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Exploring Stroke Risk Factors and Outcomes in Sexual and Gender Minority People

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Abstract

Background and Objectives

Cerebrovascular disease in sexual and gender minority (SGM) people remains poorly understood. Our primary objective was to describe the epidemiology and outcomes in a sample of SGM people with stroke. As a secondary objective, we compared this group with non-SGM people with stroke to assess for significant differences in risk factors or outcomes.

Methods

This was a retrospective chart review study of SGM people admitted to an urban stroke center with primary diagnosis of stroke (ischemic or hemorrhagic). We evaluated stroke epidemiology and outcomes, summarizing with descriptive statistics. We then matched 1 SGM person to 3 non-SGM people by year of birth and year of diagnosis to compare demographics, risk factors, inpatient stroke metrics, and outcomes.

Results

A total of 26 SGM people were included in the analysis: 20 (77%) had ischemic strokes, 5 (19%) intracerebral hemorrhages, and 1 (4%) subarachnoid hemorrhage. Compared with non-SGM people (n = 78), stroke subtypes showed a similar distribution (64 (82%) ischemic strokes, 12 (15%) intracerebral hemorrhages, 1 (1%) subarachnoid hemorrhage, and 1 nontraumatic subdural hematoma, $p > 0.05$) but suspected ischemic stroke mechanisms had a different distribution ($\chi^2 = 17.56$, $p = 0.01$). Traditional stroke risk factors were similar between the 2 groups. The SGM group seemed to have higher rates of nontraditional stroke factors, including HIV (31% vs 0%, $p < 0.01$), syphilis (19% vs 0%, $p < 0.01$), and hepatitis C (15% vs 5%, $p < 0.01$) but were more likely to be tested for these risk factors ($\chi^2 = 15.80$, $p < 0.01$; $\chi^2 = 11.65$, $p < 0.01$; $\chi^2 = 7.83$, $p < 0.01$, respectively). SGM people were more likely to have recurrent strokes ($\chi^2 = 4.39$, $p < 0.04$) despite similar follow-up rates.

Discussion

SGM people may have different risk factors, different mechanisms of stroke, and higher risk of recurrent stroke compared with non-SGM people. Standardized collection of sexual orientation and gender identity would enable larger studies to further understand disparities, leading to secondary prevention strategies.

Sexual and gender minority (SGM) people (those whose sexual orientation, gender identity/expression, or reproductive development are characterized by nonbinary and/or non-heteronormative constructs) comprise approximately 7–8% of the U.S. population.[1,2] Despite the community's diversity in racial, ethnic, socioeconomic, and cultural backgrounds, they face common adversities which can translate into poor health outcomes,[3] although to date

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most research has disproportionately focused on psychiatric conditions and HIV.[4] For example, stroke is the leading cause of disability and fifth leading cause of death in the United States[5]; however, little is known about stroke in SGM people.[6] Previous studies have identified increased cardiovascular risk among SGM people,[7,8] as well as unique and disproportionate stroke risk factors in transgender people,[9] although none have compared SGM and non-SGM people with stroke to assess for differences in clinical outcomes. These studies also tend to rely on self-reported outcomes, limiting generalizability and quantitative analysis.

Our primary objective was to characterize stroke epidemiology, risk factors, and outcomes in a sample of SGM people using patient-level data from the electronic health record. We also sought to compare these people with non-SGM people with stroke to investigate potential differences in stroke risk factors, access to care, and clinical outcomes.

Methods

Study Design

We reviewed the records of all SGM people admitted for stroke at the San Francisco General Hospital (SFGH) from January 1, 2016, to December 31, 2021, identified through a clinical database query of primary discharge diagnosis, using validated ICD-9/10 codes (see "Study Participants" below). We reviewed charts for demographics, stroke risk factors, stroke characteristics, and clinical outcomes. As a secondary aim, we randomly selected medical record numbers of people who did not identify as SGM and were admitted for stroke during the same period and matched them in a 1:3 ratio based on age and year of diagnosis to account for secular trends in clinical care practices. Given the low sample size in the SGM group, we chose to match every SGM person to 3 non-SGM people to enhance statistical power.[10] Owing to the sample size and single-center data collection, year of birth and year of admission were expanded to within a two-year period for control matching, and we did not match based on differences in lifestyle factors such as tobacco or stimulant use disorder to avoid overmatching. Because SGM identity is not an "exposure," we did not classify this as a true case-control study but compared 2 independent samples through this exploratory analysis.

Standard Protocol Approvals, Registrations, and Patient Consents

We obtained approval to conduct this study through the Institutional Review Board (IRB) at the University of California, San Francisco (19–28481). There was no patient contact required in this study, so informed consent requirements were waived.

Study Location

SFGH and Trauma Center (SFGH) is an urban level I trauma and comprehensive stroke center that serves as the safety net hospital for the City and County of San Francisco, CA, with an average of 370 stroke admissions per year. Sexual orientation and gender identity (SOGI) data are systematically collected in the primary care setting.[11] These data may also be collected when people are admitted to the hospital, but inpatient collection is not yet systematic.

Study Participants

Participants were at least age 18 years and hospitalized at SFGH during our specified time frame, with incident stroke as the primary discharge diagnosis. "Stroke" was defined through validated ICD-9/10 codes for ischemic stroke (ICD-9 codes 433*, 434*, 437.1; ICD-10 codes I63*, I65*, I66*, I67*),[12] intracerebral hemorrhage (ICD-9 codes 431, 432.9; ICD-10 codes I61.9, I62.9),[13] subarachnoid hemorrhage (ICD-9 code 430; ICD-10 code I60.9),[14] venous sinus thrombosis (ICD-9 code 437.6; ICD-10 code I67.6),[15] and cerebrovascular accident (ICD-9 code 437.8; ICD-10 code I67.89).[16] Given the different disease mechanics and risk factors, traumatic hemorrhages, including subarachnoid hemorrhage, epidural hematoma, and subdural hematoma, were not included in this study.

Records were then sorted into those whose identity fell within the SGM umbrella and those who did not. In our sample, identity terms used were lesbian, gay, and bisexual (categorized as sexual minority people) and transgender man, transgender woman, and nonbinary (categorized as gender minority people). Our study did not find people with other SGM identities (e.g., agender or pansexual). This information was collected in the primary care clinic setting, input in the demographics section (Epic "Sexual Orientation and Gender Identity" SmartForm), and was available for query in the electronic health record. The SmartForm includes fields to collect self-identified name, pronoun, sexual orientation (bisexual, gay/lesbian/same gender loving, questioning/unsure, straight/heterosexual, not listed with write-in option, or choose not to disclose), sex assigned at birth (female or male), and gender identity (man, nonbinary/genderqueer, transgender man, transgender woman, woman, not listed with write-in option, and choose not to disclose). We reviewed inpatient charts to ensure congruence between the query-based grouping and identities documented in the notes, with 3 records (10%) removed from the SGM group after review, leaving a total of 26 people in the SGM group for analysis.

Measurements

We entered clinical data into a form created in Research Electronic Data Capture (see Table 1 for details of the data abstraction process). For those with recurrent strokes, we used data from the first stroke presentation. Demographic information included age at the time of admission, self-reported race/ethnicity, insurance status, and housing status. Traditional stroke risk factors included current tobacco use and history of hypertension, diabetes, hyperlipidemia, and atrial fibrillation. Nontraditional stroke risk factors included HIV status, hepatitis C virus (HCV) antibody presence, RPR

Table 1 Clinical Chart Review Data Abstraction Process

Variable	Location within medical record	Definition
Demographics		
Age	Demographics section	Calculated based on the date of birth and the date of admission and computed as an integer year.
Race/ethnicity	"Clinical information" tab of demographics section	Categorized into "Asian," "Black," "Hispanic," "White," and "other."
Insurance status	"Primary coverage" of "Payer" subsection in demographics section	Categorized into "MediCare," "MediCal," "Health Maintenance organization (HMO)," "Preferred Provider Organization (PPO)," and "uninsured."
Housing status	"Social history" section of H&P or Social Work note	Categorized as "housed," "homeless," or unknown. If housing information was not included in the Social History, the chart was further reviewed for any notes from social workers during the admission indicating housing status.
Stroke risk factors		
Current smoking	"Social history" from H&P	Categorized as "yes" if a person was known to be currently smoking tobacco products and "no" if the person was not a smoker or had quit smoking more than 1 year before admission. If this information was not available, tobacco use was categorized as "unknown."
History of hypertension, diabetes, hyperlipidemia, atrial fibrillation	"History of present illness" and "medical history" sections of admission note. If information was missing, then the "Medications" section was reviewed for the presence of any relevant medications prescribed before admission.	Dichotomized as "yes" or "no". If information was not found in the admission note or home medications, then variable was marked as "unknown."
Substance use	Admission urine drug screen	Categorized as "positive," "negative", or "not tested." If a urine drug screen resulted positive, this was further categorized into the substance used, including "methamphetamine," "cocaine," "methadone," "heroin," "fentanyl," "benzodiazepines," "other opiates," and "other toxicology result."
HIV status	"Medical history" section of the admission note or HIV antibodies in laboratory data	Categorized as "positive," "negative," or "not tested" based on the presence of reactive antibodies to HIV tested within 1 year of admission. An individual was also considered "positive" if they had a history of HIV documented in the "medical history" section of the admission note.
History of syphilis	"Medical history" section of the admission note or RPR reactivity in laboratory data	Categorized as "positive," "negative," or "not tested" based on RPR reactivity within 1 year of admission. An individual was also considered "positive" if they had a history of syphilis documented in the "medical history" section of the admission note.
History of hepatitis C virus	"Medical history" section of the admission note or HCV antibody reactivity in laboratory data	Categorized as "positive," "negative," or "not tested" based on antibody reactivity tested within 1 year of admission. An individual was also considered "positive" if they had a history of HCV documented in the "medical history" section of the admission note.
Inpatient stroke metrics		
Time from last seen normal to Emergency Department presentation	"History of present illness" section of admission note and time of arrival in ED triage note	Calculated from information included in admission notes in the "history of present illness" section and time of arrival to ED triage. If the time that a person was last seen normal was not clear, this variable was marked as "unknown."
Initial NIHSS	"Physical examination" section of Neurology admission note	Scored by first arriving neurologist to Emergency Department.
Initial blood pressure	"ED triage vital signs" section of ED triage note	First blood pressure recorded on patient arrival to the Emergency Department.
Admission hemoglobin A1c	Laboratory results collected on admission	First laboratory result collected during admission.
Admission LDL	Laboratory result collected on admission	First lipid profile collected during admission.
tPA administration	Admission note or review of medications administered in the ED	Dichotomized as "yes" or "no."

Continued

Table 1 Clinical Chart Review Data Abstraction Process *(continued)*

Variable	Location within medical record	Definition
Performance of mechanical thrombectomy	Admission note and review of procedures, imaging, and operative reports in chart	Dichotomized as "yes" or "no."

Abbreviations: ED = emergency department; H&P = History and Physical; LDL = low-density lipoprotein; NIHSS = NIH Stroke Scale; RPR = rapid plasma reagin; tPA = tissue plasminogen activator.

reactivity, and other substance use. Inpatient stroke metrics included time from last seen normal to Emergency Department (ED) presentation, initial NIH Stroke Scale (NIHSS), initial blood pressure, admission hemoglobin A1c, admission low-density lipoprotein (LDL), administration of tissue plasminogen activator (tPA), and performance of mechanical thrombectomy.

Stroke diagnosis was categorized as "ischemic," "intracerebral hemorrhage," "subarachnoid hemorrhage," and "other" based on admission imaging results (CT of the brain without contrast or magnetic resonance imaging of the brain) and admission notes. Stroke etiologies were further categorized based on information included in the neurology service discharge summary.

For stroke outcomes, we included length of stay, discharge destination, follow-up, and stroke recurrence. Charts were reviewed up to March 1, 2022, to determine whether a participant had a recurrent stroke, and this variable was dichotomized as "yes" or "no" based on available information in the chart. Recurrent strokes were limited to ischemic and/or hemorrhagic strokes (i.e., traumatic hemorrhages were excluded) but could have been a different stroke type or mechanism compared with the participant's incident stroke.

We thoroughly reviewed charts to retrieve any missing data, but if information could not be ascertained, then this variable was categorized as "unknown."

Study Outcomes

Our primary outcome was the description of stroke epidemiology in the SGM group. These included demographic information, traditional stroke risk factors, and nontraditional stroke risk factors. We also described inpatient stroke metrics and stroke outcomes. Our secondary outcome was the comparison of these data with the non-SGM group to identify the presence of unique patterns in stroke epidemiology, metrics, and outcomes among the SGM group.

Statistical Analysis

We calculated means, percentiles, and ranges for clinical characteristics of SGM and non-SGM people. For non-normally distributed data, we reported medians and interquartile ranges (IQRs). In our secondary analysis, we used a χ^2 test to compare categorical variables (housing status, race/ethnicity, insurance, smoking, hypertension, hyperlipidemia, atrial fibrillation, diabetes, urine drug screen, HCV, HIV, syphilis, administration of tPA, performance of embolectomy, stroke diagnosis, stroke etiologies, discharge destination, follow-up, and stroke recurrence) and the difference in means (t) test to compare normally distributed continuous variables (age and initial systolic blood pressure). Presenting NIHSS, time from last seen normal to ED arrival, hemoglobin A1c, LDL, length of available follow-up, and length of stay were not normally distributed, so we used the Mann-Whitney *U* test. Statistical significance was set at $\alpha > 0.05$ level. Statistical analyses were performed using Stata (version 17, StataCorp, College Station, TX).

Data Availability

Anonymized data not published within this article can be made available by request from a qualified investigator.

Results

Stroke Epidemiology and Outcomes in SGM People

Of the 26 SGM people, we classified 19 as sexual minority people, 5 as gender minority people, and 2 as both sexual and gender minorities (Table 2). The mean age of SGM people was 55.5 years (SD 12.2 years), which was significantly younger than the overall average age of stroke patients at SFGH during the same period (69.0 years, SD 15.4 years, $t = 4.46$, $p < 0.01$).[17] There was a high prevalence of hypertension (54%), diabetes (23%), and hyperlipidemia (19%) (Table 3). Eight people had reactive antibodies for HIV. Of those, 7 were taking antiretrovirals at the time of admission. Five people had reactive RPR tests, with documentation of a completed treatment course for syphilis in 1 person. Four people had reactive antibodies for HCV. On arrival to the ED, 11 people had a positive urine drug screen (7 negative tests 8 not tested): 8 tested positive for amphetamines, 1 tested positive for cocaine, 2 tested positive for opiates, and 2 tested positive for benzodiazepines.

The median time from last known normal to ED presentation for all strokes was 24 hours (IQR 8–48), with median presenting NIHSS of 3 (IQR 2–18) (Table 4). tPA was given to 1 person, and 3 people underwent embolectomy. The most common reason for not administering tPA was presentation outside the time window (n = 15), followed by rapid improvement in symptoms (n = 2), anticoagulation use (n = 1), and recent prior stroke (n = 1).

Table 2 Population Characteristics of SGM People Admitted for Stroke Compared With Age-Matched Non-SGM People

	SGM (n = 26)	Non-SGM (n = 78)
Age (mean, SD)	56 (12)	56 (12)
Sexual orientation		
Bisexual	8 (31%)	0 (0%)
Gay or lesbian	13 (50%)	0 (0%)
Straight	2 (8%)	78 (100%)
Unknown	3 (12%)	0 (0%)
Gender Identity		
Cisgender man	16 (62%)	60 (77%)
Cisgender woman	3 (12%)	18 (23%)
Nonbinary	1 (4%)	N/A
Transgender man	2 (8%)	N/A
Transgender woman	4 (15%)	N/A
Housing status		
Homeless	5 (19%)	11 (14%)
Housed	21 (81%)	67 (86%)
Insurance		
HMO	1 (4%)	2 (3%)
MediCal	10 (38%)	49 (63%)
MediCare	10 (38%)	20 (26%)
PPO	2 (8%)	3 (4%)
Uninsured	3 (12%)	4 (5%)
Race/ethnicity		
Asian	3 (12%)	25 (32%)
Black	8 (31%)	20 (26%)
Hispanic	4 (15%)	24 (31%)
White	11 (42%)	8 (10%)
Other	0 (0%)	1 (1%)

Abbreviations: HMO = health maintenance organization; PPO = preferred provider organization; SGM = sexual and gender minority.
Data are n (%) unless otherwise listed.

The median length of stay was 5 (IQR 3–9) days (Table 5). Most people were discharged home from the hospital (n = 13), with others discharging to rehabilitation (n = 2) or nursing facilities (n = 7). One person died while hospitalized. Fourteen people presented to a posthospitalization follow-up appointment with a neurologist or primary care physician. Seven people had recurrent strokes, with a median length of available follow-up of 709 (IQR 432–1546) days.

Table 3 Prevalence of Vascular Risk Factors for SGM and Non-SGM People Admitted for Stroke

	SGM (n = 26)	Non-SGM (n = 78)	*p* Value
Atrial fibrillation[a]	1 (4%)	4 (5%)	0.79
Current smoking			0.23
No	15 (58%)	51 (65%)	
Yes	9 (35%)	26 (33%)	
Unknown/missing	2 (8%)	1 (1%)	
Diabetes[a]	6 (23%)	25 (32%)	0.39
HIV[b]			<0.01
No	15 (58%)	36 (46%)	
Yes	8 (31%)	0 (0%)	
Not tested	3 (12%)	42 (54%)	
Hepatitis C virus antibodies[c]			0.02
No	10 (38%)	15 (19%)	
Yes	4 (15%)	4 (5%)	
Not tested	12 (46%)	59 (76%)	
Hyperlipidemia[a]	5 (19%)	20 (26%)	0.51
Hypertension[a]	14 (54%)	54 (69%)	0.15
Syphilis[d]			<0.01
No	14 (54%)	25 (32%)	
Yes	5 (19%)	0 (0%)	
Not tested	7 (27%)	53 (68%)	
Urine drug screen[e]			0.04
Negative	7 (27%)	37 (47%)	
Positive	11 (42%)	19 (24%)	
Not tested	8 (31%)	22 (28%)	

Abbreviation: SGM = sexual and gender minority.
Data are n (%) unless otherwise listed.
[a] History of hypertension, diabetes, hyperlipidemia, and atrial fibrillation were dichotomized as "yes" or "no" based on information ascertained from admission notes under "history of present illness" and "medical history" sections. If this information was not present in these sections, the "Medications" section was reviewed for the presence of any relevant medications prescribed prior to admission (i.e., antihypertensives, lipid-lowering medications, insulin and/or metformin, and anticoagulation).
[b] HIV status was categorized as "positive," "negative," or "not tested" based on the presence of reactive antibodies to HIV tested within 1 year of admission. An individual was also considered "positive" if they had a history of HIV documented in the "medical history" section of the admission note.
[c] Reactive hepatitis C virus (HCV) antibodies were categorized as "positive," "negative," or "not tested" based on antibody reactivity tested within 1 year of admission. An individual was also considered "positive" if they had a history of HCV documented in the "medical history" section of the admission note.
[d] History of syphilis was categorized based on recent RPR reactivity ("positive," "negative," or "not tested"). An individual was also considered "positive" if they had a history of syphilis documented in the "medical history" or "history of present illness" sections of the admission note.
[e] Substance use was ascertained based on admission urine drug screen results and categorized as "positive," "negative", or "not tested."

Table 4 Comparison of Inpatient Stroke Characteristics, Diagnoses, and Suspected Etiologies for SGM and Non-SGM People

	SGM (n = 26)	Non-SGM (n = 78)	*p* Value
Presenting NIH Stroke Scale (NIHSS) (median, IQR)	3 (2–18)	5 (2–10)	0.61
Stroke diagnosis			0.74
Ischemic	20 (77%)	64 (82%)	
Embolectomy performed	3 (15%)	2 (3%)	0.09
Hemoglobin A1c, % (median, IQR)	5.5 (5.2–7.4)	6.0 (5.5–8.5)	0.06
Low-density lipoprotein, mg/dL (median, IQR)	99 (70–129)	96 (72–125)	0.69
tPA given	1 (5%)	8 (12%)	0.68
Suspected ischemic stroke etiology			0.01
Cardioembolic	4 (20%)	18 (29%)	
Carotid stenosis	1 (5%)	3 (5%)	
ESUS	3 (15%)	1 (2%)	
Intracranial atherosclerosis	3 (15%)	11 (17%)	
Small vessel	6 (30%)	25 (40%)	
Vertebral artery dissection	0 (0%)	5 (8%)	
Vasculitis	1 (5%)	0 (0%)	
Other	2 (10%)	0 (0%)	
Unknown	6 (30%)	16 (25%)	
Intracerebral hemorrhage (ICH)	5 (19%)	12 (15%)	
Suspected ICH etiology			0.06
Hypertension	3 (60%)	11 (92%)	
Idiopathic	2 (40%)	0 (0%)	
Other	0 (0%)	1 (8%)	
Other[a]	1 (4%)	2 (3%)	
Systolic blood pressure, mm Hg (mean, SD)	149 (30)	160 (37)	0.18
Time from last seen normal to ED, hours (median, IQR)	24 (8–48)	10 (3–23)	0.06
Ischemic strokes, hours (median, IQR)	13 (5–48)	10 (3–24)	0.18

Abbreviations: ED = Emergency Department; ESUS = embolic stroke of undetermined source; IQR = interquartile range; tPA = tissue plasminogen activator; SGM = sexual and gender minority.
Data are n (%) unless otherwise listed.
[a] There was 1 person in the SGM group who had a subarachnoid hemorrhage, 1 person in the non-SGM group with subarachnoid hemorrhage, and 1 person in the non-SGM group with nontraumatic subdural hematoma.

Table 5 Length of Stay and Posthospital Discharge, Follow-up, and Recurrence Among SGM and Non-SGM People Admitted for Stroke

	SGM (n = 26)	Non-SGM (n = 78)	*p* Value
Discharge destination[a]			0.27
Acute rehabilitation center	2 (8%)	11 (14%)	
Died	1 (4%)	4 (5%)	
Home with services	3 (12%)	10 (13%)	
Home without services	10 (38%)	32 (41%)	
Left against medical advice	1 (4%)	0 (0%)	
Long term nursing facility	3 (12%)	2 (3%)	
Skilled nursing facility	4 (15%)	17 (22%)	
Other	2 (8%)	2 (3%)	
Length of follow-up, days (median, IQR)[b]	709 (432–1546)	732 (537–983)	0.75
Length of stay, days (median, IQR)[c]	5 (3–9)	5 (3–10)	0.85
Presented to follow-up[d]			0.17
Yes	14 (54%)	56 (72%)	
No	11 (42%)	18 (23%)	
N/A	1 (4%)	4 (5%)	
Stroke recurrence[e]	7 (27%)	8 (10%)	0.04

Abbreviations: IQR = interquartile range; SGM = sexual and gender minority; SFGH = San Francisco General Hospital.
[a] Discharge destination was categorized based on information abstracted from discharge summaries in the "Discharge Disposition" heading.
[b] Length of follow-up was calculated in days from date of discharge to our predetermined study follow-up end date of March 1, 2022.
[c] Length of stay was calculated in days from date of admission to date of discharge.
[d] Stroke follow-up was defined as presentation to an outpatient clinic visit within 1 year of discharge with either a neurologist or primary care physician with primary encounter information relevant to their hospitalization for stroke.
[e] Stroke recurrence was defined by recurrent admission to SFGH with primary discharge diagnosis of stroke.

Stroke Characteristics and Outcomes in SGM People Compared With Non-SGM People

Demographics were similar across the 2 groups except for race/ethnicity: The non-SGM group was more likely to identify as Asian and Hispanic compared with the SGM group (32% vs 12% and 31% vs 15%, respectively; $\chi^2 = 16.25$, $p < 0.01$). Non-SGM people had similar rates of traditional stroke risk factors ($p > 0.05$), including current smoking (35% non-SGM vs 33% in the SGM group), history of hypertension (69% non-SGM vs 54% SGM), hyperlipidemia (26% non-SGM vs 19% SGM), atrial fibrillation (5% non-SGM vs 4% SGM), and diabetes (32% non-SGM vs 23% SGM), but most non-SGM people were not tested for HIV, HCV, or RPR reactivity, thus limiting our analysis. Among

those who had ischemic strokes, 19/20 SGM people were tested for HIV compared with 28/63 non-SGM people (χ^2 = 15.80, $p < 0.01$). Similarly, 15 SGM people with ischemic stroke had RPR tested compared with 20 non-SGM people (χ^2 = 11.65, $p < 0.01$), and 14 SGM people were tested for HCV antibodies compared with 19 non-SGM people (χ^2 = 7.83, $p < 0.01$). Within these limitations, SGM people were more likely to have reactive antibodies to HIV (31% vs 0%; χ^2 = 32.60, $p < 0.01$), positive RPR titers (19% vs 0%; χ^2 = 23.20, $p < 0.01$), and reactive antibodies for HCV (15% vs 5%; χ^2 = 8.15, $p = 0.02$). The SGM group was more likely to have a positive drug screen (42% vs 24%; χ^2 = 4.18, $p = 0.04$); however, this lost statistical significance when including people who were not tested (χ^2 = 4.16, $p > 0.05$).

Most inpatient stroke metrics were similar between the 2 groups (Table 3). Time from last known normal to ED presentation showed a trend toward delays in the SGM group (median 24 hours vs 9.65 hours) but did not reach statistical significance ($U = -1.87$, $p = 0.06$). Patterns of stroke type were similar between the 2 groups, but suspected ischemic stroke etiologies showed a different distribution between SGM and non-SGM groups (χ^2 = 17.56, $p = 0.01$) (Table 3). There was a trend toward different distributions of suspected ICH etiologies, but this did not reach statistical significance (χ^2 = 5.65, $p = 0.06$) (Table 3). Length of stay, discharge destination, follow-up rates, and length of available follow-up were similar between the 2 groups ($p > 0.05$) (Table 4). However, SGM people were more likely to have recurrent strokes (27% vs 10%; χ^2 = 4.39, $p = 0.04$).

Discussion

In this analysis of SGM people admitted for stroke in a single urban stroke center, we found a high prevalence of certain stroke risk factors, such as current tobacco use, stimulant use, hypertension, diabetes, hyperlipidemia, HIV, syphilis, and HCV. We found differences in suspected stroke etiologies and higher stroke recurrence compared with non-SGM people admitted for stroke. The SGM group was also significantly younger than the average person admitted for stroke at our hospital.

People who identify as SGM in the United States are on average younger than non-SGM people,[18] which may explain this finding. It is also possible that the SGM people in our study are at higher risk of having strokes at a younger age, perhaps because of unique stroke risk factors. Our study design limits further conclusions, but this is an avenue for further research.

We found that SGM people were similar across many demographic variables and prevalence of traditional stroke risk factors compared with the reference non-SGM group. More SGM people identified as White, while more non-SGM people identified as Asian and Hispanic. These differences may be explained by ethnic/racial differences in sexual orientation disclosure[19] or sampling bias unique to our study population in San Francisco.[20] This difference is important in light of previous studies on racial disparities in stroke,[21] including delayed presentation to the hospital,[22] which mirror our findings. Because of the small sample size of SGM people, we were unable to perform subgroup analyses to assess the interaction between sexual orientation, gender identity, race, and ethnicity. These analyses will be an important direction in future research, particularly as systemic discrimination, such as racism and transphobia, potentially share common mechanistic pathways that drive stroke disparities.

SGM people in our study did not have higher rates of tobacco use than non-SGM people, which is in contrast to previous studies.[23] These findings may be explained by the high prevalence of smoking in the non-SGM group: according to the California Health Interview Survey,[24] 11% of adults in San Francisco reported current tobacco use in 2016, which is lower than the prevalence of smoking in both the SGM (35%) and non-SGM (33%) groups in our sample.

SGM participants were more likely to have positive HIV and HCV antibodies and reactive RPR, which is consistent with previous studies,[9,25] although there were significant differences in testing for HIV, HCV, and syphilis between the groups that limit interpretation of this finding. HIV, HCV, and syphilis are associated with ischemic stroke,[26-30] and HCV and potentially HIV are associated with intracerebral hemorrhage.[31,32] If these conditions are more prevalent in SGM people with stroke, they may contribute to higher stroke recurrence, especially if left untreated after discharge. Urine drug screen positivity rates were higher in the SGM group, which is consistent with prior findings.[33] However, this may also be influenced by testing frequency as the finding lost significance when accounting for people who were not tested on admission. These findings highlight a potential testing bias toward SGM people for particular conditions (such as substance use or HIV), as has been found in other marginalized populations.[34] This bias is concerning in that it perpetuates stigma in the association between these conditions and SGM identity and is a missed opportunity to appropriately diagnose and treat these stroke risk factors in non-SGM people.

There was a significant difference between SGM and non-SGM groups in the attributed etiology for ischemic strokes. Suspected stroke mechanism can be an imprecise determination by the inpatient team at the time of discharge, which has the potential to introduce both conscious and unconscious bias. It is possible that a patient's sexual orientation and/or gender identity influences the team's reasoning on stroke etiology. This, in turn, might affect choice of diagnostics performed during the hospitalization, discharge decisions, and medication management as outpatients. This potential difference is an important consideration for future studies.

There was a trend toward SGM people delaying presentation to the ED compared with non-SGM people despite similar rates of insurance coverage, although this did not reach statistical significance. Reasons for this finding are likely multifactorial and could include fear of discrimination in the health care setting[35] and fear of cost,[36] given higher rates of unemployment and poverty in SGM people.[37] The reasons for delayed presentation to the hospital warrant further investigation given the time sensitive nature of many stroke interventions.[38,39]

Higher rates of recurrent stroke in the SGM population are another potential disparity that merits further research. Follow-up rates were similar between SGM and non-SGM groups in our sample, suggesting that access alone does not explain the difference. Future research will need to explore the drivers of recurrent stroke, including the role of minority stress. The minority stress model proposes that stigma, prejudice, and discrimination create an inherently stressful environment that translates into health issues.[40,41] Minority stress has been linked to allostatic load and epigenetic changes associated with cardiovascular health and inflammation.[42] A 2021 scientific statement from the American Heart Association highlights the potential role of minority stress in cardiovascular health disparities among transgender people.[8] The minority stress model also includes resilience as a crucial component of its framework,[43] which may explain why some disparities were not seen in our study. Future studies should explore the role of minority stress in the SGM stroke population, both in adaptive and maladaptive responses.

Our study has limitations. First, our sample only included people from certain SGM identities, limiting generalizability to all SGM people. The SGM community is heterogeneous; thus, we would caution against applying our findings to the entire SGM population. Furthermore, the sample size did not allow us to perform subgroup analyses; future research should delineate differences in stroke risk factors and/or outcomes within the SGM population. Another limitation is the use of retrospective data, which limits evaluation of causation. Our findings will need to be replicated with a larger sample as the small sample size may have led to a larger impact on statistical significance. The sample size was lower than expected, which may be a result of SOGI being underreported or undercollected despite concerted efforts to be systematic. Given the inherently self-reported nature of SOGI, it is possible that people who were in the non-SGM group may have identified as SGM. Therefore, some results from our study may be inaccurate, with the possibility that this unintended crossover could dilute some of our findings. Furthermore, SGM status was identified through primary care records with SOGI data, which may have led to sampling bias. The method of nonprobability sampling (i.e., only self-reported SGM people were included in analysis, and thus, sampling would be considered nonrandom) may affect generalizability and external validity of these results; however, previous studies suggest strength in nonprobability sampling of historically stigmatized communities, particularly when little is known about the population being studied.[44-46] Inpatient collection is not yet standardized in our facility; thus, we are likely not identifying people admitted with stroke who are not seen in the outpatient setting (e.g., people who died during the hospitalization or received follow-up outside of SFGH). This highlights the importance of comprehensive and systematic SOGI collection throughout all encounters in a health care system. Other limitations include the single-center nature of this study at a safety net hospital. San Francisco has a strong history of inclusivity for SGM people[47]; therefore, some disparities that have been linked to structural discrimination may not be as prevalent. We did not find increased rates of tobacco use, for example, which have been reported to be more prevalent in SGM samples elsewhere.

Despite these limitations, our study is a detailed review of a series of SGM people with cerebrovascular disease that raises several directions for future research. Previous work has focused on self-reported data, and this study used medical records to obtain quantitative data on important demographic and physiologic variables to improve our understanding of stroke in SGM people.

In this analysis of 26 SGM people admitted for stroke to an urban stroke center, we found differences in stroke risk factors, etiologies, and recurrence compared with age-matched non-SGM people. To elaborate on these findings, it is critical that health care systems collect SOGI in a standardized and respectful fashion so that neurologic research can be inclusive of SGM people.[48] Future research should assess all aspects of stroke care—from prehospitalization to inpatient care and postdischarge follow-up—to guide multipronged interventions[49] and improve the cerebrovascular health of these marginalized populations.

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TAKE-HOME POINTS

- Sexual and gender minority (SGM) people remain an understudied population in stroke.
- SGM people may have different risk factors for stroke compared with age-matched non-SGM people, but further research is needed to clarify these differences.
- SGM people may have higher risk for stroke recurrence despite similar follow-up rates.
- It is critical for health care systems to systematically collect demographic information inclusive of sexual orientation and gender identity to better understand the risk factors and outcomes of SGM people with stroke.

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Nicole Rosendale, MD	Department of Neurology, University of California, San Francisco, San Francisco, CA	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

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