

PREVALENCE OF THE METABOLIC SYNDROME AMONG US MIDDLE-AGED AND OLDER ADULTS WITH AND WITHOUT DIABETES — A PRELIMINARY ANALYSIS OF THE NHANES 1999–2002 DATA

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Objective: This study examined the racial differences in the distribution of the individual and clustered metabolic syndrome components among diabetics and nondiabetics and the presence of inflammatory markers.

Study Design and Method: This is a secondary data analysis of the National Health and Nutrition Examination Survey (NHANES) from 1999–2002. The analysis only included adults aged ≥ 40 years who were White, Black, and Mexican American. Differences in the rate of metabolic syndrome, each of its components, and inflammation markers among the three racial groups were examined by using chi-square tests.

Results: An estimated 12 million adults ≥ 40 years of age have diagnosed and undiagnosed diabetes. Most diabetics have metabolic syndrome (69.9% for Whites, 64.8% for Blacks, and 62.4% for Mexican Americans). Abdominal obesity is more prevalent among Whites with diabetes than Mexican Americans (80.6% vs 67.8%, $P=.008$). Hypertension is significantly greater among Blacks with diabetes (73.1%) as compared to Whites (58.6%) and Mexican Americans (50.8%); hypertension in those without diabetes was 47.5% among Blacks, 32.4% among Whites, and 23.4% among Mexican Americans. Among nondiabetics, Blacks have higher prevalence of elevated serum C-reactive protein (17.4%) and high plasma fibrinogen (49.7%) than Whites (9.7% and 36%, respectively).

Conclusion: These data demonstrate racial differences in the prevalence of components of the metabolic syndrome among diabetics and nondiabetics. They raise questions about the current definition of the metabolic syndrome, which weights each component equally. Further research is necessary to more precisely quantify the characteristics of metabolic syndrome in different racial and ethnic groups. (*Ethn Dis.* 2007;17:35–39)

Key Words: Diabetes, Metabolic Syndrome, Metabolic Syndrome Components, Prevalence, Racial Differences

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INTRODUCTION

Metabolic syndrome, a cluster of metabolic abnormalities, confers increased risk for diabetes, cardiovascular disease and premature mortality.^{1–7} In the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) report, metabolic syndrome is defined as having any three or more of the five abnormalities: abdominal obesity, hypertension, hypertriglyceridemia, high fasting glucose, and low high-density lipoprotein (HDL) cholesterol.⁸ Studies have reported the prevalence of the metabolic syndrome in the United States, and some racial/ethnic differences are noted. Mexican Americans had the highest prevalence of the metabolic syndrome (31.9%), and White Americans had a slightly higher prevalence (23.8%) than African Americans (21.6%).⁹ However, this pattern does not appear to mirror the higher prevalence of diabetes among African Americans. As most of the studies that examined association between the presence of metabolic syndrome and adverse health outcomes used primarily the White population, more research is needed to examine the characteristics of the metabolic syndrome among different racial and ethnic groups. In this study, we provide data on the prevalence of the metabolic syndrome, its components, and inflammatory markers among Whites, Blacks, and Mexican Americans, with diabetes and without diabetes, separately.

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...we provide data on the prevalence of the metabolic syndrome, its components, and inflammatory markers among Whites, Blacks, and Mexican Americans, with diabetes and without diabetes.

METHODS

Design

This is a secondary analysis of cross-sectional National Health and Nutrition Examination Survey (NHANES) data collected with a complex probability sample.

Data Source

The NHANES 1999–2002 was a series of multistage surveys and health measurement of the noninstitutionalized population by the National Center for Health Statistics.^{10,11} Participants of NHANES 1999–2002 agreed to respond to an in-home questionnaire and have physical examinations in a mobile examination center. The NHANES collected data on people at least one year of age. Data files include three components: interview data, examination data and laboratory data.

Study Population

For this study, we only used data from adults age ≥ 40 years of three racial/ethnic groups, White, Black, and Mexican American, who participated in the interview from 1999 to 2000 or

from 2001 to 2002 and who also had physical examination and laboratory test data.

Study Variables and Definitions

Diabetes mellitus was ascertained either by physician diagnosis or by fasting glucose level ≥ 126 mg/dL. The metabolic syndrome was identified by the presence of any three or more of the following abnormalities: 1) obesity (waist circumference >102 cm in men and >88 cm in women); 2) high blood pressure (defined as the average of three blood pressure measurements $\geq 130/85$ mm Hg and/or currently on antihypertensive medication); 3) hypertriglyceridemia (≥ 150 mg/dL or >1.69 mmol/L); 4) low HDL cholesterol (<40 mg/dL in men, <50 mg/dL in women); 5) high fasting glucose (≥ 110 mg/dL or ≥ 6.1 mmol/L). Inflammation variables included elevated serum C-reactive protein (≥ 1.00 mg/dL), high white blood cell count (≥ 9.1 mg/dL), and high plasma fibrinogen (≥ 379 mg/dL).

Data Analysis

Crude and adjusted prevalence of diabetes among US adults (middle age

and older) were estimated by using weighted data. We used chi-square tests to examine the differences in the distribution of each metabolic syndrome component and three inflammatory markers among three racial/ethnic groups with and without diabetes. SAS callable SUDAAN was used to conduct the analyses of NHANES data with complex survey design.

RESULTS

Prevalence of Diabetes Among US Adults

Among US adults aged ≥ 40 years, ≈ 12 million were estimated to have diagnosed and undiagnosed diabetes, which accounts for 11.2% of that population (95% CI: 10.2–12.2). African Americans have the highest prevalence of diabetes (17.8%, 95% CI: 15.3–20.3), followed by Mexican Americans (17.1%, 95% CI: 15.5–18.7) and Whites (10%, 95% CI: 8.9–11.1). After adjusting for age and sex, African Americans and Mexican Americans still have higher prevalence of diabetes than Whites (Table 1).

Prevalence of the Metabolic Syndrome and Each Component Among Three Racial/Ethnic Groups with and without Diabetes

Metabolic syndrome is present in 68.6% of diabetic persons in the study population. The prevalence ranges from 69.9% among Whites to 64.8% among Blacks to 62.4% among Mexican Americans. However, no statistically significant differences were found among the three racial/ethnic groups ($P=.32$). By examining the distribution of each metabolic syndrome component, distinct patterns emerge among three groups with and without diabetes (Table 2). Among diabetics, Whites have a higher prevalence of abdominal obesity (80.6%) as compared with Mexican Americans (67.8%), but no racial differences are found in the presence of abdominal obesity among nondiabetics. Blacks with diabetes have a higher prevalence of hypertension (73.1%) as compared with Whites (58.6%) and Mexican Americans (50.8%), and the same patterns exist among nondiabetics, 47.5% in Blacks as compared with 32.4% in Whites and 23.4% in Mexican Americans.

Table 1. Prevalence of diabetes among adults age 40+

	All Sample	Diabetes Unweighted	Weighted	Crude		Adjusted for age/sex	
				%	95% CI	%	95% CI
White	3,526	431	9,069,913	10	8.9–11.1	9.8	8.8–10.9
Black	1,252	262	2,106,159	17.8	15.3–20.3	18.7	16.3–21.3
Mexican American	1,422	306	919,503	17.1	15.5–18.7	18.8	17.3–20.3
All	6,200	999	12,095,576	11.2	10.2–12.2	11.2	10.2–12.2

Table 2. Distribution of the metabolic syndrome components among adults age 40+ with diabetes

	Metabolic syndrome	Abdominal obesity	High blood pressure	High triglycerides	Low HDL cholesterol	High fasting glucose
	%	%	%	%	%	%
White	69.9	80.6	58.6	60.2	71.3	90.4
Black	64.8	78.7	73.1	33.3	64.9	79.2
Mexican American	62.4	67.8	50.8	63.5	67.7	87.5
	$P=.32$	$P=.008$	$P=.0005$	$P=.0007$	$P=.01$	$P=.16$

Table 3. Distribution of the metabolic syndrome components among adults age 40+ without diabetes

	Metabolic syndrome	Abdominal obesity	High blood pressure	High triglycerides	Low HDL cholesterol	High fasting glucose
	%	%	%	%	%	%
White	24.1	53.6	32.4	38.6	30.4	11.6
Black	16.5	55.1	47.5	13.8	26	10.2
Mexican American	29.5	53.7	23.4	45.1	41.4	14.2
	<i>P</i> =.0007	<i>P</i> =.8	<i>P</i> <.00001	<i>P</i> <.00001	<i>P</i> =.0003	<i>P</i> =.28

Among nondiabetics of the same age group, the prevalence of the metabolic syndrome is 23.6%. The highest prevalence of the metabolic syndrome is 29.5% among Mexican Americans, followed by 24% among Whites and only 16.5% among Blacks (*P*=.0007). Like Whites, Mexican Americans have a higher prevalence of elevated triglycerides than Blacks among both diabetics and nondiabetics. No statistically significant differences among the three racial/ethnic groups were found in high fasting glucose (Table 3).

Distribution of Inflammatory Markers Among Different Racial/Ethnic Groups

Among diabetics, the prevalence of elevated C-reactive protein ranges from 24.5% among Blacks to 17.7% among Whites and 17.3% among Mexican Americans. The highest prevalence of high plasma fibrinogen was 63.8% among Blacks, followed by 55.4% among Mexican Americans and 50.3% among Whites. These differences did not reach statistical significance (*P*=.15 for each variable) (Table 4).

Racial/ethnic differences in the presence of each inflammatory marker among nondiabetics are statistically significant. The pattern of distribution of three inflammation markers among people without diabetes shows that Blacks have a higher prevalence of elevated serum C-reactive protein (17.4%) than Whites (9.7%) and Mexican Americans (11.4%). Blacks also have a higher prevalence of plasma fibrinogen (49.7%) as compared to Whites (36%) and Mexican Americans

(36.1%). However, prevalence of elevated white blood cells is higher among Whites (15.5%) and Mexican Americans (14.6%) than Blacks (9.3%) (Table 5).

DISCUSSION

Consistent with the previous report,⁹ Mexican Americans seem to have the highest prevalence of the metabolic syndrome among nondiabetics. As the cluster of the metabolic abnormalities is a risk factor for developing diabetes, the alteration of these abnormalities can reduce the incidence of diabetes among

Mexican Americans. However, why African Americans have a lower prevalence of metabolic syndrome as compared with other groups among the nondiabetics is not clear. Given that African Americans have a distinct risk profile of individual metabolic syndrome components, such as higher rates of hypertension, the current metabolic syndrome definition by the NCEP-ATP III may mask the racial differences that manifest in its components. Using a large community cohort study, McNeill et al found that elevated blood pressure and low HDL cholesterol were the strongest predictors of coronary heart disease.¹² As the predictive power

Table 4. Distribution of inflammatory markers among adults age 40+ with diabetes

	Elevated serum C-reactive protein ≥1.00 mg/dL	Elevated ≥9.2 mg/dL	High fibrinogen ≥379 mg/dL
	%	%	%
White	17.7	20.1	50.3
Black	24.5	17.5	63.8
Mexican American	17.3	21.6	55.4
	<i>P</i> =.15	<i>P</i> =.72	<i>P</i> =.15

Table 5. Distribution of inflammatory markers among adults age 40+ without diabetes

	Elevated serum C-reactive protein ≥1.00 mg/dl	Elevated white blood cells ≥9.2 mg/dl	High fibrinogen ≥379 mg/dl
	%	%	%
White	9.7	15.5	36
Black	17.4	9.3	49.7
Mexican American	11.4	14.6	36.1
	<i>P</i> =.0003	<i>P</i> =.003	<i>P</i> =.0014

African Americans with diabetes have the highest rate of hypertension, which poses higher risks for developing diabetes complications and mortality.

of a single component for eventual disease can differ across racial/ethnic groups, attention to individual components among different racial and ethnic groups is required when the prevalence of the metabolic syndrome is examined.

Among diabetics, Whites have a poorer lipid profile than African Americans, which supports the previous findings. Unlike other biological factors, lipid profiles appear to be worse in Whites with type 2 diabetes than in African Americans.¹³⁻¹⁵ Whites also have a higher rate of low HDL cholesterol as compared with Blacks. Most persons with diabetes have abdominal obesity measured by waist circumference across the three racial/ethnic groups. However, Whites appear to have a worse risk profile than the other groups in terms of abdominal obesity, which is a cardiovascular risk factor. This finding may help explain the more atherogenic risk profile in Whites¹⁶ with diabetes. The striking racial differences in prevalence of hypertension among diabetics have significant clinical implications. African Americans with diabetes have the highest rate of hypertension, which poses higher risks for developing diabetes complications and mortality. One of the effective strategies to prevent diabetes complications among African Americans is to increase the use of behavioral interventions and pharmaceutical therapy in reducing high blood pressure at clinical and community

settings. Our analysis also calls attention to the racial differences in inflammatory markers. Nondiabetic African Americans have a distinct profile of elevated C-reactive protein and high fibrinogen. The factors associated with these differences need to be explored in future studies.

More racial differences were observed in the metabolic syndrome, its components, and inflammatory markers among nondiabetics than among diabetics. This finding may be due to the use of a sub-sample who had triglycerides and fasting glucose tests. Therefore, the current analysis may have underestimated the racial and ethnic differences that could have manifested. Future studies that include more years of data can produce better estimates to examine racial/ethnic differences. Another apparent limitation is its inability to stratify the analysis by sex in each racial/ethnic group, which can provide more information regarding the racial and ethnicity issue in describing a cluster as well as single metabolic abnormalities among diabetic and nondiabetic US adults. The study findings can lead to further discussions on whether the current criteria to define the presence of metabolic syndrome need to take into consideration the distinct pattern of individual metabolic syndrome components among different racial and ethnic groups.

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AUTHOR CONTRIBUTIONS

Design concept of study: Lin, Pi-Sunyer

Acquisition of data: Lin

Data analysis interpretation: Lin, Pi-Sunyer

Manuscript draft: Lin, Pi-Sunyer

Statistical expertise: Lin

Administrative, technical, or material assistance: Pi-Sunyer

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