Background and Purpose—Warfarin reduces stroke risk by approximately 60% in patients with atrial fibrillation (AF). Differences in awareness and treatment of AF may contribute to racial and geographic disparities in stroke mortality. The objective was to examine predictors of awareness of the diagnosis of AF and treatment with warfarin.

Methods—REasons for Geographic and Racial Differences in Stroke (REGARDS) is a national, population-based, longitudinal study of 30,239 blacks and whites ≥45 years old with oversampling from blacks and the southeastern stroke belt states. Participants were enrolled January 2003 to October 2007. Data were collected using telephone interview, in-home evaluation, and self-administered questionnaires. The main variable of awareness of AF was defined by a positive answer to “Has a doctor or other health professional ever told you that you had atrial fibrillation?” and whether there was evidence of treatment on the basis of an in-home medications inventory.

Results—From baseline electrocardiograms, 432 individuals (88 black and 344 white) had AF. Of these, 88% (360 of 409) had at least 1 additional CHADS2stroke risk factor and 60% (258 of 432) were aware of their AF. The odds of blacks being aware of their AF were one third that of whites (OR = 0.32; 95% CI: 0.20 to 0.52). Among those aware, the odds of blacks being treated with warfarin were only one fourth as great as whites (OR = 0.28; 0.13 to 0.60).

Conclusion—Blacks were less likely than whites to be aware of having AF or to be treated with warfarin. Potential reasons for the racial disparity in warfarin treatment warrant further investigation. (Stroke. 2010;41:581-587.)

Key Words: atrial fibrillation ▪ racial disparities ▪ warfarin

A review of healthcare claims for approximately 4 million members of a managed care organization showed that 61% of patients with AF were candidates for warfarin, but only 39% had had initiation of warfarin therapy.6

Awareness of having AF may be poor, although this has been less studied than use of warfarin. The West Birmingham Atrial Fibrillation Project found that only 49% of patients with AF could name their cardiological condition, and only approximately half of the patients with AF knew that AF posed a risk of thromboembolism.7 Greater awareness of AF and its clinical implications might lead to greater use of warfarin, which might in turn lead to greater stroke reduction.

The Reasons for Geographic and Racial Differences in Stroke (REGARDS) study, a US national, longitudinal study of black and white adults, age at least 45 years, offered an opportunity to assess awareness of AF and compare this

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Awareness of the diagnosis with findings on electrocardiography within a cohort of nearly 30,000 participants.

Methods

Study Population

The goals and design of the REGARDS study have been described in detail elsewhere. The study was designed to investigate racial and regional disparities in stroke incidence and, as such, oversampled blacks (42% of the sample size) and residents of the southeastern “stroke belt region” (56% of the sample from North Carolina, South Carolina, Georgia, Alabama, Mississippi, Tennessee, Arkansas, and Louisiana), 2 groups that are known to have high stroke mortality rates. The study has approximately equal numbers of men and women (45% and 55%, respectively). Individuals were recruited from a commercially available list of residents by using a combination of mail and telephone contact with a 49% cooperation rate. Enrollment began in January 2003 and was completed in October 2007. The demographic information, income, medical history, and measures of cognitive function and quality of life were obtained by computer-assisted telephone interview. Standardized physical measures that included height, weight, blood pressure, and resting electrocardiography (ECG) were collected at in-home physical examination performed approximately 3 to 4 weeks after the telephone interview.

The Institutional Review Boards of participating centers reviewed and approved the study methods. Participants provided written informed consent.

Diagnosis of AF

For this report, AF was diagnosed based on ECG that was recorded during the in-home visits by a healthcare professional. Staff members were trained in standard procedures with use of centrally trained supervisors, a web-based program, and continuous quality feedback to individual examiners. The ECGs were sent to a central ECG reading center at Wake Forest University where they were read, coded, and interpreted by electrocardiographers blinded to clinical data. The first 8459 REGARDS participants underwent 7-lead ECG recording acquired by applying the standard 4 limb electrodes and a midsternal electrode; the remaining participants underwent standard 12-lead-ECG recording. Whether a participant underwent a 7-lead or 12-lead ECG would not affect the ability to detect AF.

Awareness of AF was defined as a positive response to the question, “Has a physician or a health professional ever told you that you had AF?” The telephone interview that established awareness of AF was conducted before the in-home visit where the ECG was performed. Current aspirin and warfarin treatment was defined using an inventory of current medications that was conducted as part of the in-home visit, in which all prescription and over-the-counter medications taken in the past 2 weeks were recorded. The medication inventory was conducted before interpretation of the ECG and detection of AF.

Estimating Risk of Stroke

Because both awareness of AF and aggressiveness of treatment could be higher among participants perceived to be at higher risk of stroke, the risk of future stroke was estimated using the CHADS2 score.9 “CHADS2” is derived from congestive heart failure, hypertension, age >75 years, diabetes, and history of stroke or transient ischemic attack. Congestive heart failure was defined as self-report of both orthopnea, defined as answering positively to “Do you ever have to sleep on ≥2 pillows to help you breathe?” and paroxysmal nocturnal dyspnea, defined as answering positively to “Do you ever wake at night because you are having trouble breathing?” Hypertension was defined as at least 1 of the following: systolic blood pressure ≥140 mm Hg, diastolic blood pressure ≥90 mm Hg or a self-report of currently taking medication to control blood pressure. Diabetes mellitus was defined as at least 1 of the following: fasting blood glucose ≥126 mg/dL, nonfasting glucose ≥200 mg/dL, or a self-report of currently taking an oral hypoglycemic agent or insulin. History of stroke was defined as positively answering the question “Were you ever told by a physician that you had a stroke?” Transient ischemic attack (TIA) was defined as answering positively to the question “Were you ever told by a physician that you had a stroke?” The entire cohort in this case is everyone with nonmissing values for atrial fibrillation on ECG and self-reports of AF variables.
These questions regarding stroke and TIA are the same as used in the Questionnaire for Verifying Stroke-free Status, an instrument of proven reliability and validity. Some guidelines recommend aspirin for low-risk AF patients such as those with a CHADS score of 0, aspirin or warfarin for moderate-risk AF patients such as those with CHADS2 score of 1, and warfarin for patients with AF with a CHADS2 score >1. Access to care was defined by self-report as having a “usual source of medical care.” Insurance status was defined by self-report as any kind of healthcare coverage.

Of the 30 239 participants, 377 were excluded due to missing ECG and 1 missing self-reported AF, resulting in an analysis cohort of 29 861.

Statistical Analysis
The determinants of AF awareness, warfarin use, and aspirin use were established using PROC LOGISTIC in SAS 9.2. The association of variables with AF awareness and warfarin use was assessed in: (1) univariate analyses; (2) a full multivariable model (including all predictors simultaneously); and (3) a “most parsimonious” model created using backward stepwise elimination in which the least significant variable was removed from the model until all variables had a probability value of ≤0.2. The likelihood of being treated with warfarin based on race and CHADS2 score was determined using logistic regression as well after eliminating the interactive effect of race and CHADS2 score, because it was not significant.

Results
The Figure shows the distribution of groups based on reported history of AF and ECG findings. A total of 27 558 people had agreement between self-report of AF and evidence of AF on electrocardiography. A total of 2303 people had a discrepancy between self-report of AF and evidence of AF on ECG.

Demographic and medical characteristics of participants with and without AF on electrocardiography are shown in Table 1. Of those with AF on ECG, 88 (20.4%) were black and 344 were white. Median age was 74 years (interquartile range=69 to 79 years), and 61% reported at least some college education. Prior stroke was reported by 11.1% (48 of 432), 8.9% (34 of 384) reported prior TIA, and 15.9% (61 of 384) reported stroke symptoms with no history of stroke or
TIA. Based on CHADS₂, 88% (360 of 409) had at least 1 risk factor for stroke beyond AF.

A total of 60% (258 of 432) individuals with AF on ECG were aware of the diagnosis. Race, education, and income were univariately associated with awareness of AF (Table 2). Race and income remained independent predictors in the full and most parsimonious multivariate models, but education did not. Blacks were less than one third as likely as whites to have been aware that they had AF (OR \(0.32; 95\% \text{ CI}, 0.19 \text{ to } 0.52\); \(P = 0.001\)).

In all models, race was the only significant predictor of use of warfarin treatment among individuals aware that they had AF (Table 3). Race remained an independent predictor of warfarin treatment in the full multivariable model. The odds of blacks being treated with warfarin were only one fourth as great as whites (OR \(0.26; 0.12 \text{ to } 0.57\)).

Table 4 shows the distribution by CHADS₂ score and race of individuals who did or did not receive warfarin. In a logistic regression model using race and risk of stroke from AF (CHADS₂), race remained a strong predictor of treatment with warfarin, but risk of stroke was not (Table 5).

Because aspirin is a proven but less effective means of preventing thromboembolic complications in patients with AF, we explored predictors for its use among participants who self-reported AF and had ECG evidence of the arrhythmia. The same set of covariates used to identify predictors of warfarin treatment was used to identify aspirin predictors. The only significant predictor in univariate analysis was sex. The OR for women being on aspirin therapy compared with men was \(0.35; 95\% \text{ CI, } 0.18 \text{ to } 0.68\); \(P = 0.002\). This relationship remained significant in the full multivariable model (OR \(0.25; 95\% \text{ CI, } 0.11 \text{ to } 0.59; \(P = 0.002\)).

Table 2. Results of Logistic Regression Models on Awareness of AF (ie, of Those With Positive ECG Evidence of AF, What Are the Predictors of Self-Reported AF; \(n=432\))

<table>
<thead>
<tr>
<th>Univariate Models*</th>
<th>Full Multivariable Model†</th>
<th>Most Parsimonious Model‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
<td>OR (95% CI)</td>
</tr>
</tbody>
</table>

*Univariate column of the table is the isolated association of the specific factor with the outcome of awareness of AF.
†Multivariable column is the association of the specific factor with the outcome after adjustment for all other factors shown in the table.
‡Parsimonious column is the multivariable association of those factors that remained significant with the particular outcome after adjustment for the other factors that remained significant (CI = 0.2).
most parsimonious multivariable model, the OR for women being on aspirin therapy was 0.35 (95% CI, 0.18 to 0.68; \( P = 0.002 \)). Race was not a predictor of aspirin therapy. The odds of a black individual being on aspirin relative to a white individual was 0.98 (95% CI, 0.35 to 2.73; \( P = 0.72 \)).

**Discussion**

We found that among individuals confirmed to have AF by ECG, blacks were approximately one third as likely to be aware that they had AF as whites in this US national biracial large sample of adult men and women. Because AF is such a powerful risk factor for incident stroke, these findings suggest that lower awareness of AF and reduced likelihood of treatment among blacks may place blacks at higher risk of a stroke event, which in turn could contribute to the higher stroke mortality among blacks. The reasons for the racial discrepancy are not known. Many of the study participants may be undiagnosed, because often AF itself is not symptomatic. Alternatively, these persons may have been diagnosed with the condition but simply did not remember or understand the condition. Because these results are based on self-report, we cannot distinguish these 2 possibilities.

Alternatively, individuals who are unaware that they have the diagnosis of AF might not have ever been diagnosed with the condition. Whether the participant had or lacked insurance coverage was not an independent predictor of awareness of AF but because the majority of study participants were aged >65 years (and are covered by Medicare), only a small
percentage did not have any insurance coverage. Furthermore, whether the participant had or lacked access to health care was also not an independent predictor of awareness of AF. Other possible explanations for racial differences in awareness of AF might be differences in either use or delivery of health care.

We also found that among those who were aware that they had AF and who had confirmation of the diagnosis of AF, blacks were approximately one fourth as likely to be treated with warfarin as whites. In striking contrast, risk of stroke as stratified by the CHADS2 score was not a predictor of warfarin use. The fact that risk of future stroke did not significantly alter the likelihood of warfarin use would seem to reflect an evidence–practice gap. Evidence-based guidelines on the use of warfarin in nonvalvular AF typically recommend that estimated risk of stroke be part of the decision process regarding long-term anticoagulation.13,14

Table 4. Number on and Not on Warfarin Stratified by Race and CHADS2 Score in the Group IB Population

<table>
<thead>
<tr>
<th>Race</th>
<th>CHADS2 Score*</th>
<th>On warfarin (%)</th>
<th>Not on warfarin (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Black</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On warfarin</td>
<td>0 (0)</td>
<td>9 (81.8)</td>
<td>3 (37.5)</td>
</tr>
<tr>
<td>Not on warfarin</td>
<td>2 (100)</td>
<td>2 (18.2)</td>
<td>5 (62.5)</td>
</tr>
<tr>
<td>White</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On warfarin</td>
<td>23 (82.1)</td>
<td>57 (79.2)</td>
<td>55 (88.7)</td>
</tr>
<tr>
<td>Not on warfarin</td>
<td>5 (17.9)</td>
<td>15 (20.8)</td>
<td>7 (11.3)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On warfarin</td>
<td>23 (76.7)</td>
<td>66 (79.5)</td>
<td>58 (82.9)</td>
</tr>
<tr>
<td>Not on warfarin</td>
<td>7 (23.3)</td>
<td>17 (20.5)</td>
<td>12 (17.1)</td>
</tr>
</tbody>
</table>

*Fifteen missing CHADS2 score values.

It is possible that awareness of AF was underestimated in this study because we did not capture the time of baseline ECG. The decision to anticoagulate is often complex, involving predictions of benefit from stroke reduction balanced against predictions of hemorrhagic complications. Physicians may be reluctant to anticoagulate patients who have uncontrolled hypertension. Whether this might have been a factor in the likelihood of being treated with warfarin could not be assessed in our study because there was only 1 baseline measure of blood pressure. Although CHADS2 is an example of a well-validated clinical tool for predicting stroke risk, no comparably well-validated tool exists for predicting hemorrhage risk. Study subjects were not interviewed regarding whether they were offered warfarin therapy in the past but they refused, that is, we are not able to distinguish between people who were never offered therapy from informed refusers. Information on contraindications to warfarin therapy was not available so it is not known what proportion was actually warfarin candidates. The interview did not explore whether subjects who reported no active warfarin use had taken and subsequently discontinued warfarin in the past. Finally, our study was not originally designed to test the specific and singular question of racial differences in awareness and treatment of AF. This report is of an exploratory analysis and as such is subject to the limitation common to observational studies of a possible spurious association generated by Type I error.

In this large biracial cohort, blacks were less likely to be aware of AF and less likely to be treated with warfarin than whites. These findings are consistent with prior studies demonstrating that blacks are less likely to achieve quality of
care goals for stroke risk factors such as glycemic control in diabetes and blood pressure in hypertension. Such differences may underlie racial disparities in stroke morbidity and mortality and should lend urgency to focused efforts to improve patient education and medical literacy. The additional finding that CHADS2 score was not a predictor of warfarin use highlights an evidence–practice gap that should prompt further efforts focused on practitioner awareness and education. Future investigations to further understand the determinants of racial disparities in stroke and the impact of improved diagnosis and treatment of AF on race-related stroke outcomes would be of public health importance.

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Disclosures

None.

References

Racial Disparities in Awareness and Treatment of Atrial Fibrillation: The REasons for Geographic and Racial Differences in Stroke (REGARDS) Study
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