Psoriasis does not worsen outcomes in patients admitted for ischemic stroke: an analysis of the National Inpatient Sample

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ABSTRACT

Psoriasis is a chronic inflammatory state associated with an increased risk of cardiometabolic diseases, stroke, and mortality. Although psoriasis increases the risk of ischemic stroke, whether outcomes, including mortality, are adversely affected is unknown.

This study aims to compare inpatient mortality of patients admitted for ischemic stroke with and without psoriasis. The secondary outcome measures were hospital length of stay (LOS), total hospital charges, odds of receiving tissue plasminogen activator (TPA), and mechanical thrombectomy between both groups.

Data were obtained from the National Inpatient Sample (NIS) 2016 and 2017 databases using the International Classification of Diseases, Tenth Revision, Clinical Modification codes. Multivariable logistic and linear regression analysis were used accordingly to account for confounders of the outcomes.

The combined 2016 and 2017 NIS database comprised over 71 million discharges. Of these, ischemic stroke accounted for 525,570 hospitalizations and 2425 (0.5%) had a concomitant diagnosis of psoriasis. Patients hospitalized for ischemic stroke with coexisting psoriasis did not have a difference in inpatient mortality (3.5% vs 5.5%; p=0.285) compared with those without psoriasis. However, psoriasis cohort had shorter LOS (5.0 vs 5.7 days; p=0.029) and lower total hospital charges ($60,471 vs $70,246; p=0.003) compared with the non-psoriasis cohort. The odds of receiving TPA and undergoing mechanical thrombectomy were not different in both groups.

Inpatient mortality, odds of receiving TPA, and undergoing mechanical thrombectomy in patients who had an ischemic stroke with or without psoriasis were not different. However, patients with psoriasis had a significantly shorter LOS and lower hospital charges.

Significance of this study

What is already known about this subject?

- Patients with psoriasis are known to have an increased risk of cardiometabolic diseases such as ischemic stroke.
- However, whether psoriasis affects stroke outcomes was uncertain.

What are the new findings?

- Psoriasis is not associated with increased inpatient mortality of patients admitted for ischemic stroke.
- Patients with psoriasis hospitalized for ischemic stroke had shorter length of stay and less total hospital charges compared with similar patients without psoriasis.
- However, no difference in management strategies of patients with psoriasis who had a stroke was found, as odds of receiving tissue plasminogen activator, and undergoing mechanical thrombectomy were similar to those without psoriasis.

How might these results change the focus of research or clinical practice?

- These findings indicate that although psoriasis increases the risk of developing a stroke, it does not change management strategies or increase in-hospital mortality.
- Further prospective studies are needed on this topic.

INTRODUCTION

Psoriasis is a chronic inflammatory dermatosis with a rising global prevalence. An estimated 100 million are affected worldwide.[1] The worldwide prevalence of psoriasis in adults ranges widely from 0.51% to 11.43%.[2] It is also the second largest contributor of skin-related disability-adjusted life years (DALYs).[1] Moreover, the systemic inflammatory milieu in psoriasis is known to be associated with an increased risk of atherosclerosis, metabolic diseases, and cardiovascular disorders including ischemic stroke.[3–5] A population-based cohort study found that psoriasis was an independent risk factor for stroke. They reported that, every year, there is 1 excess stroke in 530 severe psoriasis cases and 1 in 4115 patients with mild psoriasis.[6]

According to the Global Burden of Disease report, stroke is the second largest cardiovascular cause of death and accounted for 6.17

Table 1 Baseline characteristics of ischemic stroke hospitalizations with and without psoriasis

Baseline characteristics	Ischemic stroke (n=525,570)		
	Without psoriasis (n=523,145)	With psoriasis (n=2425)	P value
Mean age (y)	70.3	69.1	0.030
Female	50.2%	55.5%	0.0188
Race			<0.0001
White	70.2%	84.7%	Reference
Black	16.0%	3.9%	<0.0001
Hispanic	7.6%	5.6%	0.014
Asians	2.9%	2.4%	0.189
Native Americans	0.5%	1.1%	0.205
Others	2.7%	2.3%	0.285
Charlson Comorbidity Index			0.1676
1	14.0%	12.4%	
2	13.1%	10.9%	
≥3	72.9%	76.7%	
Hospital bed size			0.3492
Small	13.6%	15.9%	
Medium	27.1%	26.8%	
Large	59.3%	57.3%	
Hospital teaching status			0.1380
Non-teaching	26.4%	29.5%	
Teaching	73.6%	70.5%	
Hospital location			0.7794
Rural	5.9%	6.2%	
Urban	94.1%	93.8%	
Expected primary payer			0.0024
Medicare	67.2%	67.5%	
Medicaid	9.2%	7.2%	
Private	19.8%	24.0%	
Self-pay	3.8%	1.3%	
Median household income (quartile)			0.0160
1st (0th–25th)	30.0%	23.9%	
2nd (26th–50th)	26.0%	26.2%	
3rd (51st–75th)	24.2%	26.4%	
4th (76th–100th)	19.8%	23.6%	
Hospital region			0.0059
Northeast	19.1%	22.9%	
Midwest	21.4%	25.4%	
South	41.0%	33.6%	
West	18.5%	18.1%	
Dyslipidemia	59.5%	67.0%	0.0009
Old MI	7.6%	9.7%	0.0976
Old PCI	0.73%	1.2%	0.1938
Old CABG	7.0%	7.8%	0.4432
Old pacemaker	3.5%	1.9%	0.0541
Atrial fibrillation/flutter	30.8%	27.6%	0.1371
COPD	12.1%	16.5%	0.0029
Carotid artery disease	11.9%	14.0%	0.1418
Old stroke	8.6%	8.5%	0.9202
Hypertension	60.7%	63.7%	0.1772
Peripheral vessel disease	5.1%	7.4%	0.0189
Hypothyroidism	13.7%	14.6%	0.5521
DM types 1 and 2	36.5%	39.0%	0.2688
Obesity	12.3%	18.8%	<0.0001
CHF	17.2%	14.6%	0.1305
CKD	17.3%	17.9%	0.7170
Liver disease	1.5%	3.7%	0.0002
Electrolyte derangement	20.4%	18.4%	0.2756
Maintenance hemodialysis	1.2%	1.0%	0.7650
O_2 dependence	1.2%	2.5%	0.0111
Smoking	23.0%	29.5%	0.0006
Anemia	14.7%	15.7%	0.5356

Median household income refers to median household income for patient's zip code.
CABG, coronary artery bypass graft; CHF, chronic congestive heart failure; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; DM, diabetes mellitus; MI, myocardial infarction; O_2, oxygen; PCI, percutaneous coronary intervention.

million deaths in 2017. Ischemic stroke alone attributed to 2747 per 100,000 deaths.[7] In the USA, stroke is one of the major causes of long-term disability and is the second largest contributor of DALYs worldwide.[8] The individual physical, psychosocial and economic burden of psoriasis and stroke is substantial.[1 8]

Although psoriasis is known to be associated with increased odds for developing an ischemic stroke, whether there is any difference in outcome compared with patients without psoriasis is uncertain. We aimed to evaluate the outcomes of stroke in patients with and without psoriasis.

METHODS

Data source

We conducted a retrospective study of hospitalizations, from 2016 to 2017, in acute care hospitals in the USA. The search terms included a principal discharge diagnosis of ischemic stroke, with and without a secondary diagnosis of psoriasis. Data were obtained from the National Inpatient Sample (NIS) database which is created and maintained by the Agency for Healthcare Research and Quality.[9] The NIS is the largest public all-payer inpatient database in the USA. It was designed as a stratified probability sample to be representative of all non-federal acute care hospitals nationwide. Hospitals are stratified according to ownership, teaching status, bed size, geographic location, and an urban/rural designation. Subsequently, within each category, a 20% probability sample of all hospitals is collected. To ensure they are nationally representative, all the discharges are recorded and weighted. The 2016 and 2017 NIS sampling frame comprises data from 47 state-wide data organizations (46 States plus the District of Columbia) that represent about 97% of the US population. Thirty discharge diagnoses for each hospitalization were recorded using the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) in NIS 2016, and 40 were identified in the NIS 2017 database. These discharge diagnoses are classified as principal diagnoses, the main ICD-10-CM code

Table 2 Univariate association of baseline variables with inpatient mortality

Baseline variables	OR	P value
Age	1.03	<0.0001*
Female gender	1.19	<0.0001*
Race		*
White	Reference	Reference
Black	0.79	<0.0001
Hispanic	0.97	0.597
Asians	1.06	0.439
Native Americans	0.75	0.176
Others	1.16	0.063
Charlson Comorbidity Index	1.15	<0.0001*
Hospital bed size		*
Small	Reference	Reference
Medium	1.20	0.001
Large	1.43	<0.0001
Hospital teaching status	1.46	<0.0001*
Hospital location	1.28	<0.0001*
Expected primary payer		*
Medicare	Reference	Reference
Medicaid	0.73	<0.0001
Private	0.73	<0.0001
Self-pay	0.86	0.040
Median household income (quartile)		*
1st (0th–25th)	Reference	Reference
2nd (26th–50th)	0.89	0.004
3rd (51st–75th)	0.93	0.099
4th (76th–100th)	0.97	0.520
Hospital region		*
Northeast	Reference	Reference
Midwest	0.83	<0.0001
South	0.86	0.001
West	0.96	0.374
Dyslipidemia	0.50	<0.0001*
Old MI	0.99	0.904
Old PCI	0.71	0.075*
Old CABG	1.02	0.726
Old pacemaker	1.58	<0.0001*
Atrial fibrillation/flutter	2.14	<0.0001*
COPD	1.33	<0.0001*
Carotid artery disease	0.84	<0.0001*
Old stroke	2.23	<0.0001*
Hypertension	0.65	<0.0001*
Peripheral vessel disease	1.00	0.872
Hypothyroidism	0.94	0.140
DM types 1 and 2	0.85	<0.0001*
Obesity	0.66	<0.0001*
CHF	1.93	<0.0001*
CKD	1.27	<0.0001*
Liver disease	2.19	<0.0001*
Electrolyte derangement	2.25	<0.0001*
Maintenance hemodialysis	1.53	<0.0001*
O_2 dependence	1.35	0.006*
Smoking	0.72	<0.0001*
Anemia	1.46	<0.0001*

Median household income refers to median household income for patient's zip code.
*Variable included in the multivariable logistic regression model.
CABG, coronary artery bypass graft; CHF, chronic congestive heart failure; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; DM, diabetes mellitus; MI, myocardial infarction; O_2, oxygen; PCI, percutaneous coronary intervention.

or reason for the hospitalization, and secondary diagnoses, any coexistent diagnoses. Since these data represent a cross-sectional view of the diagnoses, the onset or duration of secondary diagnoses cannot be determined.

Inclusion criteria and outcomes

We included all inpatient hospitalizations recorded in the NIS 2016 and 2017. The study variables included age, race, gender, medical comorbidities, primary and secondary outcomes (outlined below) and hospital characteristics. We used the following ICD-10-CM codes to identify principal/secondary diagnoses: for ischemic stroke all I63 codes, excluding I63.89 and I63.9, and for psoriasis all L40 codes (see online supplemental table). We studied baseline characteristics and outcomes for ischemic stroke hospitalizations with and without psoriasis. Inpatient mortality was the primary outcome and secondary outcomes included hospital length of stay (LOS), mean total hospital charges, odds of receiving tissue plasminogen activator (TPA), and mechanical thrombectomy.

Statistical analysis

STATA V.16 (StataCorp, Texas, USA) was used for analysis. Unadjusted ORs for the primary outcome were calculated with a univariate logistic regression analysis using the variables and comorbidities listed in table 1. All variables with p values <0.1 were included in a multivariable logistic regression model. Univariate association of variables and comorbidities with the primary outcome, highlighting the variables included in the multivariable logistic regression model, are displayed in table 2. Threshold of p value <0.05 were considered significant in the multivariable logistic regression. Charlson index was used to adjust for comorbidity burden. Confounders selected were based on literature review. Multivariable logistic regression for categorical outcomes and linear regression analysis for continuous outcomes using all comorbidities and variables in table 1 were used to adjust for confounders for the secondary outcomes.

RESULTS

The combined 2016 and 2017 NIS database comprised over 71 million discharges. Of these, ischemic stroke accounted for 525,570 hospitalizations and 2425 (0.5%) had a concomitant diagnosis of psoriasis.

The patients in the psoriasis cohort were younger (69.1 vs 70.3 years, p=0.030) and comprised more males (55.5% vs 50.2%, p=0.0188). On subgroup analysis by race, we found that Caucasians comprised 84.7% of patients who had a stroke with psoriasis in comparison with the African-American cohort, which accounted for 3.9% (figure 1). Dyslipidemia, obesity and smoking were significantly increased in patients with psoriasis who had a stroke compared with those without psoriasis (p<0.001). Complete details of baseline characteristics of ischemic stroke hospitalizations with and without coexisting psoriasis are displayed in table 1.

Univariate association of variables and comorbidities with the primary outcome are displayed in table 2.

Patients hospitalized for ischemic stroke with coexisting psoriasis did not have difference in inpatient mortality

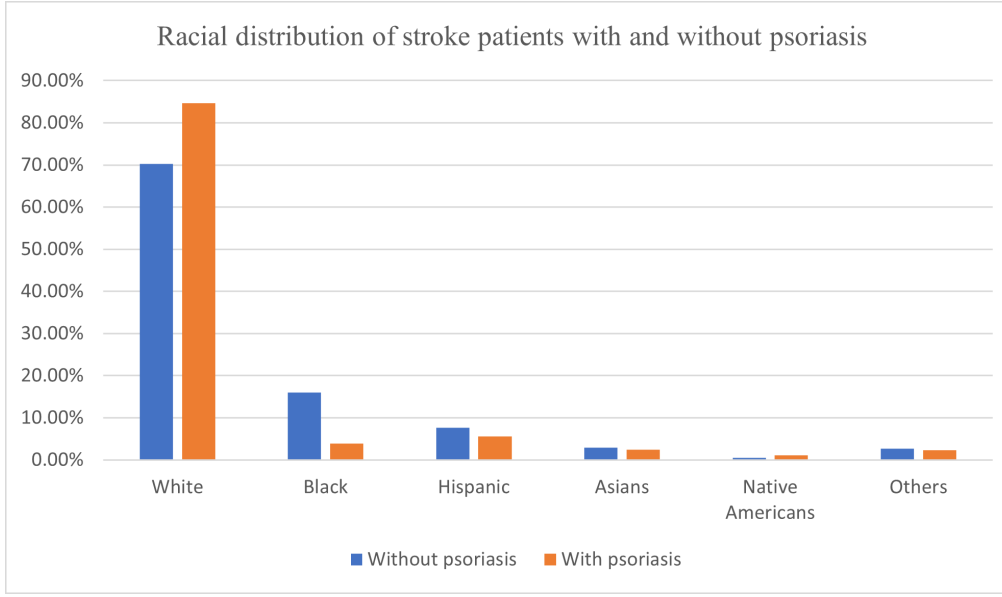

Figure 1 Histogram representation of racial distribution in this study. The total number of patients who had an ischemic stroke is 525,570 and the total number of patients with stroke and psoriasis is 2425.

(3.5% vs 5.5%, adjusted OR (AOR) 0.76, 95% CI 0.47 to 1.25, p=0.285) compared with those without psoriasis. The psoriasis group had shorter LOS (5.0 vs 5.7 days, p=0.029) and lower total hospital charges ($60,471 vs $70,246, p=0.003) compared with the non-psoriasis group. The odds of receiving TPA (9.3% vs 9.3%, AOR 1.00, 95% CI 0.72 to 1.40, p=0.985) and undergoing mechanical thrombectomy (3.5% vs 5.1%, AOR 0.67, 95% CI 0.40 to 1.15, p=0.146) were not different in both groups (table 3).

DISCUSSION

Several observations in our study were in line with previous literature. Of our patients who had an ischemic stroke, Caucasians formed the largest racial subgroup affected by psoriasis which is similar to the known racial distribution of psoriasis (84.7% of patients with psoriasis with ischemic strokes were Caucasian).[10] Although stroke incidence in the USA is known to be higher in African-Americans, we found a disproportionately higher number of Caucasians in the stroke with psoriasis cohort (84.7% vs 70.2%) compared with stroke without psoriasis.[11] In contrast, African-American patients who had an ischemic stroke with and without psoriasis accounted for 3.9% and 16%, respectively. A possible explanation could be that fewer African-Americans had an established diagnosis of psoriasis due to difficulties in diagnosis or reduced access to a dermatologist. Traditional stroke risk factors like smoking and dyslipidemia are known to be more prevalent in patients with psoriasis, similar to the findings of this study.[4] Recently, a National Health and Nutrition Examination Survey-based study found that psoriasis is independently associated with increased mortality.[12] In addition, Gelfand *et al*[6] reported that psoriasis is independently associated with stroke, possibly due to the effects of chronic inflammation.[6] However, we found that psoriasis did not contribute to increased mortality in patients with ischemic stroke. This may be because once a stroke has occurred there may be no difference in the downstream effects, such as thrombosis and ischemia. In accord with this, we also found that there was no difference in ischemic stroke management in terms of odds of undergoing TPA administration or mechanical thrombectomy. Patients with psoriasis also had shorter

Table 3 Primary and secondary outcomes of ischemic stroke hospitalizations with and without psoriasis

	Stroke with psoriasis (n=2425)	Stroke without psoriasis (n=523,145)	Adjusted OR (95% CI)	P value
Primary outcome				
In-hospital mortality	3.5	5.5	0.76 (0.47 to 1.25)	0.285
Secondary outcomes				
TPA	9.3	9.3	1.00 (0.72 to 1.40)	0.985
Mechanical thrombectomy	3.5	5.1	0.67 (0.40 to 1.15)	0.146
			Adjusted mean difference	
Mean length of stay (d)	5.0	5.7	−0.40 (−{0.77–0.04})	0.029*
Mean total hospital charge (US$)	60,471	70,246	−7993 (−{13,186–2799})	0.003*

*Statistically significant.
TPA, tissue plasminogen activator.;

hospital stays and lower hospital charges, the reason for which is uncertain—but may be due to milder strokes in this cohort.

The limitations of our study include that, first, it is a retrospective cross-sectional study, and a temporal relation of diagnoses and causation cannot be determined. Second, there may have been errors in the ICD-10-CM codes that were used at the time of discharge. Third, we were unable to subcategorize by severity of psoriasis. Lastly, we were unable to determine the effect of treatment used, if any. Further studies into how severity of psoriasis and different treatment options may affect ischemic stroke outcomes are needed.

CONCLUSION

While this study confirms that patients with psoriasis have an increased association with traditional cardiovascular risk factors like dyslipidemia, obesity and smoking, we found that psoriasis inpatients with an ischemic stroke had shorter hospital stays and lower total hospital charges compared with those without psoriasis. However, outcomes in terms of inpatient mortality, odds of receiving TPA and undergoing mechanical thrombectomy were not different in both groups. These findings indicate that although psoriasis increases the risk of developing a stroke, it does not change management strategies or increase in-hospital mortality.

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Patient consent for publication Not required.

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