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LETTER TO THE EDITOR

In Response to "Association of Serum Sodium With Morbidity and Mortality in Hospitalized Patients Undergoing Major Orthopedic Surgery"

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We thank Drs. Liu and Zhang for their letter and comments. Each diagnostic code in our dataset was individually reviewed by a board-certified senior orthopedic surgeon (Dr. Wright). We considered procedures as major if they were of long duration, had the potential for significant blood loss, or represented major physiologic stress, including significant fluid balance requirements, in the opinion of our orthopedist coauthor. This set of diagnoses did include femoral neck fractures.

In our original analyses, we included fracture as a covariate in all statistical models and subsequently performed subgroup analyses according to the presence or absence of a diagnosis of fracture. As reported in our article,[1] J-shaped associations of dysnatremia with greater length of stay were evident in those with and without fractures. In the 30-day mortality analyses, only mild hyponatremia and hypernatremia remained associated with greater mortality in those with fracture. In those without a diagnosis of fracture, only moderate/severe hyponatremia remained associated with greater 30-day mortality.

To assess for differences in associations of hyponatremia with outcomes according to age, we dichotomized this variable into those <65 years old versus ≥65 years old. We then fit model 3 from our original article to determine the adjusted effect estimates for length of stay and 30-day mortality (Tables 1 and 2, respectively).

While the associations of dysnatremia with 30-day mortality did not reach statistical significance in the <65 years age group, these results must be interpreted with caution due to the low number of events (35 deaths). We did not perform smaller subgroups analyses according to fracture type due to concerns of multiple comparisons testing, loss of statistical power, and inaccurate interpretation of effect estimates.

Reference

1. McCausland FR, Wright J, Waikar SS. Association of serum sodium with morbidity and mortality in hospitalized patients undergoing major orthopedic surgery. *J Hosp Med*. 2014;9(5):297–302.

TABLE 1. Association of Categories of Perioperative Corrected Serum Sodium With Log-Transformed Length of Stay*

	Difference (95% CI) in Length of Stay in Days According to Category of Perioperative SNa†			
	≤130 mmol/L, n = 198	131–134 mmol/L, n = 1,036)	135–143 mmol/L, n = 14,563	≥144 mmol/L, n = 409
Model 3				
<65 years old	2.3 (1.6–3.3), $P<0.001$	1.4 (1.2–1.6), $P<0.001$	Ref	1.5 (1.3–1.8), $P<0.001$
≥65 years old	1.4 (1.1–1.7), $P=0.001$	1.4 (1.2–1.5), $P<0.001$	Ref	1.3 (1.1–1.5), $P=0.002$

NOTE: Model 3 was adjusted for age, race, sex and clinical center, categories of Charlson Comorbidity Index, diagnosis of fracture, congestive heart failure, diabetes, cancer, and liver disease. **Abbreviations:** CI, confidence interval; SNa, serum sodium.
*Corrected for simultaneous measurement of glucose.
†Exponentiation of the original β coefficients was performed to determine the length of stay in days.

TABLE 2. Association of Categories of Admission Serum Sodium With Mortality*

	Hazard Ratio (95% CI) for 30-Day Mortality According to Category of Perioperative SNa			
	≤130 mmol/L, n = 198	131–134 mmol/L, n = 1,036	135–143 mmol/L, n = 14,563	≥144 mmol/L, n = 409
Model 3				
<65 years old	1.36 (0.77–10.2), $P=0.77$	2.19 (0.93–5.19), $P=0.07$	Ref	4.17 (0.97–18.0), $P=0.06$
≥65 years old	2.44 (1.27–4.69), $P=0.008$	1.64 (1.05–2.55), $P=0.03$	Ref	2.98 (1.72–5.15), $P<0.001$

NOTE: Model 3 was adjusted for age, race, sex and clinical center, categories of Charlson Comorbidity Index, diagnosis of fracture, congestive heart failure, diabetes, cancer, and liver disease. **Abbreviations:** CI, confidence interval; SNa, serum sodium.
*Corrected for simultaneous measurement of glucose.

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