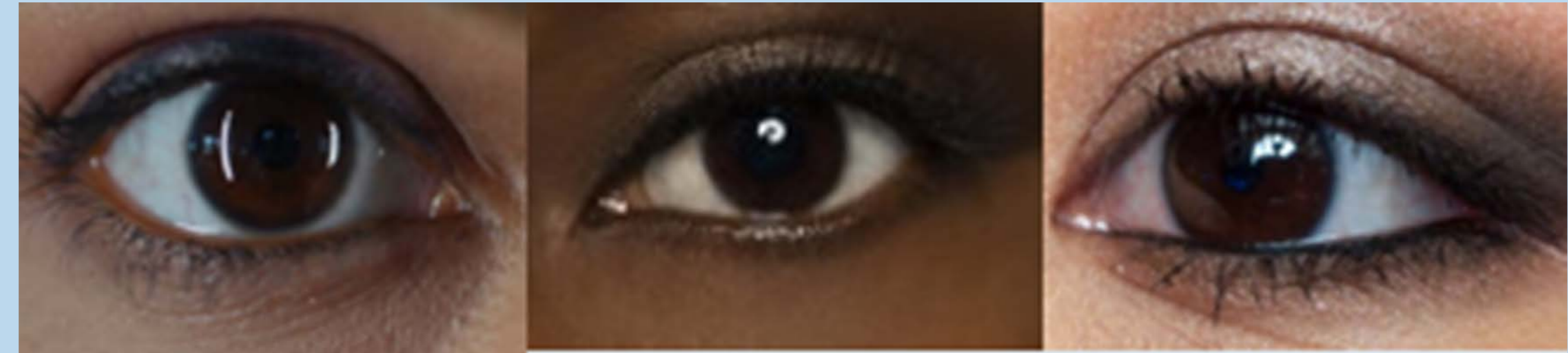


Is Variance in Pupillary Function Associated with Discharge Outcomes?

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Background

While it is widely recognized that assessing the pupillary light reflex (PLR) is fundamental to the neurological exam, the absence of a PLR is classically noted as a late sign of brain herniation. Likely due to the historically imprecise methods of quantifying PLR (e.g. absent, sluggish, brisk), there are no studies available in nursing literature to evaluate the association between PLR and outcomes. Automated pupillometry provides a more precise measure of PLR. The Neurological Pupil index (NPI®) is a derived variable that includes properties of both afferent and efferent 2nd and 3rd cranial nerve function. The purpose of this study is to explore the association between changes in NPi and hospital discharge outcomes measured by the Modified Rankin Scale (mRS).



Methods

Data for this analysis was obtained from the END-PANIC registry, a nursing-led multicenter prospective pupillometer study. Data was abstracted on patients with a hemorrhage in the brain [subarachnoid (SAH) or intracerebral (ICH)] who received pupillometer assessment as routine care. Data from 716 patients who met inclusion criteria were collected daily from the medical record and the pupillometer device. The modified Rankin Scale score was abstracted directly from the electronic medical record, or derived from clinical information in the notes of the electronic medical record.



Modified Rankin Scale

Score	Description
0	No symptoms at all
1	No significant disability despite symptoms; able to carry out all usual duties and activities
2	Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance
3	Moderate disability; requiring some help, but able to walk without assistance
4	Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance
5	Severe disability; bedridden, incontinent and requiring constant nursing care and attention
6	Dead

Table 1. Demographics

Variable	N	Mean	Median	Min	Max
ICU LOS (days)	599	6.09	3	0	90
Age (years)	716	58.29	60	18	98
Pre-Admission mRS	677		0	0	5
Discharge mRS	716		4	0	6

Table 2. Baseline Pupil Assessment

Variable	N	Mean	Median	25th %	75th %	min	max
Left Eye Readings							
NPI average	705	4.1	4.4	4.0	4.6	0.0	4.9
NPI coeff, of var.	677	14.8	4.6	1.6	11.2	0.0	382.4
Cons.Vel average	700	1.8	1.7	1.2	2.3	0.1	4.6
Cons.Vel coeff, of var.	675	27.6	27.3	11.4	38.4	0.0	144.1
Right Eye Readings							
NPI average	709	4.1	4.4	4.0	4.6	0.0	4.9
NPI coeff, of var.	671	14.3	4.9	1.7	11.4	0.0	472.1
Cons.Vel average	671	27.7	27.1	12.3	38.7	0.0	144.4
Cons.Vel coeff, of var.	699	1.8	1.7	1.2	2.3	0.1	4.0

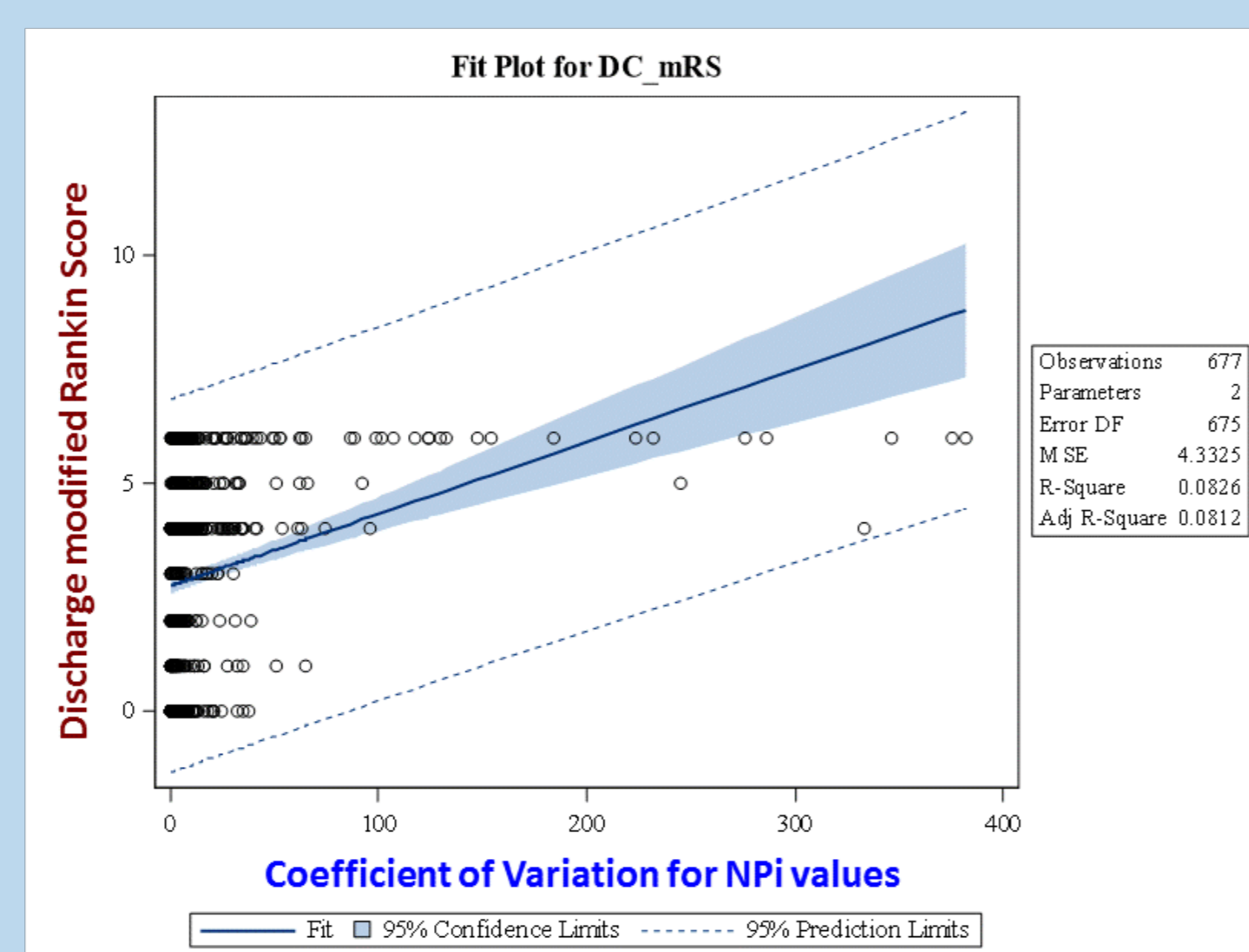
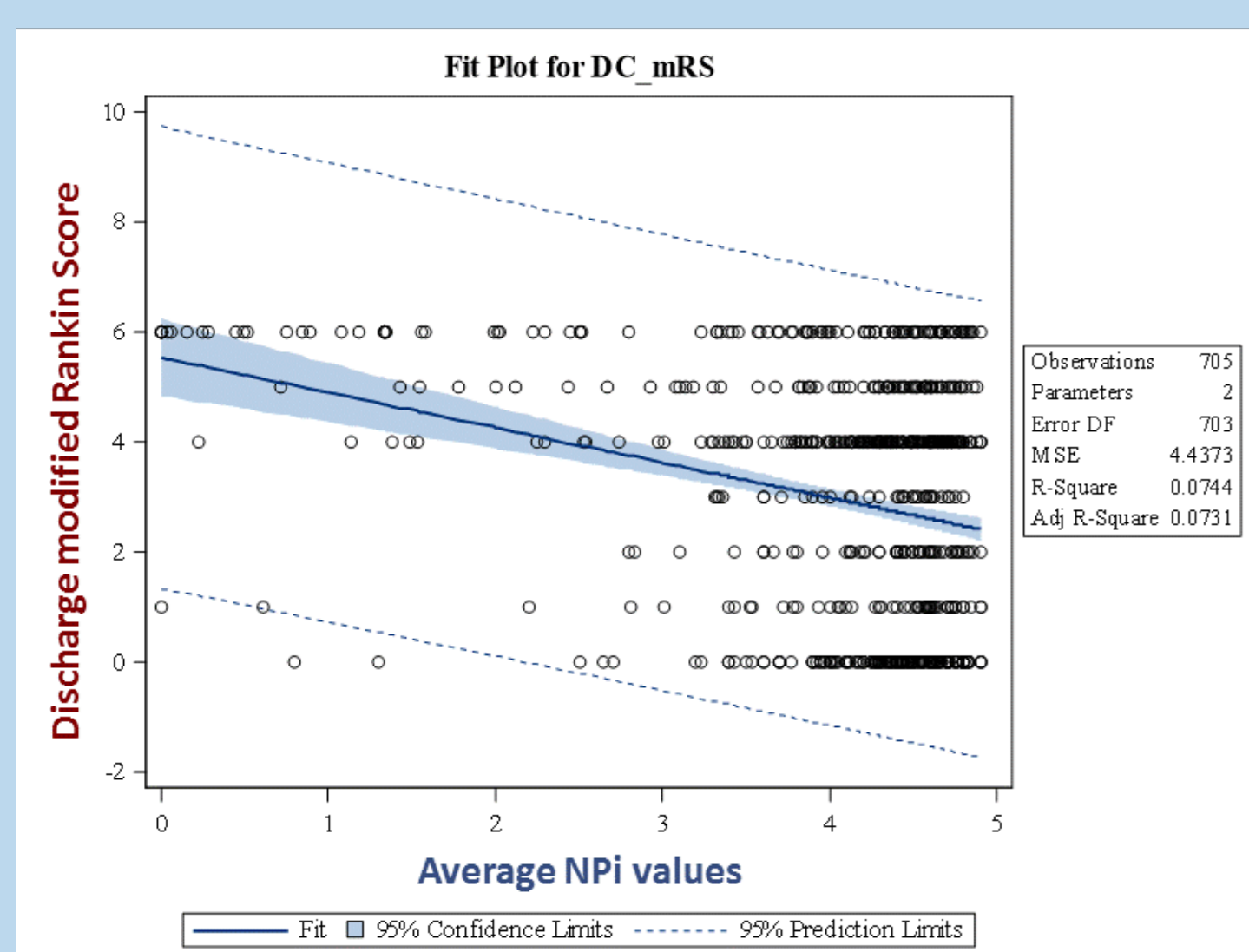
Results

There were slight differences among the 128 SAH and 24 ICH patients (Table 3). The mean and standard deviation were similar for NIHSS comparing SAH vs ICH (11.2[10.3] vs 11.9[10.7]; p=0.8). Similarly, the mean and standard deviation were similar for baseline left eye NPi comparing SAH vs ICH (4.1[0.8] vs 3.3[1.4]; p=0.02); but not for baseline right eye NPi comparing SAH vs ICH (4.2[0.8] vs 3.7[1.3]; p=0.1). There was an association between the coefficient of variance for NPi and mRS at discharge; this association was present in both the left eye (p<0.001), and the right eye (p<0.001). Higher mean NPi values were associated with higher functional outcomes (lower mRS) at discharge; this association was present in both the left eye (p<0.001) and the right eye (p<0.001).

Table 3. Results Table

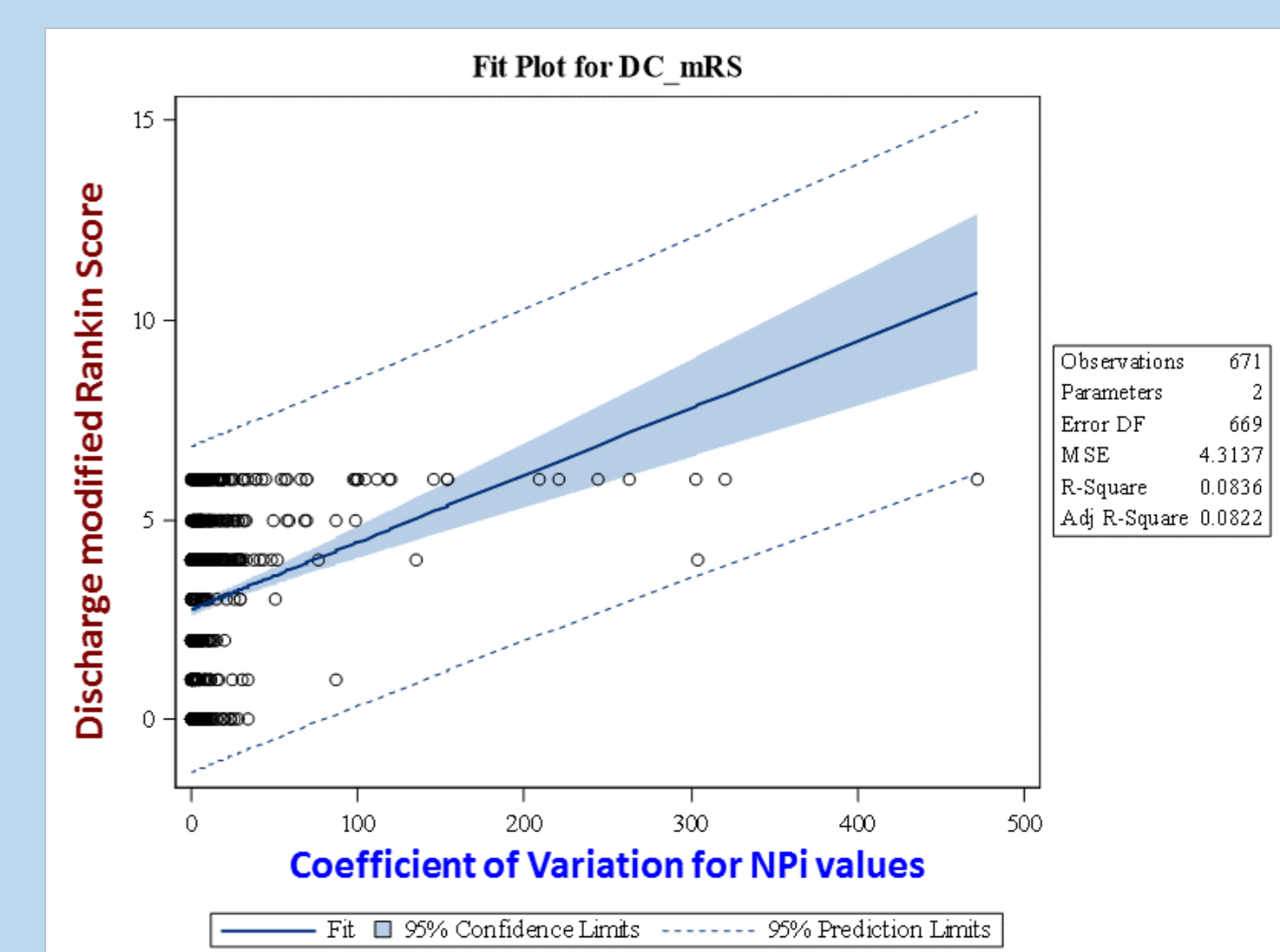
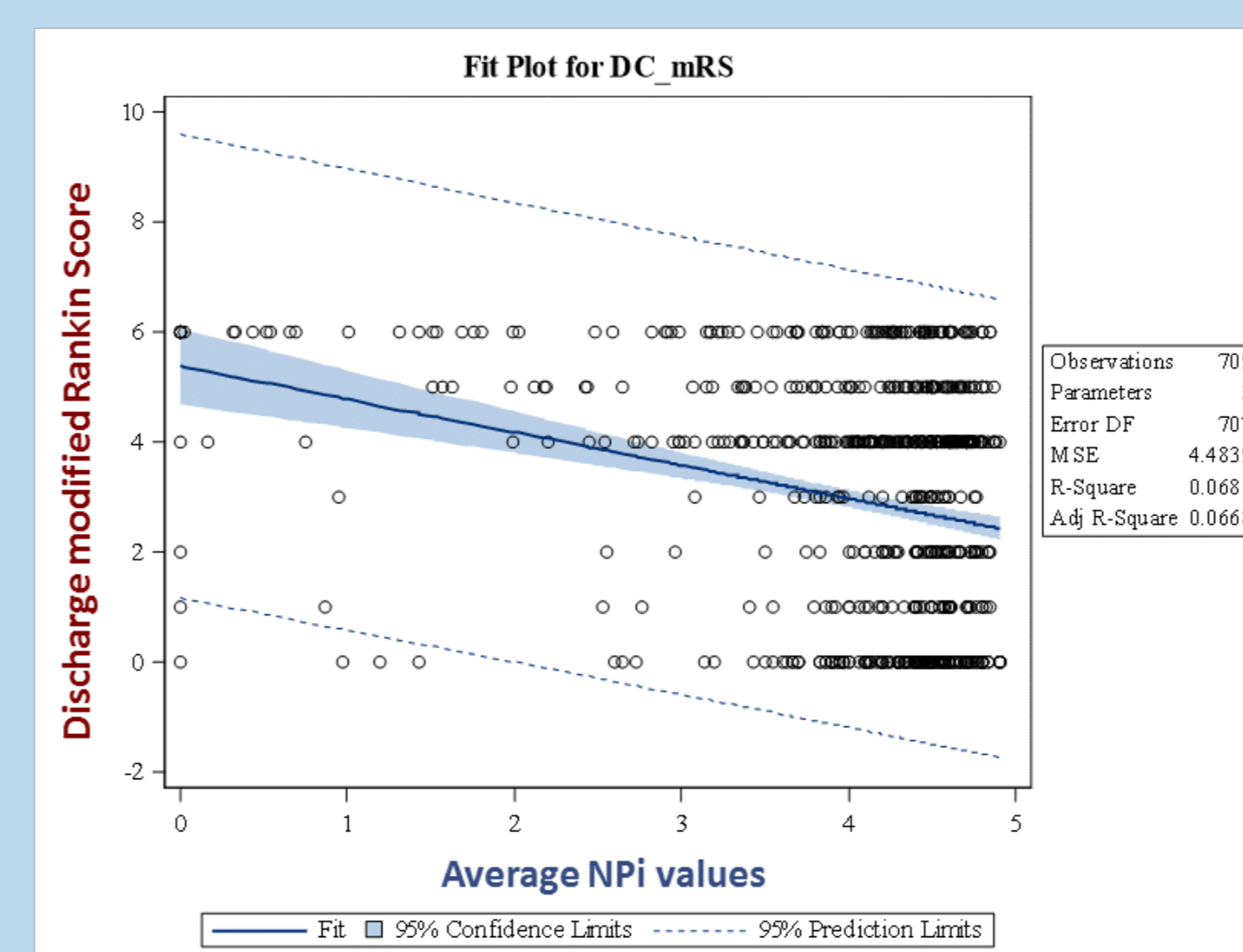
Assessment	SAH (n=128)		ICH (n=24)		p-value
	Mean (SD)	Median (Q1-Q3)	Mean (SD)	Median (Q1-Q3)	
NIHSS at baseline	11.2 (10.3)	13(2.0-20.0)	11.9 (10.7)	13.0(0.0-21.0)	0.8
NPI L at baseline	4.1 (0.8)	4.4(3.9-4.6)	3.3 (1.4)	3.7(2.9-4.3)	0.02
NPI R at baseline	4.2 (0.8)	4.5(4.0-4.7)	3.7 (1.3)	4.2(3.6-4.5)	0.1
Discharge mRS	1.5 (0.7)	1.0(1.0-2.0)	1.9 (0.6)	2.0(1.5-2.0)	0.02

Left Eye



Coefficient of variation = SD/mean

Right Eye



Coefficient of variation = SD/mean

Conclusion

This study reports that both NPi at baseline and change in NPi over time are associated with discharge outcomes in SAH and ICH patients. Lower NPi score at baseline is associated with worse (higher) mRS at discharge. The slope distribution, which describes change in NPi over time, supports a similar correlation between NPi and discharge mRS. Decreasing NPi values during the course of stay are associated with worse mRS at discharge.