ORIGINAL RESEARCH

Racial Differences in the Prevalence of Severe Aortic Stenosis

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***Background*—**In an era of expanded treatment options for severe aortic stenosis, it is important to understand risk factors for the condition. It has been suggested that severe aortic stenosis is less common in African Americans, but there are limited data from large studies.

***Methods and Results*—**The Synthetic Derivative at Vanderbilt University Medical Center, a database of over 2.1 million de-identified patient records, was used to identify individuals who had undergone echocardiography. The association of race with severe aortic stenosis was examined using multivariable logistic regression analyses adjusting for conventional risk factors. Of the 272 429 eligible patients (mean age 45 years, 44% male) with echocardiography, 14% were African American and 82% were Caucasian. Severe aortic stenosis was identified in 106 (0.29%) African-American patients and 2030 (0.91%) Caucasian patients (crude OR 0.32, 95% CI [0.26, 0.38]). This difference persisted in multivariable-adjusted analyses (OR 0.41 [0.33, 0.50], $P<0.0001$). African-American individuals were also less likely to have severe aortic stenosis due to degenerative calcific disease (adjusted OR 0.47 [0.36, 0.61]) or congenitally bicuspid valve (crude OR 0.13 [0.02, 0.80], adjusted OR dependent on age). Referral bias against those with severe valvular disease was assessed by comparing the prevalence of severe mitral regurgitation in Caucasians and African Americans and no difference was found.

***Conclusions*—**These findings suggest that African Americans are at significantly lower risk of developing severe aortic stenosis than Caucasians. **(*J Am Heart Assoc*. 2014;3:e000879 doi: 10.1161/JAHA.114.000879)**

Key Words: aortic valve stenosis • database • epidemiology • race and ethnicity • risk factor

Valvular heart disease is responsible for more than 22 000 deaths each year in the United States.[1] In particular, aortic stenosis is a progressive condition known to carry a high short-term mortality once patients become symptomatic. Risk factors have been described previously and include male sex, smoking, hypertension, elevated low-density lipoprotein cholesterol (LDL), coronary atherosclerosis, congenital bicuspid valve, and advanced age.[2] Until recently, surgical replacement of the aortic valve was the only treatment proven to alter prognosis. This left a large number of elderly patients with multiple comorbidities without a viable treatment option due to excessive surgical risk; however, the recent introduction of transcatheter aortic valve replacement (TAVR) has offered an effective alternative for these patients.[3,4]

As the population of treatment candidates expands, attention will be directed appropriately to assure equity in delivery of therapy. In several surgical series of aortic valve stenosis, it has been noted that African Americans were underrepresented.[5–7] It is unknown, however, whether this underrepresentation reflects racial differences in the prevalence of severe aortic valve stenosis by race or difference in intervention rate of those diagnosed with severe aortic valve stenosis. Therefore, we compared the prevalence of severe aortic stenosis in African Americans and Caucasians at a large, tertiary care medical center.

Methods

Study Population

The Synthetic Derivative is a database of 2.1 million de-identified records from all patients in the electronic medical record at Vanderbilt University Medical Center, a large tertiary care center in Nashville, Tennessee. All documented patient encounters at the medical center are stripped of identifying information and uploaded via a one-way hash to the Synthetic Derivative where they can be searched based on

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structured (laboratory values, ID9/CPT codes, demographics, etc.) and unstructured (text strings in narrative documents and reports) data.[8] As patient data does not contain any identifying information, use of Synthetic Derivative is classified as non-human research by Vanderbilt University's Institutional Review Board and approval was given for this study.

All records in the Synthetic Derivative were queried for documentation of an echocardiogram and race. Patients were then screened and individually reviewed for diagnosis of severe aortic stenosis, age at diagnosis, aortic valve area at diagnosis, and underlying etiology of disease. Criteria for documentation of an echocardiogram and confirmation of severe aortic stenosis are detailed in Table 1. Records that fulfilled search criteria for echocardiogram had a greater than 75% rate of having true documentation of an echocardiogram and approximately 90% of the 3500 patients with mention of severe aortic stenosis in their chart were identified using this search criteria. Race was classified using observer-reported determination, which has been shown to have >92% concordance with self-reported race and ancestry based on genetic biomarkers.[9,10]

To address the possibility that Caucasians with severe valvular disease were more likely to be referred for echocardiogram compared with African Americans with severe valvular disease, another valvular condition, severe mitral regurgitation, was assessed. Criteria for diagnosis of severe mitral regurgitation are also shown in Table 1.

Table 1. Criteria for Inclusion in Study Populations

Study Population		
Echocardiogram	Defined from keyword search in all clinical documents	All of the following criteria: • Presence of the string "echo" in any clinical document* • Race equals any of the following: African American, Caucasian
Severe aortic stenosis	Defined from keyword search in all clinical documents	All of the following criteria: • Presence of the string "echo" in any clinical document* • Presence of either of the following strings in any clinical document*: "severe aortic stenosis", "critical aortic stenosis" • Race equals any of the following: African American, Caucasian • Single-reviewer manual review for either of the following criteria: aortic valve area ≤ 1 cm^2, operative intervention on aortic valve due to stenosis
Severe mitral regurgitation	Defined from keyword search in all clinical documents	All of the following criteria: • Presence of the string "echo" in any clinical document* • Presence of the string "severe mitral regurgitation" in any clinical document* • Race equals any of the following: African American, Caucasian

Search criteria for identification of patients in the study population is shown. A combination of keyword search, demographics qualifiers, and manual review was used.
*Any clinical document includes clinical notes, procedure reports, radiology reports, problem lists, clinical communications, discharge summaries, patient letters, pathology reports or rehabilitation reports.

Assessment and Imputation of Traditional Risk Factors

Multiple traditional risk factors for aortic stenosis including sex, race, age, body mass index (BMI), LDL, creatinine, diabetes, hypertension, coronary artery disease, and statin use were assessed. Criteria for determination of each condition are shown in Table 2 with details of Synthetic Derivative search criteria for diabetes, hypertension, coronary artery disease, and statin use available in Table 3. Manual review of 500 patients with each definitive classification of a categorical variable was done (eg, 500 patients who were classified as having diabetes, 500 patients who were classified as not having diabetes, etc.) with accuracy ranging from 95% to 100% for each risk factor classification tested. Clinical judgment, shown in Table 4, was used to exclude incorrectly documented values. Each risk factor was then categorized based on percent of patients with

Table 2. Method for Determination of Each Demographic or Risk Factor

Method of Determination	Demographic or Risk Factors
Direct export	Gender
	Race
Mean of all documented values	BMI
	LDL
	Creatinine
Value at most recent clinic clinical encounter*	Age
Synthetic Derivative search	Coronary artery disease
	Hypertension
	Diabetes
	Statin use

The method of determining the demographic group or presence of a risk factor is shown. A combination of direct data export, export of laboratory or clinical measurement, and Synthetic Derivative queries was used in collecting risk factor data. Details of synthetic derivative queries for coronary artery disease, hypertension, and diabetes are shown in Table 3. BMI indicates body mass index; LDL, low-density lipoprotein.
*Defined as outpatient clinic visit, inpatient consultation, or documentation of vital signs.

Table 3. Synthetic Derivative Search Criteria for Risk Factor Determination

Hypertension		
Yes	Defined from combination of ICD9 coding and problem list search excluding common search confounders of the disease	Documentation of any of the following ICD9 codes: 401, 402, 403, 404, 405 OR All of the following criteria • Presence of any of the following strings in the problem list: "hypertension", "HTN" • Presence of none of following strings in the problem list: "portal hypertension", "pulmonary hypertension", "RV hypertension", "intracranial hypertension", "pHTN"
No	Defined from lack of ICD9 code and lack of mention of disease in any clinical document	All of the following criteria: • No documentation of ICD9 codes 401, 402, 403, 404, 405 • No presence of any of the following strings in any clinical document: "Hypertension", "HTN"
Unable to classify	Defined from lack of ICD9 coding but mention of disease in clinical document other than problem list	All of the following criteria: • No documentation of any of the following ICD9 codes: 401, 402, 403, 404, 405 • No presence of any of the following strings in the problem list: "hypertension", "HTN" • Presence of any of the following strings in any clinical document excluding problem list: "Hypertension", "HTN" OR • All of the following criteria: No documentation of any of the following ICD9 codes: 401, 402, 403, 404, 405 • Presence of any of the following strings in the problem list: "portal hypertension", "pulmonary hypertension", "RV hypertension", "intracranial hypertension", "pHTN"
Coronary artery disease requiring intervention		
Yes	Defined from combination of CPT coding and problem list search	Documentation of any of the following CPT codes: 33510, 33511, 33512, 33513, 33514, 33516, 33517, 33518, 33519, 33521, 33522, 33523, 33530, 33533, 33534, 33535, 33536, 92975, 92980, 92981, 92982, 92984, 92995, 92996 OR Presence of the any of the following strings in the problem list: "Coronary Artery Bypass", "CABG", "percutaneous coronary intervention", "PCI"
No	Defined from lack of ICD9 and mention of disease in any clinical document	All of the following criteria: • No documentation of any of the following CPT codes: 33510, 33511, 33512, 33513, 33514, 33516, 33517, 33518, 33519, 33521, 33522, 33523, 33530, 33533, 33534, 33535, 33536, 92975, 92980, 92981, 92982, 92984, 92995, 92996 • No presence of any of following strings in any clinical document: "Coronary Artery Bypass", "CABG", "Percutaneous Coronary Intervention", "PCI"
Unable to classify	Defined from lack of ICD9 coding but mention of disease in clinical document other than problem list	All of the following criteria: • No documentation of any of the following CPT codes: 33510, 33511, 33512, 33513, 33514, 33516, 33517, 33518, 33519, 33521, 33522, 33523, 33530, 33533, 33534, 33535, 33536, 92975, 92980, 92981, 92982, 92984, 92995, 92996 • No presence of the any of the following strings in the problem list: "coronary artery bypass", "CABG", "percutaneous coronary intervention", "PCI" • Presence of any of following strings in any clinical document other than the problem list: "coronary artery bypass", "CABG", "percutaneous coronary intervention", "PCI"
Diabetes mellitus		
Yes	Defined from combination of ICD9 coding and problem list search	Documentation of any ICD9 code that begins with 250 OR Presence of any of the following strings in the problem list: "diabetes mel", "IDDM", "NIDDM"
No	Defined from lack of ICD9 and mention of disease in any clinical document	All of the following criteria: • No documentation of any ICD9 code that begins with 250 • No presence of any of the following strings in any clinical document: "diabetes", "IDDM", "NIDDM"
Unable to classify	Defined from lack of ICD9 coding but mention of disease in clinical document other than problem list	All of the following criteria: • No documentation of any ICD9 code that begins with 250 • No presence of any of the following strings in the problem list: "diabetes mel", "IDDM", "NIDDM" • Presence of any of the following strings in any clinical document: "diabetes", "IDDM", "NIDDM"

Continued

Table 3. Continued

Statin use		
Yes	Defined from presence of medication in medication search	Presence of any of the following in medication search: "atorvastatin", "cerivastatin", "fluvastatin", "lovastatin", "pravastatin", "rosuvastatin", "simvastatin", "Altocor", "Altoprev", "Baycol", "Caduet", "Canef", "Crestor", "Lescol", "Lipex", "Lipitor", "Lipobay", "Lipostat", "Mevacor", "Pravachol", "Simcor", "Sortis", "Torvacard", "Torvast", "Totalip", "Tulip", "Vytorin", "Zocor"
No	Defined from lack of presence of medication in medication search	No presence of any of the following in medication search: "atorvastatin", "cerivastatin", "fluvastatin", "lovastatin", "pravastatin", "rosuvastatin", "simvastatin", "Altocor", "Altoprev", "Baycol", "Caduet", "Canef", "Crestor", "Lescol", "Lipex", "Lipitor", "Lipobay", "Lipostat", "Mevacor", "Pravachol", "Simcor", "Sortis", "Torvacard", "Torvast", "Totalip", "Tulip", "Vytorin", "Zocor"

Full Synthetic Derivative search criteria for hypertension, diabetes coronary artery disease and statin use are shown below. A combination of keyword search within problem lists and clinical charts, ICD9 codes, CPT codes and medication searches was used for each risk factor. All searches are case insensitive. ICD9: ninth revision of International Classification of Diseases.
Clinical documents includes clinical notes, procedure reports, radiology reports, problem lists, clinical communications, discharge summaries, patient letters, pathology reports or rehabilitation reports.

definitive diagnosis or laboratory measure available, shown in Table 5.

Multiple imputation incorporating severe aortic stenosis and all complete risk factors was used to predict the seldom-missed risk factors to allow for their inclusion in final analysis. Binary logistic regression was used to predict diabetes, hypertension, and coronary artery disease with random draws under fitted probability models used for imputation. The age effect was nonlinear in all models while creatinine was imputed using a linear model with random residuals added to mean predicted values. Multiple imputation was repeated 5 times to test whether results varied significantly between draws. The absolute number of complete cases was sizeable so the coefficients for imputed variables and race did not vary significantly across trials (Table 6). The final random draw was used for subsequent analysis.

Statistical Analysis

A binary logistic model based on the complete and seldom-missed comorbidities was used to model the probability of severe aortic stenosis. Age and creatinine were modeled as continuous variables and fitted using a restricted cubic spline as to not assume linear relationships between them and severe aortic stenosis. All other variables were modeled as categorical variables. The interaction between race and all other comorbidities was assessed to determine if race significantly affected any other comorbidities' prediction of severe aortic stenosis and no significant interactions were found. This entire analysis was repeated for specific etiologies of severe aortic stenosis—calcific degeneration and bicuspid valve—to determine if the race relationship was present with common etiologies of severe aortic stenosis. All analyses

Table 4. Data Exclusion Criteria for Inaccurately Reported Data

Variable	Excluded Values
Birth year	Year 1900*
BMI	Values <14 and >70
LDL	Values <1 and >1500
Creatinine	Values <0 and >30

Clinical criteria shown here was used to exclude incorrectly documented measurements. Criteria were established based off clinical judgment and applied to all patients. BMI indicates body mass index; LDL, low density lipoprotein.
*Exclude because patients whose birthdays are unknown are inaccurately classified as year 1900.

Table 5. Classification of Comorbidities Based on Data Available

Risk Factor	Criteria	Variables	% Classified
Complete	Data available for more than 99.9% of patients	Presence of aortic stenosis	100%
		Statin use	100%
		Race	100%
		Sex	99.99%
		Age at last follow-up	99.98%
Seldom-missed	Data available for between 67% and 99.9% of patients	Coronary artery disease	86.6%
		Creatinine	76.7%
		Hypertension	74.2%
		Diabetes	67.9%
Incomplete	Data available for less than 67% of patients	BMI	62.2%
		LDL	31.9%

Comorbidities were classified based on percent of patients with data available for that comorbidity. Cutoff percentages for classification category were assigned based on statistical judgment. BMI indicates body mass index; LDL, low density lipoprotein.

Table 6. Variation in Coefficients for Race and Imputed Risk Factor Between Different Draws of Imputation Model

Draw	Race	Diabetes	Hypertension	CAD
1	0.899	0.566	0.281	1.200
2	0.898	0.557	0.279	1.195
3	0.903	0.558	0.286	1.203
4	0.895	0.554	0.301	1.193
5	0.899	0.564	0.296	1.207

Coefficients for the association between race and imputed risk factors are shown below for 5 consecutive draws. The coefficients do not vary significantly between draws indicating variations due to random draw do not significantly affect the output of the model. CAD indicates coronary artery disease.

were done using the statistical programming language R, version 3.0.1 and the R rms package.[11,12]

Results

347 126 of the 2 163 553 patients in the Synthetic Derivative had documentation of an echocardiogram, of which 272 525 patients including 222 976 Caucasians (81.8%) and 36 681 African Americans (13.5%) had race denoted. Of these patients, 2598 patients including 2030 (0.91%) Caucasians and 106 (0.29%) African Americans had severe aortic stenosis and 3614 including 3013 (1.35%) Caucasian and 532 (1.45%) African Americans had severe mitral regurgitation.

Baseline characteristics of the echocardiogram population by race are shown in Figure 1 and Table 7. The mean age of African-American patients was slightly lower than Caucasian and a larger proportion of African-American patients were female. Significantly more African Americans had hypertension and diabetes while the mean creatinine and BMI were slightly higher for African-American patients. African Americans and Caucasians had similar LDL cholesterol levels while Caucasians were taking statins and had coronary artery disease more often.

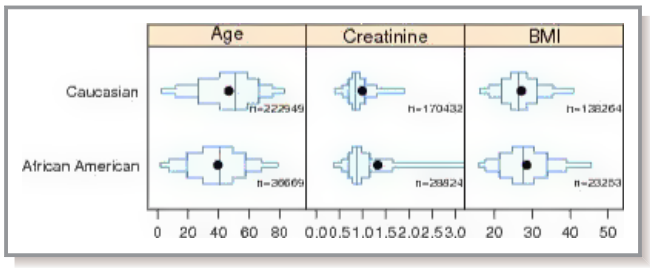

Figure 1. Baseline characteristic of the echocardiogram population by race for continuous characteristics. Baseline characteristic for the echocardiogram population are shown, stratified by race, for continuous risk factors. African-American subjects are younger and have higher BMI and creatinine than Caucasian subjects. BMI indicates body mass index.

Table 7. Baseline Characteristic of Echocardiogram Population by Race for Categorical Characteristics

		Caucasian		African American	
Risk Factor	Classification	Number	%	Number	%
Sex	Male	100 586	45.1	14 740	40.2
	Female	122 377	54.9	21 935	59.8
DM	Yes	34 157	15.3	6360	17.3
	No	117 062	52.5	18 649	50.8
	Imputed	71 757	32.2	11 672	31.8
HTN	Yes	94 090	42.2	17 110	46.6
	No	71 156	31.9	10 263	28.0
	Imputed	57 730	25.9	9308	25.4
CAD	Yes	17 774	8.0	1362	3.7
	No	174 228	78.1	31 461	85.8
	Imputed	30 974	13.9	3858	10.5
Statin use	Yes	62 719	28.1	7873	21.5
	No	160 257	71.9	28 808	78.5

Baseline characteristic for the echocardiogram population are shown, stratified by race, for categorical risk factors. Caucasian subjects were more likely to be male, have coronary artery disease and be prescribed statins while African Americans are more likely to have diabetes and hypertension. CAD indicates coronary artery disease; DM, diabetes mellitus; HTN, hypertension.

Table 8 and Figure 2 show the likelihood of severe aortic stenosis for each demographic group and based on presence of each risk factor. Correlates of severe aortic stenosis included Caucasian race, male sex, statin use, increased creatinine, extremes in age, presence of diabetes, presence of hypertension, and presence of coronary artery disease. These relationships were also seen in etiology-specific analysis looking specifically at severe calcific degenerative disease and bicuspid valve disease.

In multivariable-adjusted analysis adjusted for sex, statin use, diabetes, hypertension, age, coronary artery disease, and creatinine, the association of African-American race with lower risk for severe aortic stenosis remained significant (OR 0.41, 95% CI [0.33, 0.50]). The effect of race and age on prevalence of severe aortic stenosis is shown in Figure 3. The decreased prevalence of severe aortic stenosis in African Americans was present and consistent at all ages.

The partial effects of each risk factor and demographic group on the probability of severe aortic stenosis are shown in Figure 4. Odds ratios with confidence intervals for categorical risk factors and *P* values for continuous risk factors are shown. Age was the most significant risk factor while coronary artery disease, diabetes, race, and creatinine were also significant predictors. Sex, statin use, and hypertension had less effect on probability of disease.

Etiology-specific analyses shown in Figures 5 and 6 revealed that the association of African-American race with

Table 8. The Likelihood of Severe Aortic Stenosis, Severe Aortic Stenosis due to Calcific Degeneration of Tricuspid Aortic Valve, and Severe Aortic Stenosis due to Bicuspid Valve Disease Given Each Categorical Risk Factor

Characteristic		Total	SAS	CDT	BVD
Sex	Male	115 326	1.00%	0.55%	0.31%
	Female	144 312	0.68%	0.44%	0.14%
	OR* for males		1.47†	1.25†	2.22†
Race	African American	36 681	0.29%	0.18%	0.04%
	Caucasian	222 976	0.91%	0.54%	0.24%
	OR* for African Americans		0.32†	0.33†	0.17†
Diabetes mellitus	Yes	40 581	1.98%	1.41%	0.35%
	No	136 812	0.97%	0.51%	0.30%
	OR* ratio for diabetes		2.06†	2.79†	1.17
Hypertension	Yes	111 354	1.60%	1.04%	0.36%
	No	81 862	0.44%	0.13%	0.19%
	OR* for hypertension		3.68†	8.07†	1.90†
Coronary artery disease	Yes	19 392	4.99%	3.32%	0.98%
	No	206 343	0.57%	0.30%	0.18%
	OR* for coronary artery disease		9.16†	11.41†	5.49†
Statin use	Yes	70 592	1.89%	1.24%	0.43%
	No	189 065	0.42%	0.21%	0.13%
	OR* for statin use		4.57†	5.97†	3.32†
Overall percent			0.82%	0.49%	0.21%

The overall and etiology-specific probability of severe aortic stenosis based on presence of each risk factor or demographic is shown. Among patient with a given risk factor classification, the proportion of patients with severe aortic stenosis, severe aortic stenosis due to calcific degeneration of a native tricuspid valve, and severe aortic stenosis due to a bicuspid aortic valve are shown with the overall odds ratio for the difference. Group with higher probability of severe aortic stenosis included males, Caucasians, those with hypertension, diabetes mellitus, or coronary artery disease, and those prescribed statins. BVD indicates proportion with severe aortic stenosis due to bicuspid valve disease; CDT, proportion with severe aortic stenosis due to calcific degeneration of tricuspid aortic valve; SAS, proportion with severe aortic stenosis.

*OR: crude odd ratio for developing severe aortic stenosis given a demographic or presence of a risk factor unadjusted for any other factors.

†$P<0.0001$.

lower risk of severe aortic stenosis persisted for both bicuspid aortic valve (OR 0.13 [0.02, 0.80]) and calcific degeneration of native tricuspid aortic valve (OR 0.47 [0.36, 0.61]). The probability of bicuspid aortic valve appeared to have an age-dependent relationship with African-Americans children spared and the peak probability of severe aortic stenosis due to bicuspid valve occurring at a younger age in African Americans; however, only a small number of African Americans had bicuspid severe aortic stenosis and the age relationship in African Americans may be artifact. Still, African Americans who developed severe aortic stenosis were significantly less likely to have congenitally bicuspid valve as their underlying etiology (OR 0.49 [0.29, 0.85]).

Discussion

In summary, this study shows that African Americans are significantly less likely to have severe aortic stenosis than Caucasian individuals. The difference cannot be explained by traditional risk factors, age, or etiology of aortic valve disease.

A few smaller studies have commented on the relationship between race and aortic valve disease. Novaro and colleagues found that, among individuals referred for cardiac surgery, African Americans had significantly less aortic stenosis, aortic valve calcification, degenerative aortic valve disease, and bicuspid aortic valves and more pathologically normal aortic valves than Caucasian individuals.[6] Likewise, Yeung and colleagues reported that 10% of patients evaluated for aortic valve replacement in their hospital were African American, despite the fact that 37% of individuals in their overall population were African American.[5]

Unlike prior studies that have focused on surgical populations, this study assessed the overall and etiology-specific prevalence of severe aortic stenosis in all patients undergoing echocardiography. Racial differences in comorbid medical conditions including traditional risk factors for aortic stenosis were extensively analyzed and controlled for using multivariable statistical analysis. Not surprisingly, many known risk

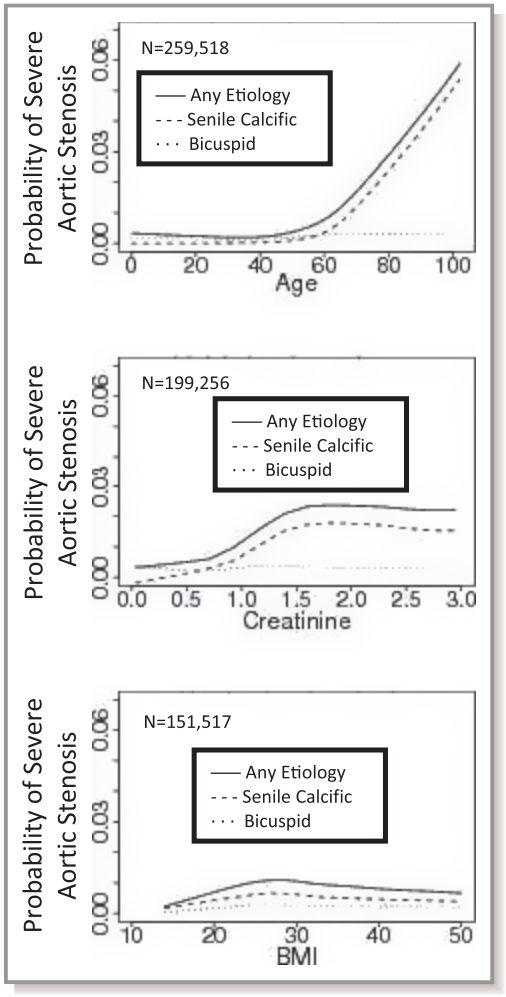

Figure 2. The overall and etiology-specific likelihood of severe aortic stenosis given each continuous risk factor. The overall and etiology-specific probability of severe aortic stenosis as a function of age, creatinine, and BMI, unadjusted for other risk factors, is shown. Older patients and patients with higher creatinine had a higher probability of having severe aortic stenosis. BMI indicates body mass index.

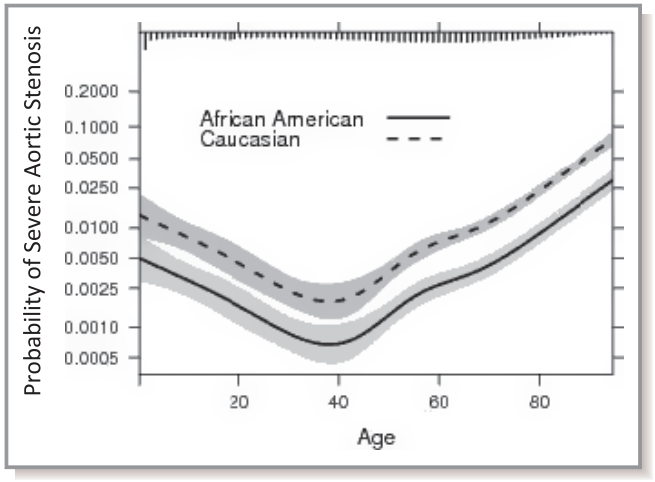

Figure 3. Probability of severe aortic stenosis by age and race. The probability of severe aortic stenosis with 95% confidence interval as a function of age for African Americans and Caucasians, adjusted for other risk factors, is shown here with distribution of patient ages noted at top. The difference in probability of severe aortic stenosis between the two races is present and significant at all ages.

factors (age, statin use, diabetes, hypertension, and coronary artery disease) were risk factors for severe aortic stenosis in this study sample[2]; however, none of these factors could explain the lower prevalence of severe aortic stenosis in African Americans, and Caucasian race remained an independent risk factor for severe aortic stenosis.

Individual analysis of the two most common etiologies of severe aortic stenosis—degenerative calcification of a tricuspid aortic valve and stenosis of a congenitally bicuspid aortic valve—revealed that the decreased prevalence in African Americans applied to both etiologies. Moreover, African Americans with severe aortic stenosis were less likely to have bicuspid valve as their underlying etiology. This is consistent with the previously reported findings that African Americans have a drastically lower risk of bicuspid aortic valves.[13]

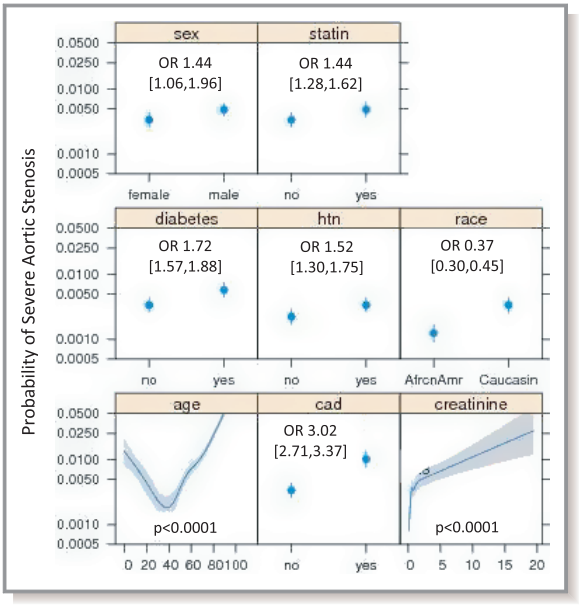

Figure 4. Partial effect of each predictor on model for severe aortic stenosis. The partial effect of each risk factor and demographic group on the probability of severe aortic stenosis is shown below. Odds ratios with 95% confidence intervals are shown for categorical values and *P* values are shown for continuous variable. Age had the greatest effect followed by coronary artery disease, diabetes, race, and creatinine. Sex, statin use, and hypertension had less predictive value. CAD indicates coronary artery disease; OR, odds ratio; HTN, hypertension.

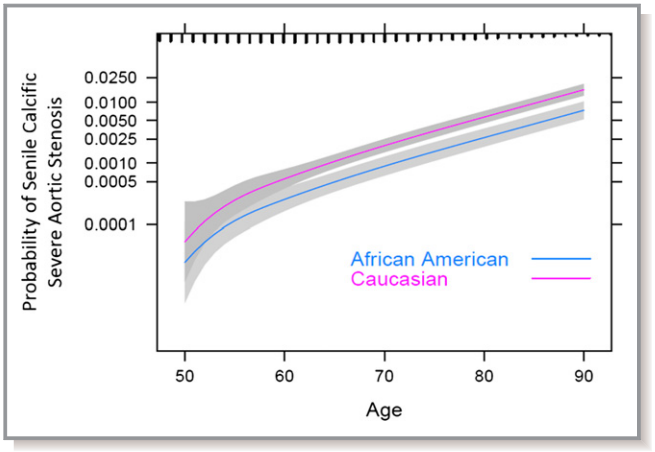

Figure 5. Probability of senile calcific severe aortic stenosis by race and age. The probability of senile calcific severe aortic stenosis with 95% confidence interval as a function of age for African Americans and Caucasians is shown here with distribution of patient ages noted at top. The difference in probability of senile calcific severe aortic stenosis between the two races is present and significant at all ages.

Extensive efforts were made to confirm the validity of search methods. Criteria were set to ensure that the diagnosis of severe aortic stenosis had high specificity. Single-reviewer manual chart review was used for each patient with severe aortic stenosis to ensure the diagnosis was made based on established guidelines on minimal valve area (<1 cm^2) or that the stenosis was severe enough to necessitate valve replacement. Previously documented racial differences in prevalence of comorbid conditions were again identified in the overall echocardiogram population.[1,14–23]

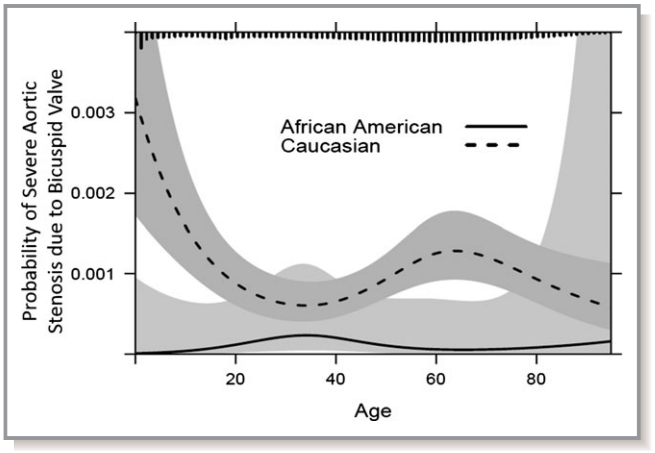

Figure 6. Probability of bicuspid severe aortic stenosis by race and age. The probability of bicuspid severe aortic stenosis with 95% confidence interval as a function of age for African Americans and Caucasians is shown here with distribution of patient ages noted at top. The difference in probability of bicuspid severe aortic stenosis between the two races is present at all ages.

To further test for unforeseen bias against African Americans with severe valvular disease, the rate of another echocardiographically diagnosed pathology, severe mitral regurgitation, was assessed. Mitral valve disorders occur at equal rates in African Americans and Caucasian.[24–26] The rate of severe mitral regurgitation in the study population was similar (1.45% for African Americans, 1.35% for Caucasians) indicating that baseline valvular pathologies were diagnosed at equal rates.

This study was not without limitations. The cohort included only patients with clinically indicated echocardiograms at a large academic referral center and may be biased toward patients with more severe disease. Any conclusion regarding the absolute prevalence of severe aortic stenosis is thus limited. Also, risk factors were classified through chart review and thus subject to provider-by-provider variations in definition and documentation of comorbid conditions, although there is no reason to believe one race would be affected more than another.

The underlying etiology of race-related differences in aortic stenosis remains to be determined. While numerous studies have identified single nucleotide polymorphisms associated with aortic valve calcification, no studies have noted racial differences in genetic risk factors for the disease.[27,28] Previous studies have assessed racial difference in aortic valve calcification and thickness but no differences between African Americans and Caucasians were identified.[29] Differences, however, have been noted in coronary artery calcification with African Americans significantly less likely to have calcification than whites, although this difference has not been associated with decreased risk of coronary heart disease.[30–34] Further understanding of the genetics and environmental factors underlying the racial difference in prevalence of severe aortic stenosis may result in novel preventative measures, early detection strategies, and therapeutic targets for the condition.

Conclusion

This study utilized a large research medical record to show that African Americans have a significantly lower prevalence of severe aortic stenosis than Caucasians. This difference cannot be explained by traditional risk factors and is present at all ages and for both common etiologies. Further genetic and laboratory investigation is warranted to determine the underlying mechanism for the lower prevalence.

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Disclosures

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