may be unstable for black men due to small number of people. †For comparison of black to white men: $P < 0.01$ for glucose < 8.9 mmol/l, $P = 0.06$ for glucose 8.9–11.0 mmol/l, and $P > 0.10$ for asymptomatic hyperglycemia and diabetes. ‡Adjusted for age (years). §Adjusted for age (years), education (years), cigarettes (number per day), BMI, BMI². ‖Adjusted for age (years), education (years), cigarettes (number per day), BMI, BMI², cholesterol (mg/dl), systolic blood pressure (mmHg), antihypertensive medication use, and any ECG abnormality. Test of trend for glucose based on Cox regression using glucose as a continuous variable (excluding diabetic men): white men $P = 0.0001$, black men $P = 0.34$. There was no statistically significant race–by–diabetes status interaction for RR.

associated with CVD mortality after adjustment for lifestyle and other CVD risk factors (RR 1.18; 95% CI 1.01–1.37), and RR was highest among those with clinical diabetes (RR 2.51; 95% CI 2.08–3.02). There was a significant positive association between glucose and mortality (P trend < 0.001). Among black men, asymptomatic hyperglycemia (RR 1.29; 95% CI 0.61–2.72) and clinical diabetes (RR 1.60; 95% CI 0.60–4.29) were associated with increases in risk of CVD mortality similar to those for white men, although these increases were not statistically significant. The mortality trend associated with glucose level approached borderline significance ($P = 0.13$).

All-cause mortality. Overall, black men appeared to be at higher risk of all-cause mortality than whites (Table 3). Among white men, the age-adjusted all-cause mortality rate increased from 118.2 per 10,000 person-years for those with baseline 1-h post–50-g load plasma glucose concentration <8.9 mmol/l to 177.2 and 240.2 per 10,000 person-years for those with asymptomatic hyperglycemia and clinical diabetes, respectively. A similar trend was observed among black men where the rate was 146.4 per 10,000 person-years for those in the group with the lowest postload glucose concentration, and increased to 214.9 in men with asymptomatic hyperglycemia and 342.3 per 10,000 person-years among those with clinical diabetes. For every stratum, all-cause mortality rates were higher in black men compared with white men.

Among both, there was a positive association between asymptomatic hyperglycemia and the age-adjusted RR of all-cause mortality, and RR was greatest in men with clinical diabetes. This pattern of findings remained after adjustment for age and lifestyle factors. After adjustment for multiple potential confounders (age, lifestyle, and other CVD risk factors), asymptomatic hyperglycemia was positively associated with all-cause mortality in white men (RR 1.24; 95% CI 1.11–1.37), and RR was highest among those with clinical diabetes (RR 1.88; 95% CI 1.63–2.17). There was a significant positive association between glucose and mortality among nondiabetic white men (P trend <0.001). Asymptomatic hyperglycemia (RR 1.37; 95% CI 0.85–2.20) and clinical diabetes (RR 1.78; 95% CI 0.97–3.25) were associated with similar (but not statistically significant) increases in risk of all-cause mortality among black men.

CONCLUSIONS—Findings from this prospective cohort study suggest that clinical diabetes at baseline has similar adverse effects on risk of CVD and all-cause mortality after 22 years of follow-up in white and black men. In addition, asymptomatic hyperglycemia is related to increased risk of mortality in both white and black men. The association between diabetes and mortality has been demonstrated and quantitated in many prospective population-based studies (3–12,19,27–29,39,40); however, only a few of these have reported results for blacks (3,29,39). The Charleston Heart Study showed nonsignificantly increased CHD mortality risk associated with diabetes in 653 white men and 333 black men after 30 years of follow-up (39). Results from the much larger Multiple Risk Factor Intervention Trial (MRFIT) screenee study showed that diabetes was independently associated with a similar and significantly increased risk of CVD mortality in both white and black men (3). Neither of these studies reported results for hyperglycemia in the absence of clinical diabetes. In an earlier report of the CHA study, Cooper et al. (29) found higher CVD and all-cause mortality in white and black men with diabetes or asymptomatic hyperglycemia (1-h post–50-g load plasma glucose ≥11.0 mmol/l or casual glucose ≥8.9 mmol/l) at baseline compared with normoglycemia. Results were not presented separately, however, for asymptomatic hyperglycemia.

The International Collaborative Group reviewed 15 population-based studies of middle-aged men and did not find consistent evidence for an independent association between asymptomatic hyperglycemia (using various measures and definitions) and coronary heart disease (26). Several more recent studies of mostly white men with longer follow-up and larger numbers of events showed that elevated glucose in the absence of diabetes is positively associ-

ated with coronary heart disease mortality risk (6,7,9,12,19–21, 23,28,41,42).

Our findings for mortality risk were slightly weaker after adjustment for education, BMI, and smoking, in addition to age. With further adjustment for other CVD risk factors, the positive association between glycemic status and mortality remained but was slightly weaker. This supports findings from other studies indicating that the effects of diabetes or asymptomatic hyperglycemia are mediated to some extent by other CVD risk factors (14,41,43), which may include insulin resistance and hyperinsulinemia (44). However, despite this, there was still evidence of an independent effect of diabetes and asymptomatic hyperglycemia on CVD and all-cause mortality.

Limitations of the present study should be considered in interpreting the results. First, the study was conducted before the establishment of the NDDG (17) and WHO (18) criteria for the classification and diagnosis of diabetes and other categories of glucose intolerance for epidemiologic studies. Findings may be biased conservatively, since the criteria we used to determine clinical diabetes may have resulted in the exclusion of individuals from the diabetic group who were truly diabetic, because individuals with diabetes not on insulin or drug treatment may have not reported the diagnosis. The classification used to define asymptomatic hyperglycemia was somewhat arbitrary, so some misclassification inevitably occurred. In addition, use of a single measurement of glucose level and other baseline risk factors may result in misclassification caused by normal physiological variation. The ability of a single oral glucose tolerance test to characterize an individual's glycemic status is relatively low (22,45). Consequently, risk relationships based on a single measurement are underestimates, owing to regression dilution bias (46). There is also lack of information on glycemic status and other CVD risk factors in this cohort after baseline assessment. One of the strongest risk factors for glucose intolerance is age (15). Therefore, in an aging population, it is likely that lack of follow-up data on glycemic status and other risk factors conservatively biases the findings.

Despite these limitations, which make it more difficult to detect an effect, the data indicate that the risk of mortality over 22 years was related to the magnitude of post–glucose load hyperglycemia at baseline. Incremental increase in risk was similar in black and white men. That risks associated with clinical diabetes and asymptomatic hyperglycemia were statistically significant only in white men is probably due to the fact that the number of black men was relatively small, and there was a limited number of CVD events in the black men; therefore, power to detect an association among black men was low.

Understanding the risks associated with asymptomatic hyperglycemia is important because individuals with mild glucose intolerance comprise more than half of those with abnormal glucose tolerance in the U.S. population (15), and impaired glucose tolerance is a strong risk factor for diabetes (47). In the CHA cohort, prevalence of several cardiovascular risk factors at baseline was higher not only among men with clinical diabetes, but also among both white and black men with asymptomatic hyperglycemia. The excess prevalence of most cardiovascular risk factors in association with abnormal glucose tolerance has been shown in several other studies (6,19,21,41,48,49). Results from this CHA analysis showed that increased mortality risk was partially mediated by these risk factors. However, increased mortality risk was not fully attenuated, which suggests that asymptomatic hyperglycemia, even in the absence of other CVD risk factors, is not a benign condition.

In summary, our findings suggest that asymptomatic hyperglycemia and clinical diabetes confer increased mortality risk in both white and black middle-aged men. In addition, mortality risk is increased with increased severity of glycemia. This shows the importance of applying efforts to reduce risk factors and prevent diabetes in blacks and whites. If studies such as the Diabetes Prevention Program find that onset of both diabetes and CVD can be prevented or delayed in high-risk subjects, multiple risk factor screening, including screening for glucose intolerance, may become part of routine preventive health care in the future.

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