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ORIGINAL ARTICLE

Reported Incidence of Atrial Fibrillation Varies by Ethnicity and Presentation in the Multi-Ethnic Study of Atherosclerosis

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BACKGROUND: Atrial fibrillation (AF) is a common cardiac arrhythmia. Its detection rates vary significantly across ethnic groups, impacting epidemiological and clinical outcomes. We aim to explore ethnic differences in self-reported versus hospital-reported AF using the MESA (Multi-Ethnic Study of Atherosclerosis).

METHODS: Six thousand seven hundred seventy-five adults aged 45 to 84 years, free from baseline AF and major cardiovascular events, were monitored over 8.4 years (2000–2012) across 6 US locations. AF incidence was measured via hospital discharge *International Classification of Diseases* codes and self-reported data, validated by follow-up questionnaires. AF incidence per 1000 person-years was assessed by ethnic group and reporting method. Incidence rate ratios and adjusted hazard ratios were calculated with White participants as the referent group.

RESULTS: The study comprised 2611 White, 800 Chinese, 1485 Hispanic, and 1879 Black participants, with a mean age of 62.15 (10.24) years; 47.1% were male. Chinese had significantly lower incidence rate ratio (0.40 [95% CI, 0.19–0.75]; P=0.009) for AF reported only during hospitalization, whereas Hispanic group had significantly lower incidence rate ratio (0.29 [95% CI, 0.15–0.51]; P<0.001) for AF only via self-reporting. The combined overall reported AF incidence was 6.4%, or 7.72 per 1000 person-years, highest in the White group (10.69 per 1000 person-years) and lower in in Chinese (6.43 [95% CI, 4.61–8.71]; P=0.003), Hispanics (4.79 [95% CI, 3.61–6.24]; P<0.001), and Blacks (6.39 [95% CI, 5.16–7.84]; P<0.001).

CONCLUSIONS: The reported incidence of AF varies with the inclusion of self-reported data and across ethnic and racial groups. The inclusion of self-reported data increased the reported incidence of AF the most among Chinese individuals and the least among Hispanic participants. In the MESA study, the inclusion of self-reported data reveals heterogeneous changes across ethnic and racial groups, which may be due to differences in true incidence, methods of ascertainment, symptom perception, or health care access, and deserves further exploration.

GRAPHIC ABSTRACT: A graphic abstract is available for this article.

Key Words: atherosclerosis ■ atrial fibrillation ■ ethnicity ■ incidence ■ self report

Atrial fibrillation (AF) is a common cardiac arrhythmia frequently requiring clinical intervention, which exhibits notable variability in incidence across ethnic groups. Studies have shown that White individuals generally exhibit higher incidence rates (IRs) of AF compared with other ethnicities, including Black, Hispanic, and Asian populations.[1,2] This is true despite similar or even greater burdens of traditional cardiovascular risk factors, such as hypertension and diabetes in ethnicities other than White participants.[1–5] Such ethnic differences in incidence could be due to differences in access to care, clinical detection, or symptom recognition/perception.

In particular, detecting AF epidemiologically by relying on *International Classification of Diseases* codes from

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WHAT IS KNOWN?

- Atrial fibrillation (AF) exhibits notable variability in incidence across ethnic groups when diagnosed clinically, with White individuals generally exhibiting higher incidence rates of AF compared with other ethnicities, including Black, Hispanic, and Asian populations.
- Results using uniform ECG monitoring have been variable, with some studies showing no ethnic variation and others showing similar differences to those with clinical diagnosis.

WHAT THE STUDY ADDS

- In a large epidemiological study with 6775 participants, the method of documenting AF has a significant heterogeneous effect on the incidence by ethnicity.
- Self-reported data on AF increased incidence the most for Chinese individuals and least for Hispanic, underscoring the importance of integrating self-reported data with health care records and ECG data when studying ethnic disparities in AF.

Nonstandard Abbreviations and Acronyms

AF	atrial fibrillation
BMI	body mass index
HO	hospital-reported only
HR	hazard ratio
IR	incidence rate
IRR	incidence rate ratio
MESA	Multi-Ethnic Study of Atherosclerosis
SO	self-reported only

hospital records and ECG data may not capture all cases, particularly those who are nonhospitalized or paroxysmal. This is likely to underestimate the true incidence of the condition by an uncertain amount.

This study compares self-reported and hospital-reported incidence of AF within the diverse, community-based MESA (Multi-Ethnic Study of Atherosclerosis), and explores the ethnic disparities in that incidence.

METHODS

All data and materials have been made publicly available at Biologic Specimen and Data Repository Information Coordinating Center and can be accessed at https://biolincc.nhlbi.nih.gov.

Study Population

MESA was a longitudinal cohort designed to investigate the prevalence, risk factors, and natural history of subclinical cardiovascular disease, with its study protocol and exclusion criteria having previously been reported.[6] In brief, the total study population consisted of 6814 men and women aged 45 to 84 years, who were recruited between 2000 and 2002 from 6 communities across the United States (Baltimore City/Baltimore County, MD; Chicago, IL; Forsyth County, NC; Los Angeles County, CA; NY; and St. Paul, MN). Participants self-identified with 1 of 4 investigator-specified ethnic groups: White, Black, Asian, and Hispanic. After the baseline study visit (2000–2002), participants were scheduled for 5 additional follow-up exam visits, with the latest occurring from 2010 to 2012. In addition to exam visits, participants were periodically contacted every 6 to 12 months for follow-up to assess new medical events and hospitalizations between the exams. The study was approved by institutional review boards at each participant location, and all participants provided written informed consent. This article was prepared using MESA research materials obtained from the National Heart, Lung, and Blood Institute Biologic Specimen and Data Repository Information Coordinating Center (Biologic Specimen and Data Repository Information Coordinating Center; https://biolincc.nhlbi.nih.gov/home) and does not necessarily reflect the opinions or views of the MESA or the National Heart, Lung, and Blood Institute.

In the current analysis, data from 2000 to 2002 through follow-up 10, occurring between 2010 and 2012, were used. We excluded participants who had prebaseline events (n=5), such as heart attack, angina, stroke or TIA, heart failure, resuscitated cardiac arrest, or had undergone procedures related to cardiovascular disease (coronary artery bypass grafting, angioplasty, valve replacement, pacemaker or defibrillator implantation, or any surgery on the heart or arteries). We also excluded patients who were lost to follow-up beyond the baseline exam visit (n=33), as well as those with prebaseline AF or atrial flutter (n=1), resulting in a final population of 6775 participants.

Ascertainment of AF

At each exam or follow-up, participants were asked about new medical conditions such as AF. Patients were asked: Since our last telephone interview with you, has your doctor or health care professional told you that you had any of the following? AF was queried specifically with responses yes, no, or unsure. Responses of yes to incident AF were further classified in 2 ways: hospital-reported AF and self-reported AF. Hospital-reported AF was based on discharge diagnostic *International Classification of Diseases* codes, which were available through the retrieval and verification of in-hospital records. Self-reported AF was based on participants' reports of new AF at each exam or follow-up contact; such cases were deemed as out-of-hospital occurrences with no further investigative process. All incident AF cases included cases with AF reported via either hospitalizations or self-reporting. Self-reported only (SO) AF included cases who self-report AF but do not have hospital-reported AF. Hospital-reported only (HO) AF includes cases reported only during hospitalization with no self-reported AF.

Statistical Analysis

Baseline characteristics of age, gender, body mass index (BMI), and clinical risk factors of hypertension, diabetes, and smoking

status were compared across the 4 ethnicities: White, Black, Chinese, and Hispanic. Continuous variables were reported as means with standard deviations, whereas categorical variables were reported as frequencies with percentages. The χ^2 test was used to compare categorical variables, whereas continuous variables were analyzed using the *t* test/ANOVA, as appropriate.

The follow-up duration for each participant was delineated as the interval from the baseline assessment to the occurrence of AF (as per hospital-reported or self-reported), death from any cause, or the last follow-up visit for those without an incident AF event. Throughout a median follow-up period of 8.4 years, the IR of AF was calculated by dividing the total number of AF cases by the total follow-up duration across subjects, reported as a rate per 1000 person-years. IR for each type of AF presentation, as well as for each ethnic group, was evaluated with White ethnicity as the referent group. IR ratios (IRRs) were calculated using White participant as the referent group. Age- and gender-adjusted IRRs were obtained through Poisson regression analysis. Statistical significance is shown for all $P<0.05$.

Incident AF was further adjusted using the Cox regression model to compute adjusted hazard ratios (HRs) and 95% CIs for total AF across ethnic groups, with the White ethnic group serving as the reference. Multivariable-adjusted regression models were constructed to include covariates known to be associated with AF at baseline, such as age, BMI, gender, hypertension, diabetes, and smoking status. The proportional-hazards assumption was validated with the Schoenfeld residuals test as well as visual inspection of the smoothed plots of scaled Schoenfeld residuals over transformed time. All statistical analyses were conducted using R, version 4.1.2 (the R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

Participant Demographics and Baseline Characteristics

The study comprised 6775 participants initially free of AF across 4 ethnic groups: 2611 White (38.5%), 1879 Black (27.7%), 1485 Hispanic (21.9%), and 800 Chinese (11.8%) participants. Over the median follow-up of 8.4 (interquartile range, 7.7–8.6) years, 407 participants developed AF, equating to an overall AF incidence of 6.4%, with a cumulative IR of 7.72 per 1000 person-years from a total follow-up of 52 706 person-years. Among all incident AF cases, 249 cases (61.2%) were identified during hospitalizations, and 260 cases (63.9%) were detected through self-reporting. Of these, 147 cases (36.1%) were identified exclusively during hospital visits, 158 cases (38.8%) were detected solely through self-reporting, and 102 cases (25.1%) were confirmed by both methods.

Baseline Characteristics by Ethnicity

Table 1 shows the baseline demographics and prevalence of AF risk factors in the study population, stratified by ethnicity. There was no significant difference in gender distribution between ethnicities ($P=0.49$). Significant differences were observed in baseline characteristics, such as age, BMI, hypertension, diabetes, and smoking status ($P<0.001$ for each). White participants recorded the oldest average age at 62.6 years and had the lowest prevalence of diabetes at 6.9%. Chinese participants had the lowest average BMI at 23.94, as well as the lowest prevalence of hypertension (37.5%) and smoking (6.0%). Black participants had the highest average BMI at 30.18 kg/m^2 and the highest prevalence of hypertension (59.7%), smoking (19.5%). Hispanic participants were the youngest on average at 61.27 years and had the highest prevalence of diabetes at 19.3%. In terms of cohort composition, White participants comprised approximately a third of the study population, whereas Black participants made up about a quarter.

Incidence of AF by Ethnicity

Table 2 presents the incidence of AF according to ethnicity and method of reporting, with the IRs expressed in count and per 1000 person-years and raw counts. Using White participant as the referent group (IR, 10.69 per 1000 person-years [95% CI, 9.32–12.22]), the overall IR of new AF was significantly lower for all non-White ethnicities, with Chinese participants at 6.43 per 1000 person-years (95% CI, 4.61–8.71; $P=0.003$), Hispanic participants at 4.79 per 1000 person-years (95% CI, 3.61–6.24; $P<0.001$), and Black participants at 6.39 per 1000 person-years (95% CI, 5.16–7.84; $P<0.001$).

Table 1. Demographic and Clinical Characteristics of Study Participants

Characteristics	White participants (n=2611)	Chinese (n=800)	Hispanic (n=1485)	Black participants (n=1879)	*P* value
Age, y (SD)	62.6 (10.25)	62.38 (10.33)	61.27 (10.34)	62.13 (10.08)	<0.001
BMI, kg/m^2 (SD)	27.71 (5.04)	23.94 (3.18)	29.44 (5.03)	30.18 (5.82)	<0.001
Gender, male, %	1251 (47.9)	388 (48.5)	716 (48.2)	839 (44.7)	0.49
Hypertension, %	1008 (38.6)	300 (37.5)	618 (41.6)	1121 (59.7)	<0.001
Diabetes, %	180 (6.9)	107 (13.4)	287 (19.3)	354 (18.8)	<0.001
Smoking, %	369 (14.1)	48 (6.0)	222 (14.9)	367 (19.5)	<0.001

Categorical variables are shown as n (%), and continuous variables are shown as mean (SD). *P* values were generated using the χ^2 test for categorical variables and ANOVA for continuous variables. BMI indicates body mass index.

Table 2. Incident AF and Incidence Rate by Ethnicity and Presentation

Incident AF, n (IR*)	White participants (reference; n=2611)			Chinese (n=800)			Hispanic (n=1485)			Black participants (n=1879		
Total	219 (10.69)			41 (6.43)†			55 (4.79)‡			92 (6.39)‡		
When reported	Hosp		Self	Hosp		Self	Hosp		Self	Hosp		Self
	140 (6.73)		146 (7.05)	15 (2.31)‡		32 (4.99)	43 (3.72)‡		24 (2.08)‡	51 (3.50)§		58 (3.99)‡
Combinations	HO	Both	SO	HO	Both	SO	HO	Both	SO	HO	Both	SO
	73 (3.47)	67 (3.19)	79 (3.77)	9 (1.38)‖	6 (0.92)†	26 (4.04)	31 (2.67)	12 (1.16)‡	12 (1.03)‡	34 (2.32)	17 (1.03)‡	41 (2.81)

Data are presented as n (incidence rate per 1000 person-years). AF indicates atrial fibrillation; Both, AF reported in hospital and by self; HO, hospital-reported AF only; Hosp, all hospital-reported AF; IR, incidence rate; Self, all self-reported AF; and SO, self-reported AF only.

*Per 1000 person-years at risk.

†P=0.003.

‡P<0.001.

§P=0.006.

‖P=0.009.

Comparison of AF Presentation by Ethnicity

When examining the presentation of AF, non-White ethnicities had significantly lower all hospital-reported AF (regardless of self-reporting status) and total AF with both hospitalization and self-reporting compared with the White group (Table 2). When looking at HO AF, Chinese participants had significantly lower IR at 1.38 per 1000 person-years (95% CI, 0.63–2.62; P=0.009) compared with White participants. For all self-reported AF, regardless of any hospital-reported AF, Hispanic and Black participants had significantly lower IR at 2.08 per 1000 person-years (95% CI, 1.33–3.09; P<0.001) and 3.99 per 1000 person-years (95% CI, 3.04–5.17; P<0.001), respectively, whereas Chinese had lower but nonsignificant IR of 4.99 (95% CI, 3.41–7.04; P=0.09). When looking at SO AF, Hispanic participants had significantly lower IR at 1.03 per 1000 person-years (95% CI, 0.53–1.81; P<0.001) compared with White participant; this was around 75% lower than Chinese individuals.

We further evaluated the IRRs for AF among study participants using White participants as the referent group. In age- and gender-adjusted analysis, the IRR of total AF was significantly lower in all non-White ethnicities, with Chinese having 40% lower incidence, Hispanics having 51% lower incidence, and Black participants having 37% lower incidence, compared with White participants (Figure [A]). When examining the adjusted IRR among HO AF, only Chinese showed a significantly lower IRR of 0.40, which is a 60% lower incidence compared with White participants (Figure [B]). Hispanic and Black participants did not significantly differ from White participants. When examining the adjusted IRR among SO AF, only Hispanics showed a significantly lower IRR of 0.29, which is a 71% lower incidence compared with White participants (Figure [C]). For the adjusted IRR for all hospitalized AF, compared with White participants, Chinese had a 66% lower incidence, whereas Hispanic and Black participants had 38% and 44% lower incidence, respectively (Figure [D]). The incidence and reporting methods of AF across different ethnic groups are also represented graphically through an Euler diagram, as illustrated in Figure S1.

Adjusted HRs for AF by Ethnicity

After adjusting for baseline differences in age, BMI, gender, hypertension, diabetes, and smoking status; HR results were similar to the trend and directionality seen in the analysis of IRRs. Chinese, Black, and Hispanic participants exhibited significantly lower HRs compared with White participants (referent group) for all AF (Figure S2A). For HO AF, only Chinese participants had significantly lower HR compared with White participants (Figure S2B); for SO AF, only Hispanic individuals had significantly lower hazards compared with White participants (Figure S2C).

DISCUSSION

It is known that there are significant ethnic differences in the overall incidence of AF, with many ethnic groups having a lower incidence compared with White individuals. Previous studies of US populations have examined the risk for incident AF among non-White ethnicities and have consistently reported lower odds for these populations[1,2,4,7,8]

In the large, multiethnic MESA cohort, our study confirmed significant ethnic differences in the overall reported incidence of AF. Our findings similarly demonstrate higher AF incidence among White participants, with lower rates among Hispanic, Black, and Chinese participants. When examining IR ratios for all hospital-reported AF, our results are very similar to Rodriguez et al[2]: Hispanics and Black participants had AF incidence that was roughly 60% that of the referent White participants, whereas Chinese had approximately one-third the rate of incident AF (Figure [D]). Our study extends previous findings by incorporating self-reported AF cases, highlighting substantial differences in incidence estimation depending on the method of ascertainment. The

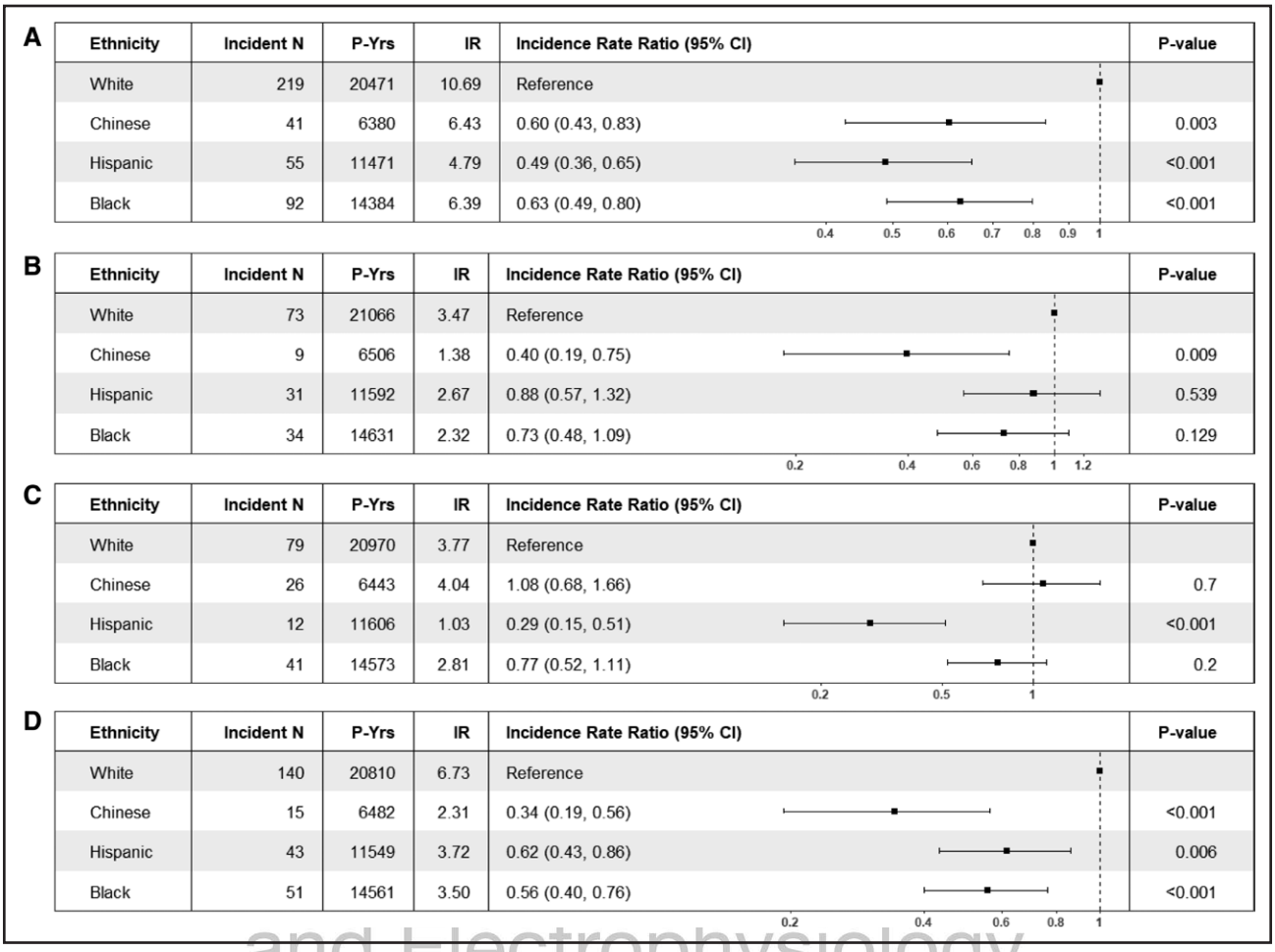

Figure. Adjusted incident rate (IR) ratio (IRR) of atrial fibrillation (AF) by presentation and ethnicity.
A, IRR for all AF (hospital-reported or self-reported), showing significantly reduced IRR across all non-White ethnicities, compared with White participant. **B**, IRR for hospital-reported AF only (HO) AF, showing significantly lower IRR in only Chinese ethnicity compared with White participants. **C**, IRR for self-reported AF only (SO) AF, showing significantly lower IRR in only Hispanic ethnicity compared with White participants. **D**, IRR for all hospitalized AF, showing significantly reduced IRR across all non-White ethnicities, compared with White participants. P-Yrs indicates person-years. *Adjusted for age and gender.

inclusion of self-reported data significantly increased the reported incidence, particularly among Chinese participants, and underscores the importance of methodological considerations in accurately assessing ethnic disparities in AF epidemiology. In addition, differences in study follow-up duration likely contribute to the observed variations, emphasizing the need to integrate multiple detection strategies to fully capture the burden of AF across diverse populations.

Ethnicity-Based Disparities in Reported AF Incidence

With White ethnicity as the referent group, we find that there are significant ethnic disparities in incident AF that vary according to the presentation of AF, as depicted in the Figure. All non-White ethnicities demonstrated lower total incident AF compared with White participants. Although Chinese and Hispanic groups had statistically significant reductions in specific categories (HO and SO, respectively), Black participants also consistently showed lower incidence across all types, with IRRs below 1, suggesting a similar directional trend despite not reaching statistical significance for the HO and SO groups. These trends were similarly seen in HR analyses. This suggests that the different methods of ascertaining AF lead to different estimates in AF incidence, with ethnic variations that deserve further exploration. For example, although the balance between hospital and self-reported detection incidence is fairly even for White and Black participants, for Chinese and Hispanics, the distribution is skewed in opposite directions, as shown in the graphical representation in Figure S1.

A recent study using MESA sub-cohort of 1556 participants examined AF detected through a 14-day ambulatory ECG versus clinically detected AF, which included self-reported cases.[9] The prevalence of clinically detected AF was higher in White participants compared with Black participants, yet AF detection by ECG monitoring in the same individuals revealed a similar proportion with AF

across all ethnicities. In contrast, other studies using uniform monitoring by ECG or ambulatory ECG[10] and pacemaker interrogation[11–13] have shown persistent and consistent racial differences.

The distinction between asymptomatic and symptomatic AF detection methods is clinically significant, as asymptomatic AF may have different prognostic implications. Emerging evidence suggests that asymptomatic AF may be associated with increased risk of adverse outcomes, including mortality,[14,15] compared with symptomatic AF. These differences underscore the need for integrated approaches that combine both symptom-based and systematic screening strategies to more accurately capture the burden and clinical implications of AF across diverse populations. In addition, multiweek or continuous long-term monitoring may enhance asymptomatic detection but is difficult to implement at scale, especially over extended periods. In this context, self-reporting remains a vital complementary tool in epidemiological research. Given these heterogeneous results and the complex nature of AF, we believe that there is no singular definitive method for AF detection; current methods of detecting AF remain imperfect and may not fully reflect the true underlying burden of disease.

Many prior studies used only *International Classification of Diseases* codes from hospital diagnoses or ECG monitor-detected data to ascertain AF, excluding information on self-reported AF.[2,4,8,11,13] In MESA, this resulted in the highest reported IRs in White participants, compared with Hispanic, Black, and Chinese individuals.[2] Our study showed the same pattern of IRR for hospital-detected AF, as mentioned previously.

When looking at total AF, however, our study shows different findings, with the key difference being the inclusion of SO data. As shown in the Figure, our results still showed that non-White ethnicities continue to have significantly lower IRRs; however, IRRs change from 0.35 to 0.61 for Chinese, 0.63 to 0.53 for Hispanics, and 0.57 to 0.64 for Black participants. The results reveal that the inclusion of self-reported AF cases, which did not result in hospitalization, differentially changes the overall IR ratio of AF for each ethnicity. In particular, the greatest increase in IRRs is seen in Chinese participants, while a reduction is seen in Hispanic participants. This finding may be due to a high IR of SO AF in Chinese and a significantly lower rate for Hispanic participants, as shown in Table 2. The importance of self-reported data has been previously demonstrated in a study by Soliman et al,[16] who showed that self-reported data significantly predicts stroke risk and can effectively be used interchangeably or in combination with ECG-detected AF for such prediction. The causes of these disparities in presentation are not clear, but possible reasons could be variations in genetic factors, duration and heart rate of episodes, symptom recognition and perception, or even disparities in provided health information and awareness.

Another consideration in interpreting the data is the differences between race, ethnicity, and genetic groups. Although the link between genetics of particular groups and health outcomes is quite reasonable, ethnicity and race are socially determined and, therefore, have a much looser relationship to genetics. Of the 2, ethnicity may denote a more geographically distinct group, which is why we have used that terminology. In the original MESA protocol documents, race/ethnicity eligibility was identified with interchangeable terms such as Black, White, and Asian/Chinese-American.[6] In particular, it should be noted that the Chinese ethnic group actually comprised of diverse Asian-American populations predominantly of Chinese descent, and Hispanic could include many different ethnicities from different continents. These nuances highlight the need for more precise and well-defined terminology in future research and data collection to identify ethnic groups, and careful consideration of current categorizations is needed before associating ethnicity with conclusions on how genetic, cultural, and environmental factors may contribute to AF risk.

Study Limitations

Self-reported AF history may not be entirely reliable, as nonhospitalized instances of AF were not further investigated per MESA protocol. A previous study indicated low sensitivity but high specificity of self-reported AF,[17] which suggests that we may potentially underestimate the true incidence of AF via self-reporting, although we are not likely to over report. We did not include ambulatory ECG data from later visits to confirm self-reported AF, as only a small number of MESA participants enrolled, particularly for non-White ethnicities, which led to a smaller power to detect differences. In addition, our study relies exclusively on hospital discharge codes and self-reported diagnoses, thereby not including outpatient and emergency department-only cases of AF, potentially underestimating AF incidence. Furthermore, hospital-diagnosed AF cases in our data set include both primary AF and provoked AF events associated with acute stressors such as surgery or severe illness. These provoked AF episodes may differ substantially in their natural history from community-diagnosed primary AF. This limitation highlights the need for future studies to incorporate outpatient, ED-based, and continuous ECG monitoring data to more accurately characterize AF subtypes and improve epidemiological assessments. Finally, due to the nature of MESA recording only the first outcome data, we are not able to look at the consistency of self-reported AF (ie, multiple self-reported events) across the entire study period, which may point to more persistent/permanent forms of AF.

Conclusions

The reported incidence of AF varies by presentation. Self-reported AF incidence is different from hospital-recorded

International Classification of Diseases coding of AF. When compared with White participants, Hispanics had a lower rate of self-reported AF, whereas Chinese had a lower rate of hospital-identified AF. For all reported AF, all other ethnic groups had lower AF IRs compared with White participants. Our study shows that the reported AF IR changes differentially with the inclusion of self-reported data. This underscores the importance of integrating self-reported data with health care records and ECG data when studying ethnic disparities in AF. Future research is needed to elucidate the underlying mechanisms of disparities in AF presentation, preferably with well-defined genetic or population/ethnicity groups. The results may have important implications in AF screening strategies, targeted prevention, and subsequent prevention of adverse outcomes.

ARTICLE INFORMATION

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Disclosures

None.

Supplemental Material

Figures S1–S2

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