

Sonja Stutzman¹, Venkatesh Aiyagari¹, Michelle Hill², Chad Miller², Folefac Atem³, DaiWai Olson¹

The University of Texas Southwestern Medical Center (Dallas, TX)¹, Riverside Methodist Hospital (Columbus, Ohio)², University of Texas Health Science Center (Houston, TX)³

Purpose

Handheld pupillometry provides several novel measures, such as the neurological pupillary index™ (NPi) that can assist in understanding other elements such as constriction velocity (CV) that may be more quantifiable than the pupillary light reflex (PLR). The purpose of this analysis is to examine the relationship between CV and NPi in neurologically injured patients.

Background

The historical tradition of examining the PLR required the examiner to score the size and reactivity of the pupil; generally classified at brisk, sluggish, or fixed. Previous research has shown inconsistency in rating the PLR with a pen light, especially when the pupil is considered sluggish or fixed.¹ A change in the PLR from brisk to sluggish or fixed may be a marker of a pathological process and a need for intervention (e.g., CT scan, medication administration, decreased time between neurologic assessment intervals). The NeuroOptics Pupillometer has shown promise in standardizing pupillary assessments that can be trended over time.² An NPi < 3.0 is considered to be abnormal.² Additionally, when the CV <0.8 the pupillary reaction is considered to be abnormal in a health patient population, but little has been done to research the correlation between NPi and CV in the neurocritical care population.

Methods

The END-PANIC Registry is a multi-center prospective registry of pupillometer values and variables associated with intracranial dynamics (e.g., ICP).³ Data collection is prospective and ongoing for this study. Data is collected directly from the Pupillometer SmartGuard™ and then matched with abstracted data from the EMR. This analysis from 1,140 adult (over 18 years) patients from two hospitals includes 43,084 pupillometer readings; left eye (21,299), and right eye (21,979).

Table 1. Correlations between NPi and CV

Left Eye	NPi > 3.0	NPi < 3.0	Right Eye	NPi > 3.0	NPi < 3.0
CV > 0.8	4469	357	CV > 0.8	4357	857
CV < 0.8	703	2185	CV < 0.8	815	1685



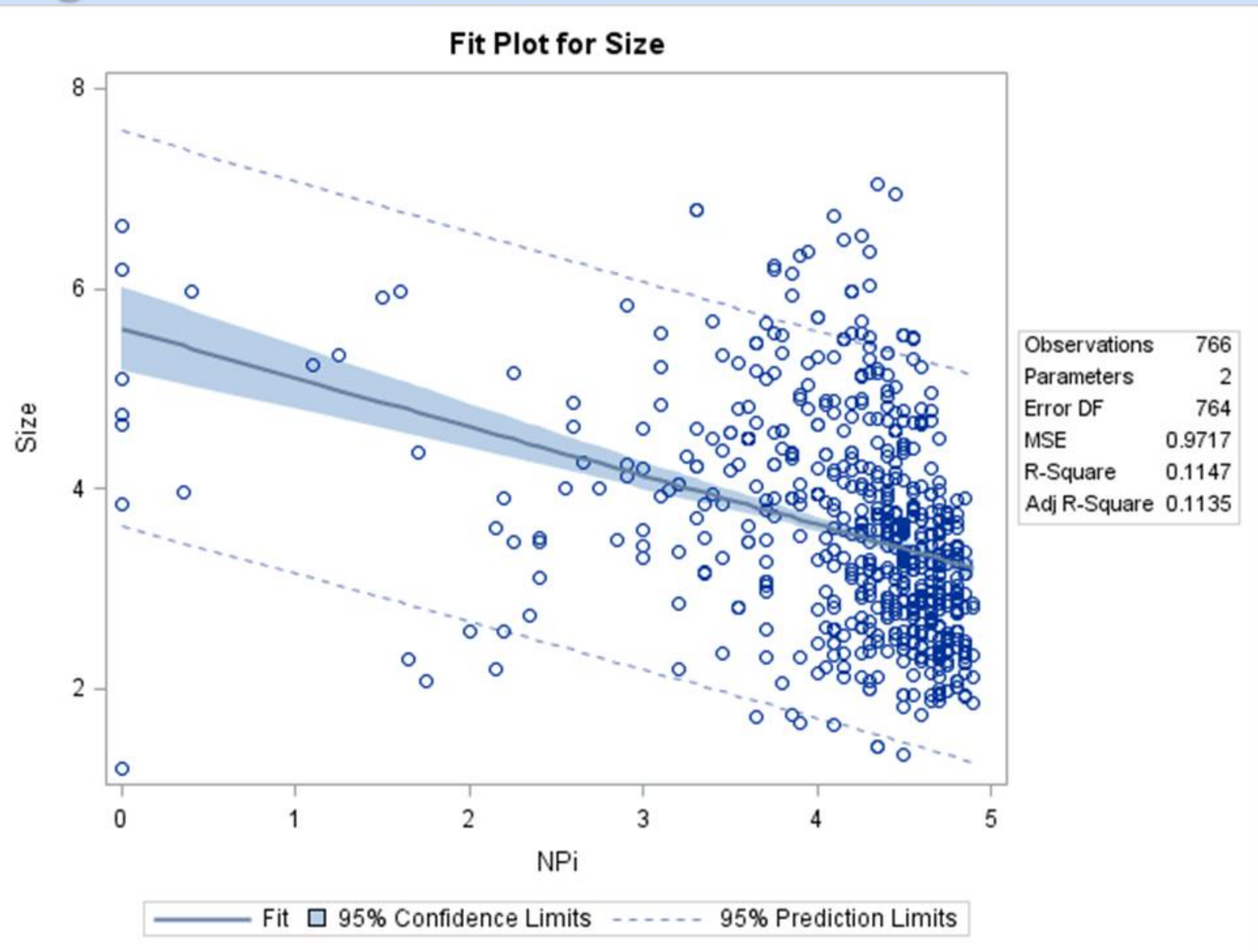
Results

-Subjects had a mean age of 57.3 years and 50% were male. The primary admission diagnosis included cerebral neoplasm (286), ischemic stroke (195), SAH (94), ICH (111), and other (454). The left eye mean/s.d. CV (1.8/0.9) NPi (4.2/0.8) and size (3.5/1.1) were similar to the right eye CV (1.9/0.9) NPi (4.2/0.8) and size (3.5/1.1). The statistically significant difference in size and NPi (p<0.001) is likely related to the large sample size.

-Table 1 shows that there were a total of 6,654 readings (86%) for the left and 6,042 (78%) for the right eye where the CV and NPi were in agreeance. There were 1,060 (14%) for the left eye and 1,672 (22%) for the right eye where the CV and NPi were not in agreement.

-The correlation between left eye CV and NPi (r²=0.36, p<0.001) was significantly improved after controlling for size (r²=0.77, p<0.0001). The correlation between right eye CV and NPi (r²=0.31, p<0.001) was significantly improved after controlling for size (r²=0.63, p<0.0001).

Figure 1. Fit Plot between NPi and Size



Conclusion

Constriction velocity is highly dependent on size of the pupil. These initial analyses show that the NPi can be abnormal even when both size and CV are normal. This indicates that NPi and CV are not interchangeable. We postulate that the NPi may be a more sensitive indicator of pupillary dysfunction than the CV. Further studies need to be undertaken to test this hypothesis.

References

1. Olson DM, Stutzman S, Saju C, Wilson M, Zhao W, Aiyagari V. Interrater Reliability of Pupillary Assessments. *Neurocritical care*. 2016;24(2):251-257.
2. Chen JW, Gombart ZJ, Rogers S, Gardiner SK, Cecil S and Bullock RM. Pupillary reactivity as an early indicator of increased intracranial pressure: The introduction of the Neurological Pupil index. *Surgical neurology international*. 2011;2:82.
3. Olson DM, Stutzman SE, Atem F, Kincaide JD, Ho TT, Carlisle BA and Aiyagari V. Establishing Normative Data for Pupillometer Assessment in Neuroscience Intensive Care: The "END-PANIC" Registry. *The Journal of neuroscience nursing : journal of the American Association of Neuroscience Nurses*. 2017;49:251-254.