# Relation of Body Mass Index to Development of Atrial Fibrillation in Hispanics, Blacks, and Non-Hispanic Whites

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**No previous studies have examined the interaction between body mass index (BMI) and race/ethnicity with the risk of atrial fibrillation (AF). We retrospectively followed 48,323 persons free of AF (43% Hispanic, 37% black, and 20% white; median age 60 years) for subsequent incident AF (ascertained from electrocardiograms). BMI categories included very severely underweight (BMI <15 kg/m$^2$), severely underweight (BMI 15.1 to 15.9 kg/m$^2$), underweight (BMI 16 to 18.4 kg/m$^2$), normal (BMI 18.5 to 24.9 kg/m$^2$), overweight (BMI 25.0 to 29.9 kg/m$^2$), moderately obese (BMI 30 to 34.9 kg/m$^2$), severely obese (BMI 35 to 39.9 kg/m$^2$), and very severely obese (BMI >40 kg/m$^2$). Cox regression analysis controlled for baseline covariates: heart failure, gender, age, treatment for hypertension, diabetes, PR length, systolic blood pressure, left ventricular hypertrophy, socioeconomic status, use of β blockers, calcium channel blockers, and digoxin. Over a follow-up of 13 years, 4,744 AF cases occurred. BMI in units of 10 was associated with the development of AF (adjusted hazard ratio 1.088, 95% confidence interval 1.048 to 1.130, p <0.01). When stratified by race/ethnicity, non-Hispanic whites compared with blacks and Hispanics had a higher risk of developing AF, noted in those whom BMI classes were overweight to severely obese. In conclusion, our study demonstrates that there exists a relation between obesity and race/ethnicity for the development of AF. Non-Hispanic whites had a higher risk of developing AF compared with blacks and Hispanics.**  **(Am J Cardiol 2018;■■:■■–■■)**

Obesity has been identified as a risk factor for atrial fibrillation (AF) in several studies.[1–3] These studies have consistently found that as weight and body mass index (BMI) increase, the risk of AF increases, although cardiovascular outcomes and mortality vary. Most studies have been conducted in homogenous white populations.[4,5] Data on racially and ethnically diverse communities is limited.[4,5] Blacks and Hispanics tend to have higher rates of obesity as well as a higher number of risk factors for developing AF.[6,7] However, they have a paradoxically lower incidence of AF compared with whites,[8–11] referred to as the "racial paradox." Given limited epidemiological literature, our objective was to describe the interaction of BMI and race/ethnicity on the development of AF. We hoped to provide insight into the "racial paradox" to identify groups at higher risk of AF among Hispanics, blacks, and non-Hispanic whites to target better therapies for the prevention of both obesity and AF.

## Methods

This study is a retrospective epidemiological study of AF in both inpatients and outpatients (n = 239,741) with n = 1,239,593 cumulative electrocardiograms (ECGs) obtained at Montefiore Medical Center (Bronx, New York) between January 1st, 2000, and September 8th, 2013. Patients were included if they had 2 or more ECGs. Patients were excluded if they had AF on their initial ECG, 1 recorded ECG, or incomplete covariate data. Patients were followed for a maximum of 10-year incidence risk, and there was a minimum follow-up of 2 ECGs per patient.

Race/ethnicity was self-reported, and all race/ethnic categories were mutually exclusive.

The study protocol conforms to the ethical guidelines of the 2013 Declaration of Helsinki as reflected in a priori approval by the institution's human research committee. The research was limited to materials (i.e., data or records) that have been collected solely for nonresearch purposes (such as medical treatment or diagnosis). The submission was approved with a waiver of informed consent.

Diagnosis of AF was determined by ECG. Montefiore Medical Center uses a computerized ECG system to collect, store, and analyze ECGs. This system is widely used and has been validated by the Food and Drug Administration and meets all applicable standards for resting computerized ECG analysis.[12] The computerized system includes the 12SL (GE

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This author takes responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

See page •• for disclosure information.

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0002-9149/
https://doi.org/10.1016/j.amjcard.2018.01.039

Healthcare, Wauwatosa, Wisconsin) program for automated ECG interpretation, which was used in this study. The 12SL (GE Healthcare) algorithm to detect AF has been validated in multiple studies[13,14] with a reported sensitivity of 90.8% and a specificity of 98.9%.[15] All ECGs were reviewed, and diagnosis of AF confirmed by board-certified cardiologists.

All variables were obtained through electronic medical record query during the study dates of the administrative data. These variables were closer to the initial, as opposed to subsequent ECGs. The authors believed that the initiation of β blockers, calcium channel blockers, or digoxin would have minimal effects on study outcomes, as these medications are typically started after a diagnosis of AF. As such, the current study did not restrict the initiation of medication to the timing of the first ECG.

BMI was analyzed as a continuous and categorical variable. BMI (kg/m$^2$) categories included <15, 15.1 to 15.9, 16 to 18.4, 18.5 to 24.9, 25.0 to 29.9, 30 to 34.9, 35 to 39.9, and >40.

A socioeconomic status (SES) variable was calculated for each in the cohort. Six SES variables for each neighborhood by zip code (log of median household income; log of median value of housing units; the percentage of households receiving interest, dividend, or net rental income; education; the percentage of adults who completed college; and the percentage of employed individuals in executive, managerial, or professional positions) were normalized (Z scored) to the New York state average.

Wilcoxon–Mann–Whitney test with interquartile ranges was used for the comparisons of continuous variables, and chi-square tests were used to compare dichotomous variables between patients. Statistical significance was defined by $p < 0.05$. Cox regression analysis controlled for all baseline differences, which estimated the independent predictive ability of various risk factors for the development of AF. Model 1 included BMI. Model 2 included race/ethnicity and BMI. Model 3 included race/ethnicity, BMI, heart failure, gender, age, treatment for hypertension, diabetes, PR length, systolic blood pressure, and left ventricular hypertrophy and SES. Model 4 included covariates of model 3 including also the use of β blockers, calcium channel blockers, and digoxin.

Regression modeling was initially performed for the overall cohort and then stratified by race/ethnicity and BMI category. Spline analysis was performed, stratified by race/ethnicity with knots at BMI groups of 15, 16, 18.5, 25, 30, and 35 kg/m$^2$. P-interaction testing was performed between race/ethnicity and BMI for the development of AF. SPSS (IBM, Armonk, NY) Version 22.0 and R Studio (RStudio, Inc, Boston, MA) Version 0.98.507 were used for all statistical analyses. Proportional hazard assumptions were met as verified by plotting the Schoenfeld residuals. Model 4 was used for all final regression modeling.

## Results

A total of 48,323 patients met inclusion criteria; 9,425 were non-Hispanic white (19.5%), 18,039 were black (37.3%), and 20,859 were Hispanic (43.2%). There was a total of 156,511 person-years of follow-up (2.26 median years from first ECG and a median of 6 ECGs per patient), of which 4,744 developed AF.

General baseline characteristics by race/ethnicity are listed in Table 1. Non-Hispanic whites were older and had a higher incidence of AF but lower BMIs, lower rates of diabetes, and a higher SES compared with blacks and Hispanics. Blacks and Hispanics had significantly higher rates of co-morbidities including obesity, diabetes, heart failure, and left ventricular hypertrophy compared with non-Hispanic whites despite lower rates of AF.

Table 2 lists 4 Cox Regression models for the hazard ratios (HRs) for the development of AF. Model 3 and Model 4 showed significant hazard to develop AF as BMI increased. Subsequent p-interaction testing between BMI and race/ethnicity were 0.627, 0.231, and 0.405 for Model 2, Model 3, and Model 4, respectively.

The HRs of BMI to develop AF were further stratified by race/ethnicity. There was no significant difference in rates of AF development in any BMI category in either the total population or any racial/ethnic subcohort (BMI <15 were used as reference). Figure 1 demonstrates the risk of developing AF as stratified by race/ethnic as a spline analysis with BMI categories as knot groups.

The HR of race/ethnicity to develop AF, stratified by BMI category, is listed in Table 3. Although there was no significance difference in HRs among lower BMI classes between race/ethnicity, blacks and Hispanics had significantly lower HRs for development of AF in BMI categories of 25 to 39.9 kg/m$^2$ compared with non-Hispanic whites.

## Discussion

This is a large-scale retrospective study of the relationship between race/ethnicity and BMI for the development of AF in a racially and socioeconomically diverse inner-city population. We confirm previous findings, demonstrating that despite having many risk factors for AF, Hispanic and black patients, relative to non-Hispanic white patients, have a lower risk of developing AF. Moreover, we found no formal interaction between race/ethnicity, BMI, and the development of AF. However, we observed that in those who were overweight to morbidly obese, black and Hispanics had a lower risk of developing AF compared with non-Hispanic whites.

Our findings are consistent with previous studies finding racial/ethnic differences in risk factors for and incidence of AF.[16,17] In our inner-city population, non-Hispanic whites continued to have the highest incidence of AF compared with black and Hispanics. Moreover, we confirm previous studies that show overweight and obese subjects have a higher risk of developing AF.[18,19]

We acknowledge slight differences in the risk of developing AF by race/ethnicity. Non-Hispanic whites, compared with black and Hispanics, had a higher chance to develop AF, noted in those whom BMI classes were overweight to severely obese. To the authors' knowledge, this is the first study to provide an in-depth analysis on the varying effects of obesity classes between racial/ethnic groups. Limited previous studies have also suggested that race/ethnicity impacts the development of AF by obesity class. In the MESA study, the attributable fractions of established modifiable AF risk for BMI >30 were 17.7 for Hispanics, 2.9 for non-Hispanic whites, and -0.6 for blacks.[17] Schnabel et al validated an AF risk algorithm in whites and blacks looking at the Cardiovascular