

# Associations of Obesity and Neighborhood Characteristics with Urinary Risk Factors for Kidney Stone Disease

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## Background

- To date, there is limited research evaluating the influence of socioeconomic status (SES) on urinary risk factors for KSD.
- The relationship between SES and urine chemistry among stone formers is further complicated by risk factors that may vary by sociodemographic group. Obesity is one such risk factor for KSD.<sup>1</sup>
- While obesity is inversely associated with SES,<sup>2</sup> its prevalence has increased across all sociodemographic groups.<sup>3</sup>
- It is unclear whether an interaction between SES and obesity influences urinary risk factors for KSD.

## Objective

- To assess the extent to which obesity and neighborhood characteristics jointly contribute to urinary risk factors for KSD.

## Methods

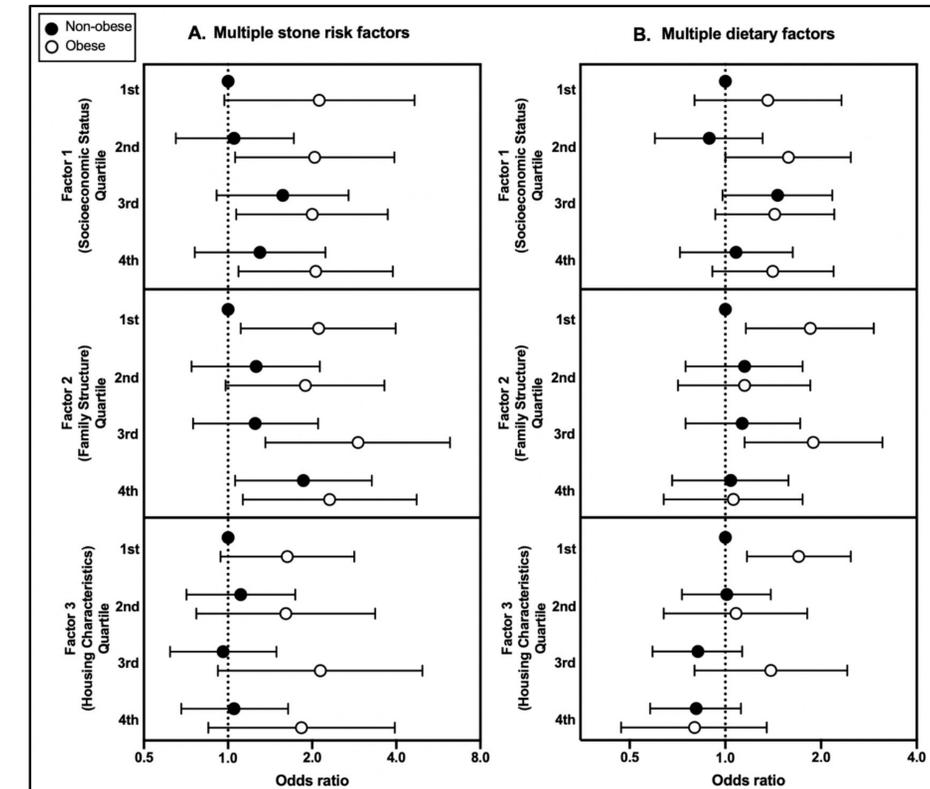
- We performed a retrospective analysis of adult patients with KSD evaluated with 24-hour urine collection at The University of Alabama at Birmingham Medical Center (2001-2020).
- We excluded patients without at least one BMI measurement, patients with diagnoses or procedures associated with gastrointestinal malabsorption, patients with missing Census tract information, patients not residing in Alabama or a neighboring state, and patients without at least one adequate 24-hour urine creatinine (Cr).
- We obtained neighborhood-level socioeconomic data from the U.S. Census and performed a principal component analysis (PCA) using fifteen variables in the domains of education, income, disability, healthcare access, family structure, and housing and living conditions.
- We then assessed associations between these factors and 24-hour urine measurements through linear regression with adjustment for multiple testing, as well as groupings of 24-hour urine results (stone risk factors and dietary factors, as defined by a commercial vendor) through multivariable logistic regression.
- Finally, we assessed multiplicative interactions testing effect modification by obesity, and performed analyses stratified by obesity.

## Results

- We identified 1,264 patients meeting study criteria.
- Factors retained on PCA represented SES, family structure, and housing characteristics.
- Using linear regression, we detected a significant inverse relation between SES and 24-hour urine sodium ( $p=0.0002$ ).
- Using multivariable logistic regression, obesity was associated with increased odds of multiple stone risk factors and multiple dietary factors (see Table).
- We did not observe significant and consistent multiplicative interactions between obesity and quartiles of neighborhood SES, family structure, or housing characteristics.
- Analyses stratified by obesity supported these findings (see Figure).

Characteristic	Multiple stone risk factors		Multiple dietary factors	
	Odds ratio	95% CI	Odds ratio	95% CI
<b>Age</b>				
18-34	Reference	Reference	Reference	Reference
35-49	0.49	0.27 to 0.86	1.04	0.72 to 1.51
50-64	0.58	0.33 to 1.02	1.16	0.81 to 1.66
≥65	0.58	0.32 to 1.07	0.97	0.65 to 1.44
<b>Male</b>	0.90	0.66 to 1.24	1.21	0.96 to 1.52
<b>Married</b>	0.81	0.58 to 1.14	0.64	0.50 to 0.81
<b>Race</b>				
White	Reference	Reference	Reference	Reference
Black	0.53	0.31 to 0.92	0.77	0.50 to 1.18
Other or unknown	1.48	0.83 to 2.65	1.14	0.79 to 1.66
<b>Obese</b>	1.61	1.15 to 2.26	1.33	1.06 to 1.67
<b>Chronic kidney disease</b>	0.82	0.57 to 1.18	0.89	0.68 to 1.16
<b>Diabetes</b>	0.90	0.54 to 1.52	1.14	0.78 to 1.66
<b>Hypertension</b>	1.28	0.85 to 1.91	0.82	0.61 to 1.09
<b>Socioeconomic Status (Factor 1)</b>				
1 <sup>st</sup> quartile (least disadvantaged)	Reference	Reference	Reference	Reference
2 <sup>nd</sup> quartile	1.14	0.75 to 1.72	1.06	0.77 to 1.45
3 <sup>rd</sup> quartile	1.43	0.93 to 2.21	1.33	0.97 to 1.83
4 <sup>th</sup> quartile (most disadvantaged)	1.32	0.86 to 2.03	1.16	0.85 to 1.59
<b>Family Structure (Factor 2)</b>				
1 <sup>st</sup> quartile (least disadvantaged)	Reference	Reference	Reference	Reference
2 <sup>nd</sup> quartile	1.09	0.72 to 1.66	0.88	0.64 to 1.20
3 <sup>rd</sup> quartile	1.15	0.75 to 1.75	1.00	0.73 to 1.37
4 <sup>th</sup> quartile (most disadvantaged)	1.39	0.89 to 2.16	0.78	0.57 to 1.07
<b>Housing Characteristics (Factor 3)</b>				
1 <sup>st</sup> quartile (least disadvantaged)	Reference	Reference	Reference	Reference
2 <sup>nd</sup> quartile	1.06	0.68 to 1.64	0.94	0.69 to 1.28
3 <sup>rd</sup> quartile	0.89	0.58 to 1.36	0.79	0.57 to 1.07
4 <sup>th</sup> quartile (most disadvantaged)	1.01	0.65 to 1.56	0.76	0.55 to 1.03

**Table** Odds of multiple stone risk factors (urine volume, calcium, oxalate, citrate, pH, and uric acid) and multiple dietary factors (urine sodium, potassium, magnesium, phosphorus, ammonium, sulfate, and urea nitrogen).



**Figure** Odds of multiple stone risk factors and multiple dietary factors by obesity and quartiles of neighborhood factors. The 1<sup>st</sup> quartile corresponds to the least disadvantaged group and the 4<sup>th</sup> quartile corresponds to the most disadvantaged group.

## Conclusions

- Obesity was independently associated with the presence of multiple stone risk factors and multiple dietary factors; however, the strength and magnitude of these associations did not vary significantly across sociodemographic groups.
- Urinary risk factors for KSD are present throughout all neighborhood strata, emphasizing the need for enhanced access to guideline-based evaluation and management.
- Obesity is likely associated with urinary risk factors across all sociodemographic groups; thus, weight loss could be a worthwhile preventive measure for many stone formers.

## References

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