RISK FACTORS FOR CORONARY HEART DISEASE IN A BLACK POPULATION

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A matched case control study using population-based controls was done over a 2-year period in an urban, public hospital setting. The object of the study was to determine if the established risk factors for coronary heart disease—hypertension, diabetes mellitus, hypercholesterolemia, cigarette smoking, low socioeconomic status (as reflected by occupational class and educational level), marital status, and obesity were associated with coronary heart disease in a black population. The established risk factors were found to be significant in this patient population, as was obesity. Being divorced or separated was a risk factor for women but not for men. (*J Natl Med Assoc.* 1992;84:393-398.)

Key words • coronary heart disease • risk factors

Coronary heart disease is the leading cause of death among blacks and whites in the United States. The mortality rate for US blacks from coronary heart disease are among the highest in the world, higher than most white populations in Europe and elsewhere.[1]

For many years, the incidence of coronary heart disease was thought to be low in blacks compared to whites, probably in part because of a low rate of case finding in blacks. Studies in Evans County, Georgia,[2] showed a lower incidence of coronary heart disease in blacks.

Peniston and Randall[3] cite a 25-year prospective study by Thomas et al of a large cohort of black and white male physicians, with 80% follow-up of each cohort. The study showed that 52% of black physicians compared to 13.8% of white physicians developed hypertension, and 4% of blacks versus 0.3% of whites developed myocardial infarctions.

The established independent risk factors for coronary heart disease are hypertension, cigarette smoking, hypercholesterolemia, diabetes mellitus, electrocardiographic abnormalities, age, and male sex. Less established risk factors are obesity, physical inactivity, hypertriglyceridemia, psychosocial stress, and low socioeconomic status.[4] Alcohol has been shown to have a protective effect in both men and women.[5,6]

Those risk factors are not so clear-cut for blacks. Gillum did not find a familial aggregation of coronary heart disease in black populations. Male sex was a risk factor in blacks, but less so than in whites. Hypertension was a risk factor in blacks, but coronary heart disease rates were lower for black males at every level of hypertension. The rates were similar in black and white females at similar blood pressure levels. There was no consistent relationship between hypertension or serum cholesterol and coronary heart disease in blacks.[7]

Gillum also found that there was no relationship between coronary heart disease incidence and serum lipid levels in black females. Also, black males had a lower incidence of coronary heart disease than white

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males at all serum lipid levels.[7] The Evans County study found no consistent relationship between hypertension or cholesterol and coronary heart disease.[8]

The Framingham minority study, however, showed lower HDL cholesterol levels in blacks than in whites. This correlated with a higher educational level for blacks compared to whites in that population.[9]

Other risk factors—electrocardiograph abnormalities, overweight, physical inactivity, alcohol, low fibrinolytic activity, and low socioeconomic status—are suspected of being associated with coronary heart disease, but have not been proved conclusively in blacks.

A study by Walter and Hofman suggested that in children, environment rather than race determine risk factors for coronary heart disease.[10]

The present study was undertaken to assess the risk factors for coronary heart disease in an urban, black population.

MATERIALS AND METHODS

All 115 black patients who were admitted to the coronary care unit between July 1, 1987 and June 30, 1989 and who were 30 to 69 years old with documented angina or myocardial infarction were included in the study. One of three cardiologists made the diagnosis in each instance. Patients with sudden death were not included in the study. Where available, angiographic data were used to support the diagnosis of coronary heart disease. The medical records of the cases were reviewed. A telephone interview was conducted to complete the data collection on the cases.

Age- and sex-matched controls were obtained for 82% of the male cases and 92% of the female cases through a random digit dialing telephone survey of wards 2, 5, 6, 7, and 8 in Washington, DC. These wards are the wards from which the cases came. The population-based control group was obtained using the method of Hartge et al.[11] The city wards used in the study constitute the service area of DC General Hospital.[12]

A random sample was drawn from the telephone exchanges of all the cases. Eligible subjects in each household were those between 30 and 69 years of age who had no personal history of angina pectoris or myocardial infarction, as determined by the Rose Questionnaire.[13] One eligible subject in each household was interviewed.

Exclusion bias was minimized in the control group by taking all possible measures to optimize the response rate, including repeated calls to unanswered numbers. The controls were limited to those who had telephones—this excluded the homeless (most of the homeless in DC are younger than 40 years of age), households without phones, and households where the occupants do not speak English. Most of the target population, however, do speak English.

The variables used in the study were:

- age (matched within 5 years),
- sex,
- body mass index (BMI weight [kg]/height [m^2]),
- hypertension (systolic blood pressure [BP] $\geq$ 160 mm Hg or diastolic BP $\geq$ 90 mm Hg),
- diabetes mellitus (fasting blood glucose $>$ 140 mg/dL),
- cigarette smoking (smoking every day for the 3 months preceding the study),
- number of cigarettes smoked,
- hypercholesterolemia, and
- alcohol intake.

Alcohol intake was based on the following: 12-ounce beer = 13.2 g, 4-ounce wine = 10.8 g, one standard drink of liquor = 15.1 g.[5]

Stratification of alcohol intake was based on the following: low intake = 0.1 to 5 g per day, moderate intake = 5.1 to 30 g per day; and high intake = $\geq$ 31 g per day.[6] Hypercholesterolemia was defined as total cholesterol level $\geq$ 200 mg/dL, measured by the Ectochem 700 Kodak dry slide method.

Obesity was defined as BMI $\geq$ 27 kg/m^2 in males and $\geq$ 25 kg/m^2 in females.

Occupational classes were divided as follows: manual labor (requiring $>$ 75% physical work); service job (sales, office work, etc); professional (white collar); and housewife (working in the home). A case or control was considered working if he or she had been working for at least 6 months prior to the study.

Marital status was characterized as married, single, widowed, or separated/divorced.

To decrease the difference in precision in the measurement of variables between cases and controls, controls were asked when they last visited a physician and when they were last told by the physician that their blood pressure, blood sugar, or cholesterol were normal or abnormal.

McNemar's test with Yates' correction was used to calculate odds ratios. Occupational class, educational level, number of cigarettes smoked, amount of alcohol consumed, marital status, and educational level were subdivided and odds ratios calculated for the matched pairs. Logistic regression was done using the logit module of the Systat statistical package.

TABLE 1. CHARACTERISTICS OF CASES AND CONTROLS

	Males		Females	
	Cases	Controls	Cases	Controls
Number	45	45	52	52
Average age (years)	53	52	60	58
Body mass index (average)	28.3	27.0	29.6	28.0
Hypertension (%)	64	36	87	40
Diabetes mellitus (%)	27	7	46	13
Hypercholesterolemia (%)	43	35	64	21
Cigarette smokers (%)	64	49	52	27
Average no. cigarettes/day	21.0	17.8	15.6	11.1
Percent using alcohol	67	73	38	29
Low intake (%)	50	67	94	93
Moderate intake (%)	10	27	6	7
High intake (%)	40	6	0	0
Occupational class				
Manual labor (%)	58	32	26	28
Service job (%)	36	32	29	34
Professional (%)	6	36	16	28
Housewife (%)	0	0	29	10
Percent working at least six months prior to the study	27	60	12	37
Marital status				
Married (%)	38	27	17	33
Single (%)	22	38	13	10
Widowed (%)	11	8	32	37
Separated/divorced (%)	29	27	38	20
Educational attainment				
Less than high school (%)	55	22	52	34
High school (%)	39	39	39	40
Some college or other post-high school (%)	6	39	9	26

RESULTS

Forty-five males and 52 females were paired with age and sex-matched controls.

Comparing male cases with controls, both were obese (BMI $\geq$ 27 kg/m^2), and more cases than controls were hypertensive, diabetic, cigarette smokers, manual laborers, and less well-educated. Fewer cases than controls had worked in the 6 months prior to the study (Table 1).

Both female cases and controls were also obese (BMI $\geq$ 25 kg/m^2). More female cases than controls were hypertensive, diabetic, hypercholesterolemic, cigarette smokers, separated or divorced, and less well-educated. Fewer were working outside the home in the 6 months prior to the study (Table 1).

Significance testing for the matched pairs showed that in men hypertension, diabetes mellitus, unemployment, and low educational achievement were risk factors for coronary heart disease. Hypercholesterolemia, cigarette smoking, and alcohol use were not significantly different between the cases and controls.

Body mass index, number of cigarettes smoked, amount of alcohol consumed, occupational class, marital status, and educational achievement were subdivided in men and odds ratios performed on the strata (Table 2). Normal body weight decreased the coronary heart disease risk by one half (odds ratio 0.5) and obesity doubled the risk (odds ratio 2.0). Smoking more than one pack of cigarettes a day increased the risk of coronary heart disease by one and a half times.

Low to moderate intake of alcohol decreased the risk by one third but high intake of alcohol ($>$ 31 g per day) increased the risk elevenfold.

The difference in manual labor was not significant when controlled for the number of cases and controls unemployed. Marital status was not significant except that in men being single seemed to decrease the risk by one third (odds ratio 0.36). Lower educational achievement conferred a substantial risk for coronary heart disease (odds ratio 11.0) (Table 2).

Significance testing on the matched pairs in women showed that the cases had significantly higher levels of

TABLE 2. SUBDIVISION OF VARIABLES

	Odds ratio*	
	Males	**Females**
Body Mass Index		
≤ 27 kg/m² (males)	0.62	
≤ 25 kg/m² (females)		0.50
≥ 28 kg/m² (males)	2.00	
≥ 26 kg/m² (females)		2.50
Number of Cigarettes Smoked/Day		
< 10	0.83	0.25
11-20	1.43	5.00
> 20	1.50	1.50
Amount of Alcohol Used		
Low	0.36	1.00
Moderate	0.33	1.00
High	11.00	†
Occupational Class		
Manual labor	3.20	1.0
Service job	1.20	1.50
Professional	0.09	†
Marital Status		
Married	1.8	0.4
Single	0.36	1.3
Widowed	1.0	0.75
Separated/divorced	1.3	2.3

*Mantel-Haenszel summary odds ratio.
†Insignificant numbers for computation.

hypertension, diabetes mellitus, hypercholesterolemia, and cigarette smoking. There were no significant differences between cases and controls for alcohol use, unemployment, or low educational attainment (Table 3).

When the variables were subdivided in women and odds ratios performed on the strata, normal body weight decreased the risk of coronary heart disease by one half (odds ratio 0.5), while obesity more than doubled the risk (odds ratio 2.5). Smoking more than half a pack of cigarettes a day increased the risk substantially. Being married decreased the risk and being separated or divorced increased the risk twofold. Low educational attainment risk in women was not as substantial a risk for coronary heart disease as in men, but did confer some risk (odds ratio 0.4) (Table 2).

Multivariate analysis confirmed that when adjusted for other variables, hypertension, diabetes mellitus, unemployment, and cigarette smoking were still risk factors for coronary heart disease in both men and women (Tables 4A & 4B). When controlling for other factors, hypercholesterolemia was a risk factor in men as well as women (odds ratio 2.0 in men, 4.7 in women). Low educational achievement still conferred less risk in females (odds ratio 1.5) than in males (odds ratio 3.8).

DISCUSSION

The small number of cases admitted to the coronary care unit over this 2-year period suggests a relatively low overall prevalence rate of coronary heart disease. The authors looked only at angina and myocardial infarction, however, and not at sudden death. Sudden death is thought to be more common among blacks than whites and to account for a substantial percentage of coronary heart disease in blacks.[14,15]

The telephone survey probably captured most of the target population, even in this largely low income group. According to Hartge et al,[11] telephone coverage is high in most regions of the United States among most demographic and economic groups. Even in families with an annual income less than $3000, over 70% of homes have telephones. Ninety-four percent of whites and 84% of blacks live in households that own phones. Hartge[16] was able to get high response rates in phone interviews. The response rate to the authors' survey was similar.

Matching for age and sex was done to decrease selection bias and to increase the power of the statistical tests.

An important source of bias may have been introduced because of a difference in precision in measuring diabetes mellitus, hypertension, and hypercholesterolemia in the cases compared to controls. For the cases, the actual values for blood sugar and blood cholesterol as well as actual measurements of blood pressure were recorded. The variables were self-reported for controls. To minimize this bias, the study instrument—the questionnaire—was designed so that the respondents were asked if they have ever been told by a physician that they had diabetes mellitus, hypertension, or hypercholesterolemia. The respondents were also asked when a physician had last checked these three risk factors.

There was no incentive for false reporting of the presence or absence of the conditions. The respondents were given the opportunity to answer "yes," "no", or "don't know" when asked if the condition was present.

Nondifferential random error in nominal independent variables will variably bias the point estimate, interval estimate, and inference, depending on the sensitivity and specificity.[17,18] If more of the respondents who do not really have the risk factor say they do, the

TABLE 3. TEST FOR SIGNIFICANCE—MATCHED PAIRS

	Males		Females	
	Chi square*	*P*	Chi square	*P*
Hypertension	7.34	<0.001	24.00	<0.001
Diabetes mellitus	8.33	<0.005	10.70	<0.005
Hypercholesterolemia	0.22	NS	15.38	<0.001
Cigarette smoking	3.20	NS	8.17	<0.005
Alcohol use	0.05	NS	1.85	NS
Working status (not working vs working)	5.76	<0.025	3.27	NS
Educational level	7.00	<0.01	2.78	NS

*Chi square using McNemar's test with Yates' correction.
Not significant at $P>.05$.

TABLE 4A. MULTIVARIATE ANALYSIS (MALES)

Variable	Estimate	Standard Error	Adjusted Odds Ratio
Hypertension	−50.14849	227139.5	6.0
Diabetes mellitus	−178.3175	447533.7	2.8
Cholesterol	−180.3418	420327.5	2.0
Cigarettes	.5173546	.3271603	1.7
Work status	−54.90623	180824.0	7.0
Education level	−1.341895	.5563667	3.8

TABLE 4B. MULTIVARIATE ANALYSIS (FEMALES)

Variable	Estimate	Standard Error	Adjusted Odds Ratio
Hypertension	1.327878	2.890319	3.8
Diabetes mellitus	3.262079	4.034221	26.1
Cholesterol	1.542695	5.428576	4.7
Cigarettes	.6817197	.5654326	2.0
Work status	1.387991	3.319199	4.0
Education level	.3773325	.4024403	1.5

specificity is decreased, so the bias is away from the null and the odds ratio is overestimated. If more respondents who do really have the risk factor but don't know it report that they don't have it when they actually do, then the sensitivity is decreased and the odds ratio underestimated, as in this study.[17,18]

It is interesting that more women than men were diagnosed with coronary heart disease. Again, a larger percentage of males could have had out-of-hospital deaths.

The stratification of variables resulted in smaller samples, so the finding of single marital status for men having a protective effect needs to be investigated further with a larger study sample.

Manual labor has been used as a barometer of physical activity and has been linked to increased fibrinolytic activity in blacks.[19-21] The effect of not working in the cases would diminish the fibrinolytic activity and increase the risk of coronary heart disease. In this study population, not working at all, as opposed to doing manual labor, is the risk factor for coronary heart disease. The larger percentage of controls who were working may illustrate a healthy worker effect, in that the cases may have been too ill to work.

Total cholesterol was used in this study, as opposed to low density lipoprotein (LDL) cholesterol and high density lipoprotein cholesterol. This may account in part for the discrepancy of hypercholesterolemia not being a risk factor in men when matching was taken into account in the bivariate analysis, though it was a risk factor in the multivariate analysis. Total cholesterol as well as LDL-cholesterol levels have, however, been shown to be associated with coronary heart disease in black men and women.[22,23]

This study further supports the relationship between the established risk factors and coronary heart disease in

blacks. Preventive efforts to decrease the incidence of the risk factors noted should decrease the incidence of coronary heart disease in the black population.

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