Letter to the Editor Regarding "Relationship of Malnutrition during Hospitalization with Functional Recovery and Postdischarge Destination in Elderly Stroke Patients"

To the Editor,

We read with great interest the article by Sato et al on the relationship of malnutrition with acute stroke in 205 patients hospitalized at the Shinshu University hospital, Japan.[1] We would like to provide an additional nationwide United States (US) perspective on outcomes of hospitalized stroke patients with protein energy malnutrition (PEM).

Decreased dietary consumption, secondary to socioeconomic barriers, is the primary etiology for PEM in developed countries.[2,3] PEM actively deters tissue healing postsevere illnesses like stroke.[2] Thereby depleting the body of its first line of defense at a critical juncture. Owing to the intricate involvement of the nervous system throughout the body, disease burden in stroke patients is significantly amplified. There lacks empirical data on outcomes, in the event these 2 highly impactful diseases coexist. Our letter aims to fulfill this knowledge gap and add to the findings of Sato et al.

We investigated the relationship of PEM with outcomes in hospitalized stroke patients in the US populace using the US National Inpatient Sample databases (2012-2014) (https://www.hcup-us.ahrq.gov/nisoverview.jsp). We analyzed in-hospital outcomes of all adult stroke-related hospitalizations with or without comorbid PEM. All primary hospitalizations for stroke and prior history of stroke were identified using ICD-9 codes detailed in our earlier studies.[4,5] Infusion of intravenous tissue plasminogen activator (ICD-9: 99.10) and endovascular mechanical thrombectomy (ICD-9: 39.74) were also identified. All patient and hospital-level variables, including identification of PEM diagnoses, were accomplished using ICD-9 codes detailed in Table 1 footnote. All stroke patients with comorbid PEM were matched without replacement with non-PEM cases via 1:1 propensity-matching. Caliper scale was .2.

Of total 313,611 stroke-related admissions (2012-2014), 16,022 (5.1%) admissions revealed coexisting PEM. A 1:1 propensity matching yielded 16,018 admissions in each group (stroke with PEM, stroke without PEM). Both groups were comparable in demographics (Table 1). However, all-cause in-hospital mortality was significantly higher in PEM group (11.3% vs 9.8%, $P < .001$). Similarly, PEM group was more likely to undergo an endovascular

Table 1. *Nationwide United States stroke hospitalizations (2012-2014) with vs without comorbid protein energy malnutrition in 1:1 propensity matched data*

Characteristics	Protein energy malnutrition*		*P* value
	No (n = 16018)	Yes (n = 16018)	
Age, median [IQR] (Years)	76 [64-85]	76 [64-85]	.28
Sex			.29
Male (%)	43.9	44.4	
Female (%)	56.1	55.6	
Race			.90
White (%)	67.7	67.4	
African American (%)	19.1	19.3	
Hispanic (%)	6.9	6.9	
Asian or Pacific Islander (%)	2.9	2.8	
Native American (%)	.4	.4	
Others (%)	3.0	3.1	
Admission Type			.62
Non-Elective (%)	95.7	95.6	
Elective (%)	4.3	4.4	
Stroke Outcomes			
All-cause in-hospital mortality (%)	9.8	11.3	**<.001**
IV-tPA infusion (%)	5.6	5.6	.81
Mechanical thrombectomy (%)	1.0	1.6	**<.001**
Discharge			**<.001**
Routine (%)	25.0	11.1	
Transfer – short-term hospital (%)	2.6	2.4	
Transfer – other facility**(%)	49.3	62.8	
Home health care (%)	12.6	11.9	
Length of stay, median [IQR] (d)	4 [3-8]	8 [4-15]	**<.001**
Total charges, median [IQR] ($ USD)	36,494 [20,912-69,258]	59,079 [29,198-135,236]	**<.001**

IQR, interquartile range; IV-tPA, intravenous tissue plasminogen activator.

Bold *P*-value <0.05 indicates statistical significance.

*ICD-9 codes used to identify patient and hospital level variables: 260.x, 261.x, 262.x, 263.x, 269.8, 799.4, 783.3, 783.21, 783.22, 783.7.

**Other Facilities = Skilled Nursing Facility, Intermediate Care Facility, etc.

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mechanical thrombectomy (1.6% vs 1.0%, $P < .001$). PEM group was more frequently transferred to specialized facilities (63% vs 49%, $P < .001$). The length of stay with concomitant PEM was double than non-PEM admissions (8 vs 4 days, $P < .001$). Total hospital charges were also significantly higher for stroke admissions with PEM ($59,079 vs $36,494, $P < .001$).

Our analysis reveals a 15% higher all-cause mortality and a 60% higher endovascular mechanical thrombectomy use in stroke patients with PEM. Also, length of stay (100%) and hospital charges (62%) were higher in PEM-related stroke admissions. Mechanical thrombectomy, an invasive vascular procedure, carries an innate risk of complications including refractory stroke in uninvolved regions.[6] The disproportionate utilization requirement of healthcare resources for stroke is strongly attributable to many socioeconomic factors affecting PEM,[7,8] which can and should be successfully addressed with nutrition education and stronger health policies.

In summary, we provide augmentative data proving the deleterious relationship between PEM and stroke. A comprehensive approach to improve nutrition supplementation and dietary education has the potential to curtail the negative health and financial outcomes of stroke and other cardiovascular diseases.

Author Contributions

Conception and design: R. Desai and A.R. Amraotkar; Collection and assembly of data: R. Desai and A.R. Amraotkar; Drafting of article: R. Desai and A.R. Amraotkar; and Critical revision for important intellectual content: R. Desai and A.R. Amraotkar.

Declaration of Competing Interest

Both authors have no financial, personal, or other conflicts of interests to disclose.

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