RESEARCH ARTICLE

Comparative Rates of Acute Ischemic Stroke Incidence

Native Hawaiians or Pacific Islanders vs Other Races and Ethnic Groups in 4 US States

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Abstract

Background and Objectives

There are limited data on the incidence of acute ischemic stroke (AIS) among Native Hawaiian or Pacific Islander (NHOPI) individuals in the United States and on how their incidence compares with that of other racial and ethnic groups. We compared age and sex-specific incidence of AIS in NHOPI individuals with those of non-Hispanic White (NHW), non-Hispanic Black (NHB), Hispanic and Asian individuals residing in 4 states of the United States over the past decade.

Methods

Using a retrospective approach, we examined the State Ambulatory Surgery, Emergency, and Inpatient Databases of Florida (2005–2020), Georgia (2010–2020), Maryland (2012–2020), and New York (2005–2020). Based on available data, we applied a 6-year look-back period for Florida and New York and a 3-year look back period for Georgia and Maryland. Incident AIS cases among adults (≥18 years) were identified using International Classification of Diseases codes. Cases were combined with census data to compute incidence. Random-effects Poisson regression models were used to compare incidence between various race and ethnicity groups.

Results

We identified 799,150 incident cases of AIS among residents of all 4 states. The median age of these cases was 70.0 years, and 50.1% were female individuals. The age and sex-standardized incidence of AIS in NHOPI was 591.4 (95% CI 559.3–623.5), whereas that in NHW individuals was 179.7 (95% CI 179.2–180.3). After multivariable adjustment, the incidence in NHOPI was >3 times that of NHW individuals (adjusted incidence rate ratio [aIRR] 3.30, 95% CI 1.70–6.42). Incidence was also higher in NHOPI compared with Hispanic (aIRR 3.91, 95% CI 2.13–7.19) and Asian individuals (aIRR 5.66, 95% CI 3.27–9.80), whereas the NHOPI incidence in comparison with that of NHB individuals showed a trend toward significance (aIRR 1.94, 95% CI 0.99–3.77, $p = 0.052$). After further stratification by age, the incidence gap between NHOPI and NHW individuals was present in most age groups but was most marked in adults age ≥80 years (aIRR 4.24, 95% CI 2.46–7.33).

Discussion

Over the period 2011–2020, incidence of AIS among NHOPI individuals residing in Florida, Georgia, Maryland, and New York was higher than among individuals from other major race and ethnicity groups. Additional studies are needed to see whether the findings in these 4 states are occurring nationally.

MORE ONLINE

Supplementary Material

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Glossary

aIRR = adjusted incidence rate ratio; **AIS** = acute ischemic stroke; **CVD** = cardiovascular disease; **HCUP** = Healthcare Cost and Utilization Project; **ICD-9** = International Classification of Diseases, Ninth Revision; **ICD-9-CM** = ICD-9, Clinical Codification; **ICD-10** = International Classification of Diseases, 10th Revision; **ICD-10-CM** = ICD-10, Clinical Codification; **NHOPI** = Native Hawaiian or Pacific Islander; **NHB** = non-Hispanic Black; **NHW** = non-Hispanic White.

Introduction

Multiple prospective cohorts have established sex,[1] racial, and ethnic disparities[2] in acute ischemic stroke (AIS) incidence in the United States. AIS risk among Black individuals in the United States is 1.5 to 2.5 times that of non-Hispanic White (NHW) individuals.[3-7] Incidence in select groups of Hispanic individuals may be up to 1.5 times the risk in NHW individuals,[6,8] but incidence data in some racial and ethnic groups such as Native Hawaiian or Pacific Islander (NHOPI) and Asian individuals who are among the fastest growing populations in the United States are lacking.[9] Data from the National Vital Statistics suggest that NHOPI individuals may have the third highest cardiovascular disease (CVD) mortality rate in the United States,[10] but population-level data on AIS incidence in NHOPI individuals in the contiguous US mainland are sparse.

The aims of this study were to (1) quantify and compare age-specific and sex-specific differences in incidence of AIS between various race and ethnic groups of the United States over the past decade, with focus on NHOPI individuals as a unique group that is disaggregated from Asian individuals and (2) describe trends in age-specific and sex-specific incidence between various demographic subgroups of the United States over this period.

Methods

This study was written to comply with The Strengthening the Reporting of Observational Studies in Epidemiology Statement: guidelines for reporting observational studies. F.O. Otite was responsible for data stewardship.

Data Sources

We used the State ambulatory, emergency, and inpatient databases of Florida (2005–2021), Georgia (2010–2020), Maryland (2012–2021), and New York (2005–2021) to conduct a retrospective cohort study. These administrative databases are published by the Agency for Healthcare Research and Quality as part of the Healthcare Cost and Utilization Project (HCUP). The databases of these states encompass all hospitalizations in participating states and contain unique patient identifiers that allow for tracking individuals across hospitalizations and databases over the years. Together, the combined population of these states account for >17% of the total US population. Georgia was specifically included because it is the only state in the traditional US stroke belt[11] with available HCUP data on unique patients in all 3 databases for >7 years of the past decade. Georgia and Maryland are top 5 states in the United States in terms of %Black individuals,[12] Florida and New York are 2 of the top 5 states for Hispanic individuals in the United States,[13] whereas New York is second only to California in terms of actual numbers of Asian individuals. All 4 states account for 9.4% of the NHOPI in the US mainland.

Study Population

We identified all adult (age ≥18 years) hospital encounters (including inpatient, emergency or ambulatory surgery encounters) in these administrative databases with a primary or secondary diagnosis of AIS using ICD-9 codes (43301, 43311, 43321, 43331, 43381, 43391, 43401, 43411, 4349, 43491 and 436) and ICD-10-CM codes I63.xx. These codes have been validated previously and found to be concordant with physician diagnosed AIS in >90% of cases.[14] ICD-10 codes have also been shown to have sensitivity of 77.9%–94.5% and specificity of 98.4%–98.9% for incident AIS.[15] We excluded hospitalizations with missing patient identifiers, those with missing age or sex and those in nonresidents of the participating states (eFigure 1).

Definition of Incident AIS

Incident AIS was defined as first hospital encounter (inpatient, emergency room, or ambulatory surgery) with documented AIS and with no prior hospitalization for AIS in that patient in the preceding years. We used a 6-year look-back period (2005–2010) for Florida and New York state patients and only a 3-year look-back period for Georgia (year 2010–2012) and Maryland (2012–2014) because unique patient identifiers became available for Georgia in 2010 and Maryland in 2012. All previous hospitalizations in identified patients were reviewed, and additional patients were excluded if they had codes corresponding to those for "personal history of TIA and cerebral infarction without residual deficit" (ICD-9 V12.54 or ICD-10 Z86.73). All hospitalizations preceding the index AIS hospitalizations in identified patients were reviewed, and those with codes for sequelae of cerebrovascular diseases such as aphasia and hemiparesis (ICD-9-CM 438.x and ICD-10-CM I69.3x, I69.8x and I69.9X) were also excluded.

State Population Data

We obtained the annual mid-year population of the selected states by age, sex, and race and ethnicity using data obtained from the US Census Bureau website.[16]

Definition of Race and Ethnicity

Race and ethnicity groupings were obtained separately for NHW, non-Hispanic Black or African American (NHB), Asian individuals separately, NHOPI separately, and Hispanic individuals of any race. HCUP collected information on race and ethnicity for participating hospitals in each state using state-specific uniformly coded data. Further details on race and ethnicity in the state databases are available online.[17]

Definition of Covariates

Risk factors for AIS were defined using constellation of ICD codes as documented in eTable 1. To increase the capture of risk factors, all hospitalizations before AIS in identified patients were reviewed, and patients were categorized as having these risk factors if present in prior hospitalizations.

Statistical Analysis

Primary Analysis

We summarized baseline characteristics of incident cases using descriptive statistics. We calculated crude and age-stratified estimates of AIS incidence by sex and by race and ethnicity using the incidence counts and the mid-year population of the selected states as denominators. Incidence estimates for each race and ethnicity were age and sex-standardized to the 2020 US population and differences in AIS incidence between racial groups evaluated using the 2-proportions Z-test.

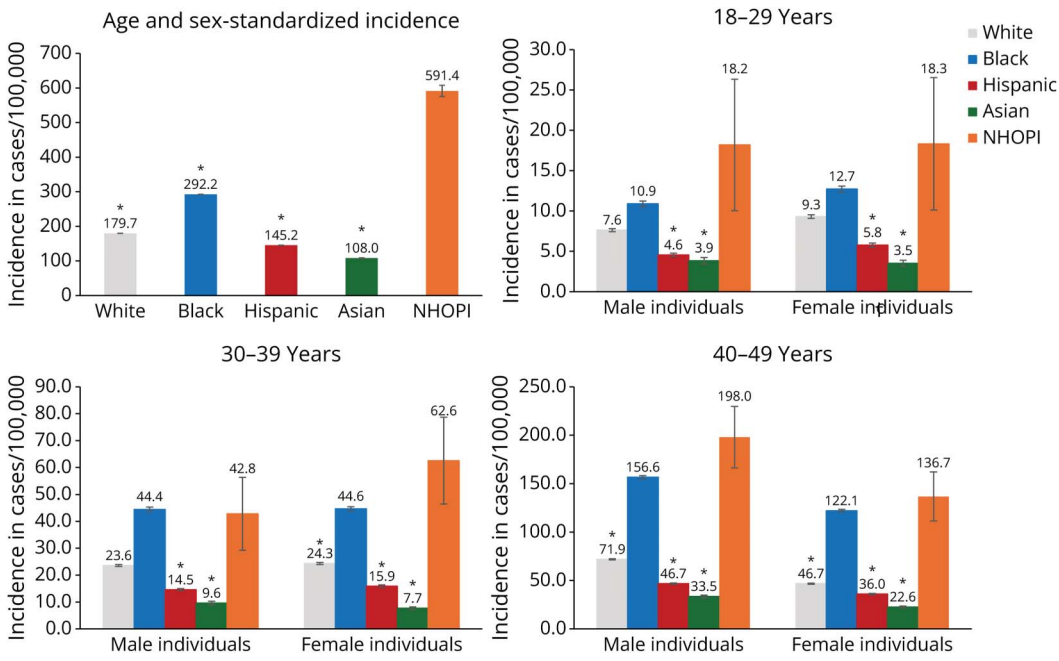
We further used several panel data random-effects Poisson regression models with clustering by state and robust standard errors to compare overall and age-specific incidence between various race and ethnicity subgroups. Overall models across the entire age spectrum were adjusted for age, sex, and race and ethnicity, whereas age-stratified models were adjusted for sex and race and ethnicity as appropriate.

Overall trends in annual age and sex-standardized incidence for each race and ethnicity were evaluated using Joinpoint regression with autocorrelation errors. Age and sex-specific trends in incidence by race and ethnicity was evaluated using several Poisson regression models with year evaluated as a continuous variable with significance of trends over time evaluated using the Wald test. Because of variability in start dates for the various states, trend analysis was done only for states that had up to 8 years of incidence data that is, Florida, Georgia, and New York. A 2-tailed α of <0.05 was required for statistical significance. Adjustment for multiple comparison was not considered necessary because this is a purely descriptive study with no specific hypothesis being tested.[18,19] All primary analyses were done by F.O.O. using Stata (version 16).

Missing Data

Race and ethnicity data were missing in 4.4% of patients. Patients with missing race and ethnicity data were classified under an unknown or other race category.

Figure 1 Age and Sex-Standardized and Age-Stratified Incidence in Cases/100,000 of Acute Ischemic Stroke in Florida, Georgia, Maryland, and New York From 2011 to 2020 According to Race and Ethnicity and Sex in Individuals 18–49 Years



Error bars represent standard error of the mean. NHOPI = Native Hawaiian or Pacific Islander Individuals. *Represents *p* value for comparison to NHOPI <0.05 obtained from univariable Poisson regression model in the relevant age and sex group.

Standard Protocol Approvals and Registrations

This project was approved by the Agency for Healthcare Research and Quality after the agency determined this project to be consistent with the HCUP Data Use Agreement. According to HCUP, utilization of the deidentified data contained in the state administrative databases does not require approval by an institutional review board.

Data Availability

HCUP Data Use Agreement limitations prohibit the authors from sharing HCUP data. However, all data sets used in this study are publicly available for purchase from HCUP. Analyses codes will be shared on request.

Results

Baseline Characteristics

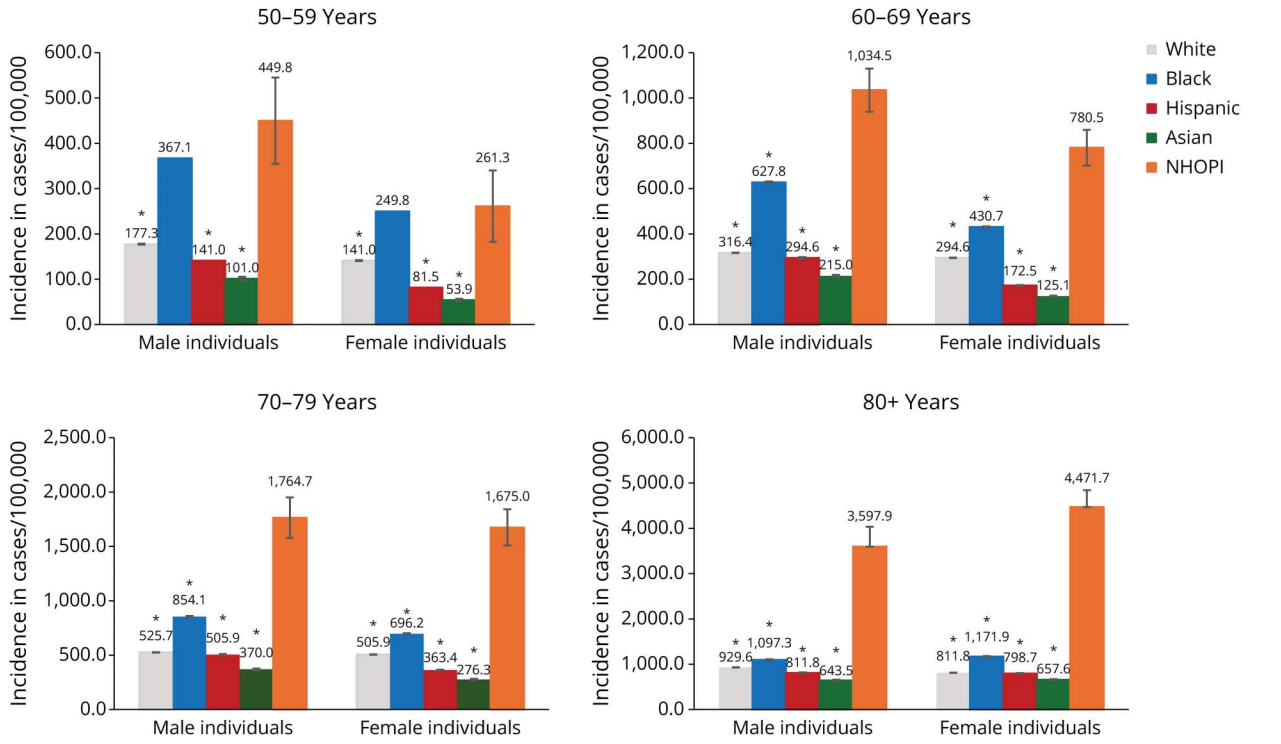
There were 799,150 patients with AIS in the 4 states that met our inclusion criteria (eFigure 1). 50.1% of these patients were female. The median age of all patients was 70.0 years (interquartile range 60.0–81.0). NHOPI were 5 years younger, and NHB patients were 9 years younger compared with NHW patients (eTable 2). Almost half of NHB patients were in the lowest quartile for income vs 21.8% in NHW patients and 19.6% for NHOPI individuals. Atrial fibrillation was most prevalent in NHW individuals particularly NHW female individuals, whereas hypertension and chronic kidney disease were most prevalent in NHB individuals (eTable 2).

Age, Sex, and Racial Differences in Incidence Across the 4 States

The annual crude incidence of AIS in these 4 states in cases/100,000 across the study period was 195.8 (95% CI 195.4–196.2), but the crude incidence in NHOPI individuals was significantly higher compared with that of individuals of other race and ethnic groups (eFigure 2). After age and sex standardization to the 2020 US population, the average annual incidence in NHOPI individuals was 591.4 (95% CI 559.3–623.5) compared with 179.7 (95% CI 179.2–180.3) in NHW and 292.2 (95% CI 291.0–293.4) in NHB individuals (all *p*-values for comparison <0.001) (Figure 1). Age and sex-stratified estimates of incidence demonstrated that the higher incidence in NHOPI individuals was present in almost all age and sex groups across the entire age continuum (Figures 1 and 2).

After multivariable adjustment for age, sex, and year of hospitalization, the adjusted incidence in NHOPI individuals was >3 times that of NHW individuals (adjusted incidence rate ratio [aIRR] 3.30, 95% CI 1.70–6.42), almost 4 times that of Hispanic individuals (aIRR 3.91, 95% CI 2.13–7.19) and >5 times that of Asian individuals (aIRR 5.66, 95% CI 3.27–9.80) (Table 1). This higher adjusted incidence in

Figure 2 Age-Stratified Incidence of Acute Ischemic Stroke in Cases/100,000 in All 10 Year Age Groups ≥50 Years According to Race and Ethnicity and Sex in Residents of Florida, Georgia, Maryland, and New York From 2011 to 2020



Error bars represent standard error of the mean. NHOPI = Native Hawaiian or Pacific Islander Individuals. *Represents *p* value for comparison to NHOPI <0.05 obtained from univariable Poisson regression model in the relevant age and sex group.

Table 1 aIRRs for the Association Between Demographic Characteristics and Incident Ischemic Stroke in 4 States of the United States

	All states			Florida			Georgia			Maryland			New York		
Variable	a IRR	95% CI	*p* Value	aIRR	95% CI	*p* Value	aIRR	95% CI	*p* Value	aIRR	95% CI	*p* Value	aIRR	95% CI	*p* Value
Race and ethnicity															
NHOPI vs NHW	3.30	1.70–6.42	<0.001	1.20	0.96–1.49	0.112	4.63	3.90–5.49	<0.001	5.41	4.08–7.15	<0.001	5.01	4.09–6.14	<0.001
NHOPI vs NHB	1.94	0.99–3.77	0.052	0.68	0.54–0.85	<0.001	2.86	2.41–3.41	0.001	3.33	2.52–4.42	<0.001	2.92	2.38–3.60	<0.001
NHOPI vs Hispanic	3.91	2.13–7.19	<0.001	1.49	1.20–1.86	<0.001	5.24	4.37–6.29	<0.001	7.53	5.66–10.02	<0.001	5.45	4.44–6.68	<0.001
NHOPI vs Asian	5.66	3.27–9.80	<0.001	2.49	1.99–3.11	<0.001	9.46	7.86–11.40	<0.001	10.1	7.60–13.49	7.45	6.06–9.16	<0.001	<0.001

Abbreviations: aIRR = adjusted incidence rate ratio; NHB = non-Hispanic Black; NHOPI = Native Hawaiian and Pacific Islander; NHW = non-Hispanic White. Estimates for all states obtained from separate random-effects Poisson models adjusted for age, sex, year of hospitalization, and with clustering by states and each race and ethnicity group as reference group to allow for comparison with NHOPI. State-specific estimates obtained from Poisson regression models with robust standard errors for each state.

NHOPI individuals compared with individuals of other race and ethnicity was present in all 4 states except for NHB individuals who had greater incidence vs NHOPI individuals in Florida but lower incidence vs NHOPI individuals in the states of Georgia, Maryland, and New York (Table 1).

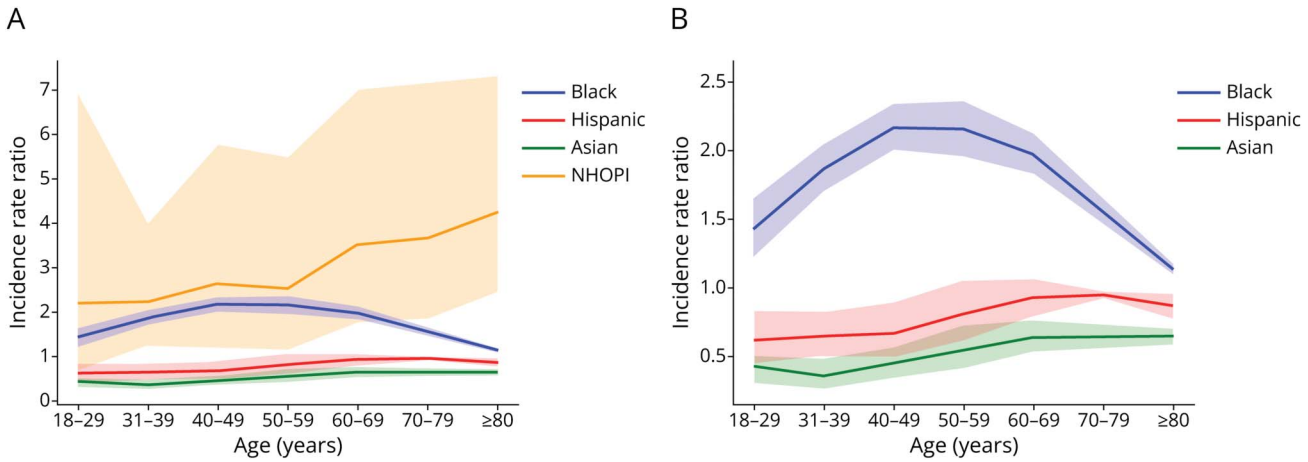
With NHW individuals as the reference group, the incidence in NHB individuals was 70% higher than that of NHW individuals (aIRR 1.71, 95% CI 1.66–1.76) (eTable 3). Although the NHB vs NHW incidence gap was the widest in individuals age 40–49 years and 50–59 years, that between NHOPI vs NHW individuals increased with age (Figure 3, eTable 4).

Trends in Incidence Over Time

On Joinpoint regression, the age and sex-standardized incidence of AIS did not change significantly over time for NHOPI, NHB, Hispanic, and Asian individuals over time, whereas that of NHW individuals increased marginally over time (annualized percentage change: 1.0%, 95% CI 0.7%–1.2%, $p < 0.001$) (Figure 4).

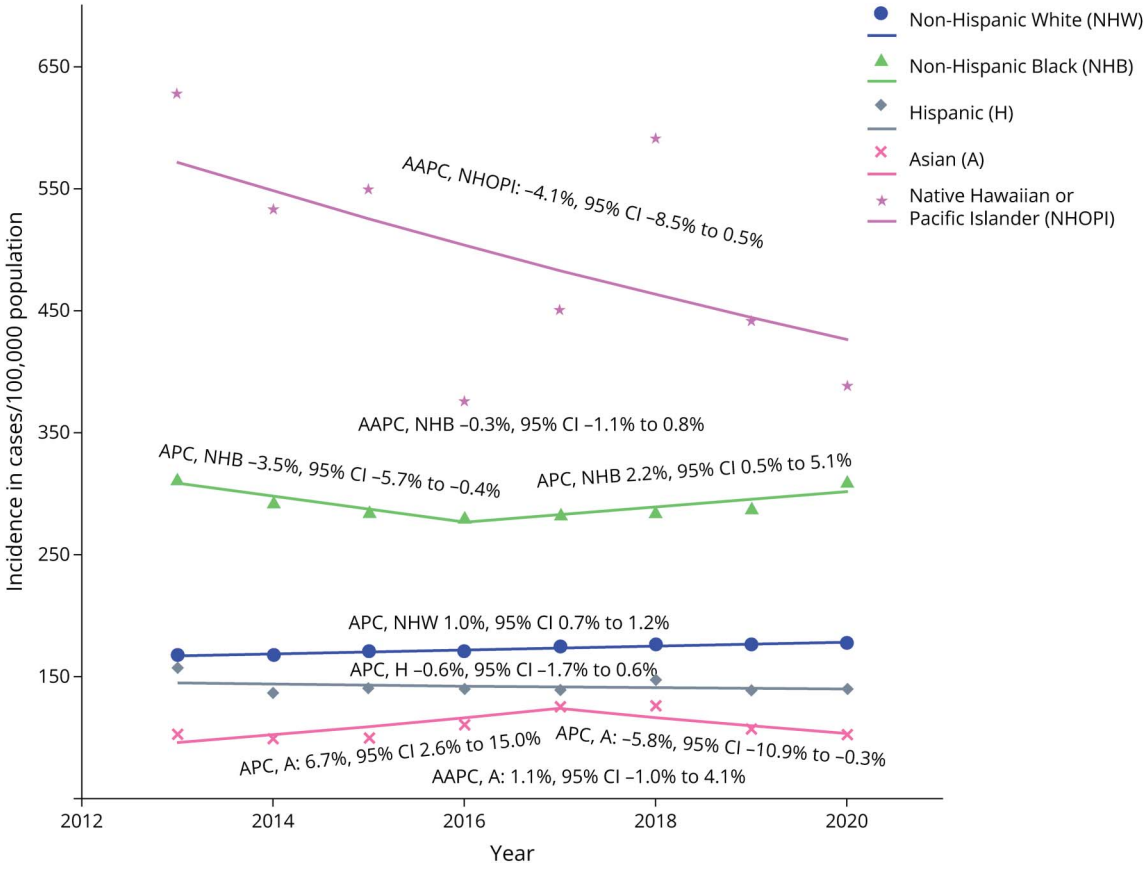
Age-stratified estimates demonstrated that there was no definite change in AIS incidence in NHOPI individuals 18–49 years of age over the period 2013–2020, whereas those of individuals in other race and ethnic groups increased over time (Figure 5, eTable 5). Among individuals in other age

Figure 3 Incidence Rate Ratios of Acute Ischemic Stroke for Various Race and Ethnic Groups vs Non-Hispanic White Individuals Across the Age Continuum in 4 US States



Lines represent smoothed incidence rate ratios normalized to Non-Hispanic White individuals in each age groups in panels A and B. Bands around lines represent 95% CIs around incidence ratio estimates. Further details of age-specific incidence ratios are presented in eTable 3. Panel A represents actual incidence ratios in all racial groups. Panel B represents incidence ratios without Native Hawaiian or Pacific Islander individuals to allow for better appreciation of the relationship across the age continuum in other race and ethnic groups.

Figure 4 Joinpoint Regression of Trends in the Age and Sex-Standardized Incidence of Acute Ischemic Stroke in Cases/100,000 by Race and Ethnicity in Residents of Florida, Georgia, Maryland, and New York From 2013 to 2020



APC = annualized percentage change; AAPC = average weighted APC across the study period when multiple Joinpoints are present. Annual incidence estimates are age and sex standardized to the 2020 US population.

groups, AIS incidence trends by race and ethnicity were very variable: increasing over time among NHW and Asian individuals 50–59 and 60–69 years of age, whereas those in individuals of other race and ethnicity in these age groups did not change significantly over time (Figure 6, eTable 5).

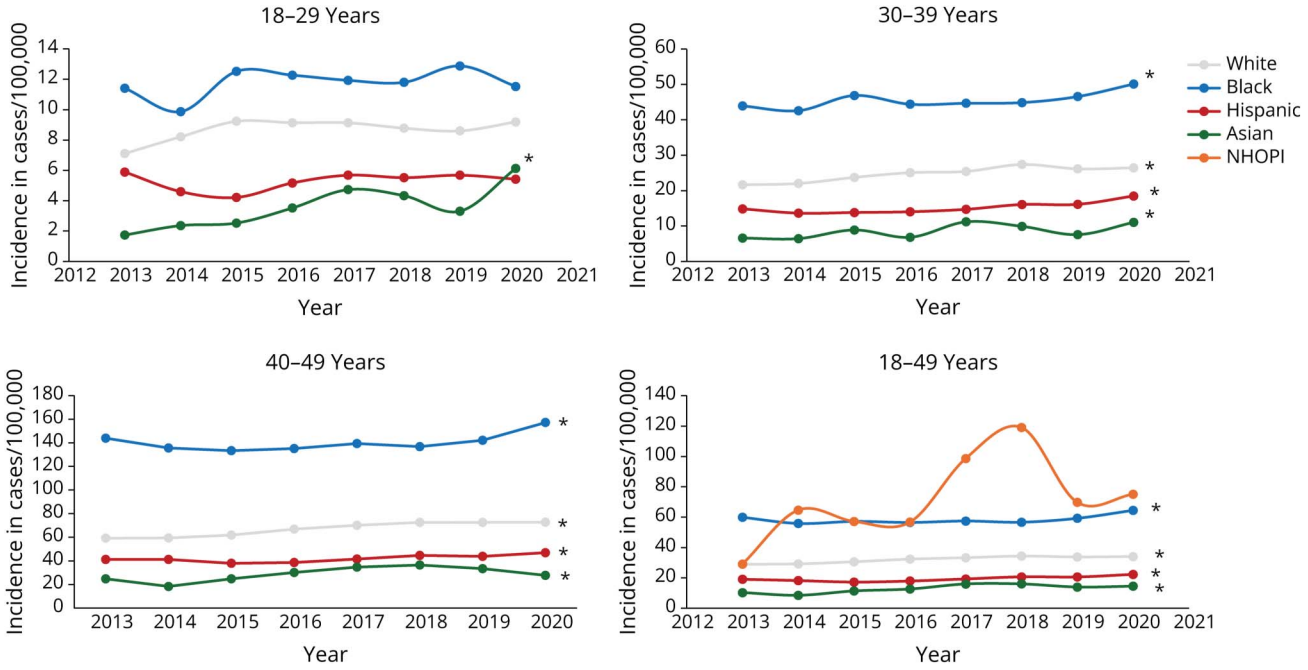
Discussion

In this contemporary analysis of multiple state administrative health care databases, we found that among residents of Florida, Georgia, Maryland, and New York over the period 2011–2020, Native Hawaiian or Pacific Islander individuals had the highest incidence of AIS compared with individuals of other race and ethnic groups. The ratio of the NHOPI incidence in comparison with NHW individuals was approximately 3:1 while that of NHB to NHW individuals was 1.7:1.

The Center for Disease Control's 2014 summary of the adult National Health Interview Survey reported a 3.9:1 prevalence ratio of all strokes (including hemorrhagic strokes) in NHOPI vs NHW individuals in the United States,[20] but to the best of our knowledge, this is the first study to ever quantify AIS risk longitudinally within the NHOPI population in the United States. The findings of this study align with the Auckland Regional Community Stroke studies (ARCOS I–V) study demonstrating a 1.5 to 2.0 times greater risk of all strokes in the Māori and Pacific people of New Zealand in 2021–2022 when compared with that of New Zealanders of European descent.[21]

The NHOPI population has traditionally been underrepresented or aggregated with other racial subgroups such as Asian individuals in most prospective cohorts[22,23] which may have led to gross underappreciation or negligence of the burden of CVDs within this population. Our study however brings the disproportionate burden of AIS experienced by this group to the fore and will require future studies to define the underlying reasons for this variation so that it can be appropriately tackled. Other studies evaluating AIS risk in NHOPI individuals have drawn attention to the possible lower age at onset and greater prevalence of selected CVD risk factors such as hypertension, diabetes, and obesity in NHOPI patients with AIS compared with NHW patients.[24,25] Similarly higher burden and/or poor control of risk factors have been reported in NHB individuals who also carry a disproportionate

Figure 5 Trends in the Incidence of Acute Ischemic Stroke in Cases/100,000 by Race and Ethnicity in Residents of Florida, Georgia, Maryland, and New York From 2013 to 2020 in All Age Groups From 18 to 49 Years



NHOPI = Native Hawaiian or Pacific Islander Individuals. NHOPI not reported in each approximately 10-year age groups because of cells with <10 counts. This is to allow for compliance with Healthcare Cost and Utilization Project data use agreement. However, trends depicted in the combined age range for NHOPI individuals as 18–49 years. *Indicates *p* value for trend towards significant annual increase <0.05. †Indicates *p* value for trend toward significant annual decline <0.05.

AIS burden.[26] While focus on controlling these risk factors in these minority populations may be of paramount importance, the root causes of the differential burden of these CVD conditions and risk factors in NHB individuals extends beyond simple risk factor control to systemic factors such as social adversity and structural racism.[26,27] NHOPI individuals also experience gross socioeconomic negligence from colonialism and structural racism,[22,28] and how these factors may systematically increase AIS risk in this population warrants further exploration.

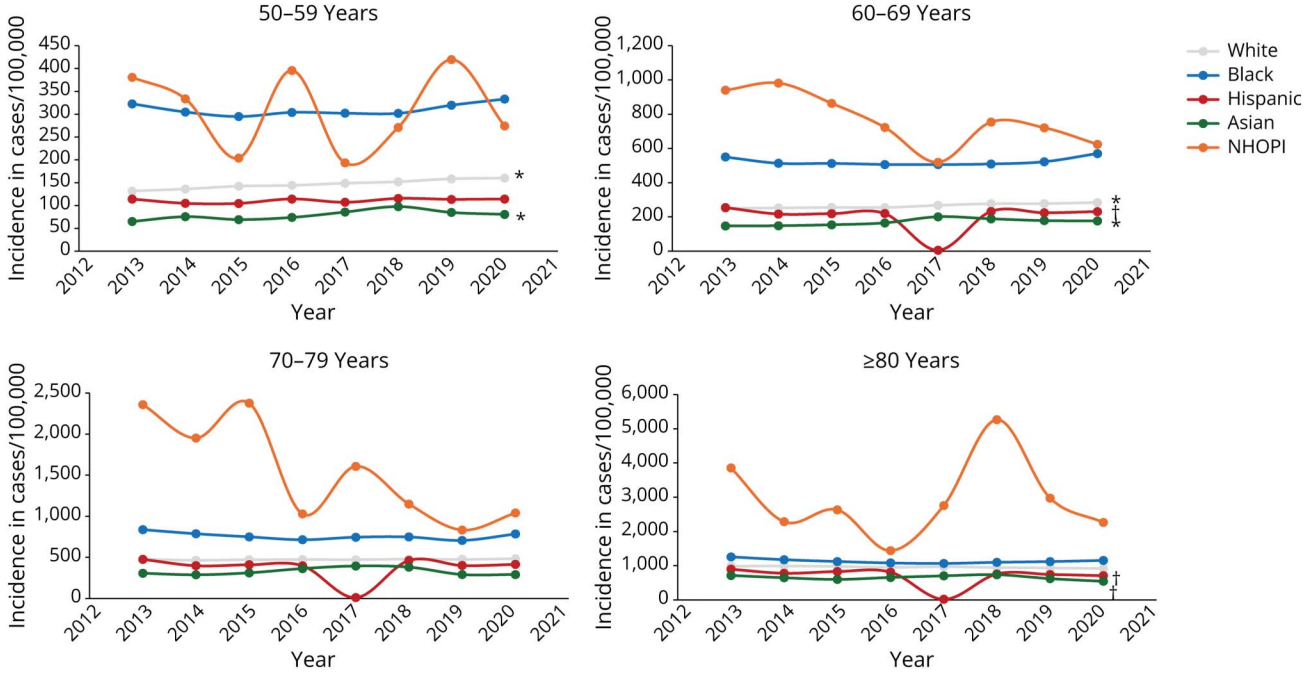
Our results also lend support to the need for disaggregation of race and ethnicity (particularly for Asian and NHOPI individuals) in health care administrative databases because a key step in addressing health inequities is reconciling deficiencies in how race and ethnicity data are collected.[29,30] As at the time of this study, health care databases with widespread national representation such as the National Inpatient Sample that may have allowed for study of the differential prevalence of AIS by race and ethnicity aggregate Asian and NHOPI individuals into 1 broad group. Further studies would be needed to understand the genetic heritage of NHOPI individuals and how this may be associated with AIS risk.

We also found that the incidence did not change significantly over time for NHW, Hispanic, and NHB individuals while that in Asian individuals increased over time. Relatively stable overall age and sex-adjusted incidence estimates over time in most racial subgroups indicates that not much progress has been achieved in eradicating previously reported NHB: NHW incidence disparity over the last decade Additional efforts are required to move the needle toward reduced AIS incidence in individuals of all racial/ethnic backgrounds but more especially NHB and NHOPI individuals who bear a disproportionately greater burden.

The lower AIS incidence in Hispanic individuals compared with NHW individuals is also remarkable. Notably, this lower incidence was seen in each of the 4 states of the study with varying estimated lower incidence in this ethnic group in comparison with NHW individuals ranging from 8% in New York to 29% in Maryland. This finding contradicts reported data demonstrating a 48% higher AIS incidence in the predominantly Caribbean Hispanic population vs NHW individuals contained in the Northern Manhattan Study (NOMAS).[6] Reasons for this discordance are not very clear, but similar discrepancy has been noted in other studies demonstrating lower rate of stroke prevalence in Mexican Americans nationwide when compared with those of regional cohort studies of Mexican Americans or other Hispanic groups which typically report higher incidence or prevalence in comparison with NHW individuals.[31]

The Hispanic population in the United States comprises a very heterogeneous group with those of Mexican descent possibly having different cardiovascular risk profiles compared

Figure 6 Trends in the Incidence of Acute Ischemic Stroke by Race and Ethnicity in Cases/100,000 in Residents of Florida, Georgia, Maryland, and New York From 2013 to 2020 in All 10-Year Age Groups ≥50 Years



NHOPI = Native Hawaiian or Pacific Islander Individuals. † Indicates *p* value for trend toward significant annual decline <0.05.

with those of Latin American or Caribbean descent.[32] Varying risk profile for CVD between varying groups of Hispanic patients may present unique AIS risk that may be captured differently depending on the population studied. Moreover, recently published population-based stroke surveillance data shows equal or lower AIS incidence rate in most age groups of Mexican American individuals compared with that of NHW individuals residing in Nueces county, Texas in the years 2016 and 2017,[33] so there are actually groups of Hispanic individuals in which the Hispanic: NHW incidence gap may have closed.

This study should be viewed within the framework of its limitations. This study likely underestimates the true incidence of AIS in the community as it does not capture AIS not presenting for hospitalization. Our study relies on previously validated ICD-9/10 codes, but we cannot exclude inaccuracies because of coding errors. We report on the presence or absence of CVD risk factors but are unable to provide any information on control of these risk factors. Notably, certain risk factors such as obesity and cigarette smoking are poorly captured in administrative databases, so we are unable to accurately evaluate the association of risk factor burden with AIS risk. Our primary results may not be generalizable to individuals residing in the western parts of the United States or to NHOPI individuals residing in the state of Hawaii. Moreover, incidence estimates pattern for Florida differs from those of other states, and this raises further concern about the generalizability of disparities in incidence estimates to the entire US population. We could not study incidence in Hawaii state residents as individual patient identifiers only became available for Hawaii in the state administrative databases in 2019. The relatively few cases (<1,000 total cases) in the NHOPI population may make incidence estimates for this population more susceptible to overestimation from coding errors but prior data demonstrating 4:1 prevalence of all strokes in NHOPI vs NHW individuals render some internal validity to current estimates. Furthermore, it is expedient that age and sex-stratified incidence estimates for NHOPI individuals by year be viewed with caution because these estimates had wide variation likely because of small annual number of cases. Our retrospective study, which used administrative data sources, did not apply all aspects of the CONSolidated critERia for strengthening the reporting of health research involving Indigenous peoples: CONSIDER statement, as these guidelines are intended to support improved reporting of such research.[34] Prospective studies that actively engage NHOPI communities are still needed to fully understand potential peculiar factors that are associated with the excess AIS risk experienced by this population.

Collection of race and ethnicity in these state administrative databases is not standardized and is not always based on the gold standard of self-report. We report significantly lower incidence of AIS in Asian individuals, but this group is still very heterogeneous.[30] AIS risk in individuals of South Asian descent such as Pakistan, India, and Bangladesh may possibly

be very different from those of Southeast Asia such as Thailand and possibly different from those of East Asian descent of Chinese origin, so aggregating the AIS risk of all these individuals into a single group may potentially hide health inequities experienced by individual subpopulations within the group. We were unable to evaluate incidence in American Indian or Alaska Native individuals due to very low counts. We have no information on nonbinary sex expressions because this information is not currently captured in HCUP databases.

Among the combined residents of Florida, Georgia, Maryland, and New York from 2011 to 2020, the incidence of AIS in NHOPI individuals was 300% higher than that of NHW individuals which is higher than the AIS incidence gap between NHB and NHW individuals. Additional studies are needed to examine whether this higher incidence in NHOPI individuals extends to NHOPI residing in other parts of the country and in the island state of Hawaii.

Author Contributions

F.O. Otite: drafting/revision of the manuscript for content, including medical writing for content; major role in the acquisition of data; study concept or design; analysis or interpretation of data. N.A. Morris: analysis or interpretation of data. N. Anikpezie: major role in the acquisition of data; analysis or interpretation of data. D. Pitter: analysis or interpretation of data. R. Miller: analysis or interpretation of data. A.T. Bako: analysis or interpretation of data. E. Aneni: analysis or interpretation of data. K. Atchaneeyasakul: analysis or interpretation of data. S.D. Patel: analysis or interpretation of data. A. Sahoo: analysis or interpretation of data. C.D. Wee: major role in the acquisition of data; analysis or interpretation of data. K.C. Albright: major role in the acquisition of data; analysis or interpretation of data. J.G.S. Latorre: analysis or interpretation of data. A. Singla: analysis or interpretation of data. P. Khandelwal: analysis or interpretation of data. O.A. Williams: analysis or interpretation of data. S. Chaturvedi: analysis or interpretation of data. B. Ovbiagele: analysis or interpretation of data.

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Disclosure

K.C. Albright is a consulting reviewer for *Stroke*. S. Chaturvedi is an associate editor for *Stroke* and *NEJM Journal Watch Neurology*. F.O. Otite is an assistant editor for the *Journal of the American Heart Association.* B. Ovbiagele is the Editor-in-Chief of the *Journal of the American Heart Association*. All other authors report no relevant disclosures. Go to Neurology.org/N for full disclosures.

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