Research Article

The important role of serum albumin levels in female urge urinary incontinence

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Abstract

Background: Low serum albumin is linked to poorer health and may influence pelvic conditions. **Objective:** The objective of the study is to investigate the connection between serum albumin (SA) and urge urinary incontinence (UUI) in women. **Methods:** Included in this analysis were 12,113 participants from the United States National Health and Nutrition Examination Survey with valid data. Weighted logistic regression models evaluated the SA-UUI relationship while adjusting for key confounders. Subgroup and interaction analyses further explored potential effect modifiers. **Results:** The mean SA level was significantly lower in women with UUI (4.12 ± 0.32 g/dL) than in the healthy controls (4.18 ± 0.33 g/dL). After full adjustment for covariates, higher SA levels were associated with a 31% reduction in the odds of UUI (adjusted odds ratio = 0.692, 95% confidence interval = 0.581–0.825; $p<0.001$). Subgroup analyses showed that SA was significantly negatively associated with UUI in all subgroups of age, education, body mass index (BMI), smoking, alcohol consumption, hypertension, history of vaginal delivery, cesarean delivery, and hysterectomy (all $p<0.05$). Interaction tests showed that the association between SA and UUI was not significantly different among each stratification (all p for interaction >0.05). **Conclusion:** SA levels are significantly correlated with the risk of urinary incontinence. Although the direction of the causal relationship remains uncertain, SA, as a clinically modifiable indicator, may help identify high-risk individuals and provide a reference for future exploration of the role of nutritional intervention in the prevention and management of urinary incontinence.

Keywords: Urge urinary incontinence, Serum albumin, National Health and Nutrition Examination Survey, Female

1. Introduction

Urinary incontinence (UI) is prevalent among women and can develop at any age. UI is mainly defined as uncontrolled urine loss. According to epidemiological studies, its prevalence is 17% in women over 20 and 38% in women over 60, seriously affecting the quality of life of these patients.[1] Urge urinary incontinence (UUI) is a frequent type of UI, characterized by unpredictable, involuntary urine flow, accompanied or immediately preceded by urgency. The main reason for the occurrence of UUI may be an uncontrolled contraction of the bladder detrusor muscle, causing an overactive or unstable bladder.[2] Age, obesity, mode of delivery, birth weight, socioeconomic status, mental health, and food security are all potential risk factors associated with UUI.[2-5] In recent years, clinicians have been investigating how to control symptoms and improve patients' quality of life by targeting the underlying risk factors for UUI.

The most abundant protein in plasma, serum albumin (SA), dictates plasma osmolality and plays a crucial role in controlling blood distribution throughout the body.[6]

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It can act as a carrier of many substances in plasma and exerts a wide array of effects, such as antioxidation and immunomodulation.[7,8] SA is not only an important biomarker for many diseases but is also used in the treatment of many clinical diseases.[9,10] It has been shown that UUI is associated with immune and inflammatory indicators like C-reactive protein.[11] A recent study demonstrated that patients with cirrhosis and UUI had lower albumin levels than their counterparts who did not.[12] Additionally, another study discovered that perioperative adverse events were more common in UUI patients who suffered from preoperative hypoalbuminemia.[13] However, data on the relationship between SA and UUI are still limited.

In this study, we hypothesized that a relationship exists between SA and UUI. We used data from the United States (US) National Health and Nutrition Examination Survey (NHANES) from 2007 to 2016, and using statistical analysis, we looked into the relationship between SA and UUI.

2. Materials and methods

2.1. Study design and participants

The NHANES is a survey carried out on a nationally representative sample of Americans. It is designed to assess the health and nutritional status of citizens. Our analysis included data spanning a period of 10 years (2007–2016) from NHANES. Data were retrieved from a total of 50,588 participants in NHANES. We excluded 25,370 participants whose UUI data were missing and removed 1,273 participants lacking SA data. Of the remaining 23,945 participants, 11,832 male participants were eliminated, resulting in a final sample of 12,113 eligible participants.

2.2. Assessment of UUI

The diagnosis of UUI was primarily based on the self-reporting of participants. All participants were asked to respond to the following question: "during the past 12 months, (have you/has SP_) leaked or lost control of even a small amount of urine with an urge or pressure to urinate and (you/he/she) couldn't get to the toilet fast enough?"[4] Participants who answered "yes" were diagnosed as having UUI; otherwise, they were classified as not having UUI.

2.3. Measurement of SA

SA was quantified using the bromocresol violet dye method, as previously described, with results reported in g/dL.[14] To enhance the persuasiveness of our findings by elucidating a potential dose–response relationship, SA was treated as a continuous variable in correlation analyses with UUI.

2.4. Other covariates

We also harvested data on age, race (non-Hispanic white, black, other Hispanic, and other races), educational level (lower than high school, high school, and higher than high school education), body mass index (BMI; <25, 25–30, and ≥30), and family poverty-to-income ratio (PIR; <1.3, 1.3–3.5, and ≥3.5). For the survey on smoking, participants were classified into the following three categories: never smokers, former smokers, and current smokers.[15] Alcohol consumption was also an important covariate, classified as drinking and non-drinking according to whether or not they consumed more than 12 drinks a year. Participants who were previously diagnosed with diabetes or had fasting blood glucose levels above 124 mg/dL were considered diabetic. Blood pressure was calculated by averaging the results of four measurements taken at different time points. Participants who had previously been diagnosed with hypertension or whose blood pressure exceeded 140/90 mmHg were considered hypertensive. Participants who scored over 10 on the Patient Health Questionnaire-9 depression scale[16] were classified as depression, and a score of less than 10 indicated no depression. The other four important covariates that were closely related to women included history of vaginal delivery, cesarean delivery, macrosomia, and hysterectomy.

Given that renal function is a known confounder influencing both SA levels and urinary symptoms, we aimed to minimize residual confounding by adjusting for estimated glomerular filtration rate (eGFR) in our analysis. eGFR was calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation.[17] Specifically, for the female cohort, the formula applied was:

$$GFR = 141 \times \min\left(\frac{Scr}{k}, 1\right)^{\alpha} \times \max\left(\frac{Scr}{k}, 1\right)^{-1.209} \times 0.993^{Age} \times 1.018 \quad (1)$$

where Scr is serum creatinine (mg/dL), with $\kappa = 0.7$ and $\alpha = -0.329$.

2.5. Statistical analysis

Baseline information was described differently by data type. Means and standard deviations (mean ± SD) were used to describe continuous variables, whereas the number of cases and percentages were used to represent categorical variables. The Chi-square test, or Fisher's exact test, was employed to assess categorical variables, and the *t*-test was utilized to evaluate differences between groups. NHANES data were obtained through multilevel, complex sampling. The samples were analyzed after weighing using Mobile Examination Center weights according to the website requirements. Five

cycles were combined for NHANES 2007–2016; thus, we weighted the data in accordance with the guidelines published by the National Center for Health Statistics on how to combine several cycles and determine the proper weights:[14]

$$MEC10YR = \frac{1}{5} \times WTMEC2YR \quad (2)$$

We explored the relationship between SA and UUI by using two logistic regression models, including an unadjusted model (Model 1) and adjusted models (Models 2 and 3). In Model 2, the following confounders were taken into account: age, race, education level, BMI, PIR, hypertension, diabetes, smoking, alcohol consumption, depression, vaginal delivery, cesarean delivery, macrosomia, and hysterectomy. In Model 3, we further adjusted the regression model by including eGFR as a covariate based on Model 2.

Based on all covariates, we grouped them and examined the association between SA and UUI in different groups using subgroup analysis. Multivariate logistic regression was used for the analysis, and all covariates except grouping variables were included in the model for analysis. The heterogeneity of associations between subgroups was tested by adding an interaction test. Two-tailed $p<0.05$ was regarded as statistically significant for all statistical analyses, which were carried out in Stata 16 (StataCorp LLC, US) and SPSS 27 (IBM, US).

3. Results

3.1. Characteristics of participants

A total of 12,113 women were ultimately included in the research based on the inclusion and exclusion criteria (Figure 1). The basic information of these participants is shown in Table 1. There were 3,582 participants with UUI, and their mean age was 57.41 ± 16.48 years. In participants with and without UUI, mean SA levels were 4.12 ± 0.32 and 4.18 ± 0.33, respectively. UUI was most common in non-Hispanic White women ($p<0.001$), involving 1,596 cases (44.6%). The UUI was also more common in women with a BMI over 30 kg/m^2 and a history of smoking, hypertension, diabetes, depression, vaginal delivery, macrosomia, and hysterectomy.

3.2. Relationship between albumin and UUI

Univariate logistic models showed that SA levels were negatively associated with the occurrence of UUI (odds ratio [OR] = 0.543, 95% confidence interval [CI] = 0.468–0.630, $p<0.001$). Model 2 likewise exhibited a correlation between SA levels and the occurrence of UUI (OR = 0.689, 95% CI = 0.578–0.822, $p<0.001$). After adjustment for all confounding factors, SA still bore a negative correlation with UUI (OR = 0.692, 95% CI = 0.581–0.825; $p<0.001$).

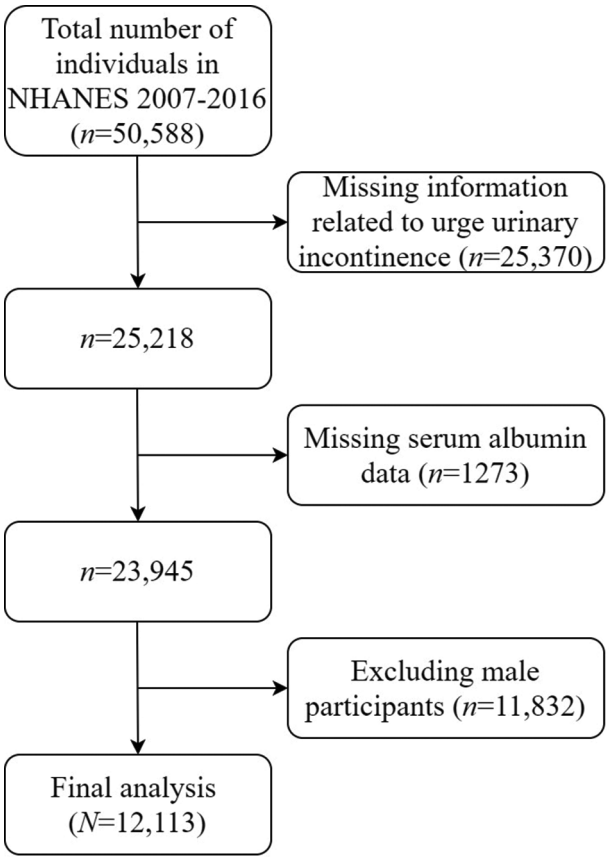

Figure 1. Flow chart of the screening process for participants eventually included in the study

Additionally, age, BMI (≥30), race (non-Hispanic Black), alcohol intake, smoking (current), depression, diabetes, PIR (≥3.5), history of vaginal delivery, and hysterectomy were all associated with the occurrence of UUI (Table 2).

3.3. Subgroup analysis

Our subgroup analysis revealed that SA was significantly associated with UUI in each of the subgroups by age, education level, BMI, smoking, alcohol consumption, hypertension, history of vaginal delivery, cesarean delivery, and hysterectomy (all $p<0.05$). Of the subgroups stratified by race, only non-Hispanic whites and other races showed statistical significance (all $p<0.05$). Of the subgroups stratified by depression, only the subgroup of non-depressed participants demonstrated statistical significance ($p<0.05$). We also observed significant differences in the subgroups without diabetes and without a history of macrosomia (all $p<0.05$). In subgroups stratified by PIR, 1.3–3.5 and ≥3.5 exhibited a significant difference (all $p<0.05$) (Table A1).

Interaction tests showed that the association between SA and UUI was not significantly different among each stratification, indicating that age, race, education level, PIR, BMI, hypertension, diabetes, depression, smoking, alcohol consumption, history of vaginal delivery, cesarean delivery,

Table 1. Baseline characteristics of the study population, unweighted

Variables	UUI		*p*-value
	Yes	No	
Participants (*n*)	3,582	8,531	
Age (year)	57.41±16.48	46.54±17.16	<0.001*
BMI			<0.001*
<25	769 (21.5)	2,802 (32.8)	
25–30	953 (26.6)	2,488 (29.2)	
≥,4	1,811 (50.6)	3,188 (37.4)	
Missing	49 (1.4)	53 (0.6)	
Race			<0.001*
Non-Hispanic White	1,596 (44.6)	3,579 (42.0)	
Non-Hispanic Black	831 (23.2)	1,623 (19.0)	
Other Hispanic	384 (10.7)	1,023 (12.0)	
Other races	771 (21.5)	2,306 (27.0)	
Level of education			<0.001*
Less than high school	1,017 (28.4)	1,916 (22.5)	
High school	825 (23.0)	1,781 (20.9)	
Higher than high school	1,735 (48.4)	4,827 (56.6)	
Missing	5 (0.1)	7 (0.1)	
Poverty-to-income ratio			<0.001*
<1.3	1,183 (33.0)	2,588 (30.3)	
1.3–3.5	1,264 (35.3)	2,863 (33.6)	
≥,86	809 (22.6)	2,388 (28.0)	
Missing	326 (9.1)	692 (8.1)	
Smoking			<0.001*
Never	2,114 (59.0)	5,620 (65.9)	
Former	814 (22.7)	1,468 (17.2)	
Current	650 (18.1)	1,439 (16.9)	
Missing	4 (0.1)	4 (0)	
Alcohol use			0.02*
Yes	2,091 (58.4)	5,200 (61.0)	
No	1,487 (41.5)	3,326 (39.0)	
Missing	4 (0.1)	5 (0)	
Hypertension			<0.001*
Yes	2,079 (58.0)	3,086 (36.2)	
No	1,474 (41.2)	5,312 (62.3)	
Missing	29 (0.8)	133 (1.6)	
Diabetes			<0.001*
Yes	711 (19.8)	804 (9.4)	
No	2,750 (76.8)	7,561 (88.6)	
Borderline	116 (3.2)	161 (1.9)	
Missing	5 (0.1)	5 (0.1)	
Depression			<0.001*
Yes	667 (18.6)	739 (8.7)	
No	2,858 (79.8)	7,737 (90.7)	
Missing	57 (1.6)	55 (0.6)	
Vaginal deliveries			<0.001*
Yes	2,789 (77.9)	5,538 (64.9)	
No	426 (11.9)	1,451 (17.0)	
Missing	367 (10.2)	1,542 (18.1)	
Cesarean deliveries			<0.001*
Yes	630 (17.6)	1,738 (20.4)	
No	1,097 (30.6)	2,146 (25.2)	
Missing	1,855 (51.8)	4,647 (54.5)	
Macrosomia			<0.001*
Yes	614 (17.1)	1,095 (12.8)	
No	2,453 (68.5)	5,487 (64.3)	
Missing	515 (14.4)	1,949 (22.8)	
Hysterectomy			<0.001*
Yes	1,206 (33.7)	1,554 (18.2)	
No	2,369 (66.1)	6,952 (81.5)	
Missing	7 (0.2)	25 (0.3)	
Serum albumin (g/dL)	4.12±0.32	4.18±0.33	<0.001*

Notes: Data are presented as mean±SD for continuous variables and *n* (%) for categorical variables. *$p<0.05$.
Abbreviation: BMI: Body mass index.

macrosomia, and hysterectomy did not significantly depend on this negative association (all p for interaction >0.05) (Table A1).

4. Discussion

Our study discovered a complicated relationship between SA levels and UUI in women upon an analysis of data from NHANES collected over a 10-year period. Multivariate logistic regression showed that SA level was negatively correlated with UUI. Our subgroup analysis revealed a strong negative relationship between SA and UUI in all subgroups of age, education, BMI, smoking, alcohol consumption, hypertension, history of vaginal delivery, cesarean delivery, and hysterectomy. Further subgroup analyses of race, depression, history of diabetes, and history of macrosomia exhibited significant differences only in non-Hispanic Whites, non-depressed participants, those without diabetes, and those without a history of macrosomia. Our study is significant since it was the first research to examine how SA correlates with UUI in women.

Although our analysis demonstrates a significant negative association between SA levels and UUI risk, the cross-sectional nature of the study limits causal interpretation. The relationship may be susceptible to residual confounding or reverse causality. Consequently, these findings are principally hypothesis-generating. They emphasize the imperative for future prospective cohort studies to delineate the temporal sequence and for mechanistic investigations to explore the specific pathways linking systemic protein homeostasis to lower urinary tract dysfunction. From a clinical perspective, SA represents a routine, cost-effective biomarker. Its

Table 2. Association between serum albumin and urge urinary incontinence

Variable	Model 1		Model 2		Model 3	
	OR (95% CI)	*p*–value	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value
Serum albumin (g/dL)	0.543 (0.468–0.630)	<0.001*	0.689 (0.578–0.822)	<0.001*	0.692 (0.581–0.825)	<0.001*
Age (year)	1.041 (1.038–1.044)	<0.001*	1.040 (1.036–1.044)	<0.001*	1.045 (1.039–1.050)	<0.001*
BMI (vs. BMI <25)						
25–30	1.408 (1.224–1.619)	<0.001*	1.150 (0.988–1.338)	0.072	1.148 (0.986–1.337)	0.075
≥0.0	2.150 (1.895–2.438)	<0.001*	1.669 (1.441–1.932)	<0.001*	1.670 (1.442–1.934)	<0.001*
Race (vs. Non-Hispanic White)						
Non-Hispanic Black	1.220 (1.091–1.364)	<0.001*	1.241 (1.088–1.414)	0.001*	1.193 (1.044–1.363)	0.010*
Other Hispanic	0.753 (0.648–0.875)	<0.001*	0.896 (0.754–1.064)	0.210	0.868 (0.730–1.033)	0.111
Other races	0.759 (0.669–0.861)	<0.001*	1.022 (0.885–1.180)	0.770	0.987 (0.853–1.142)	0.862
Level of education (vs. less than high school)						
High school	0.917 (0.794–1.058)	0.235	1.051 (0.895–1.235)	0.541	1.058 (0.901–1.243)	0.489
Higher than high school	0.662 (0.587–0.746)	<0.001*	1.021 (0.881–1.183)	0.780	1.030 (0.888–1.194)	0.697
Poverty-to-income ratio (vs. <1.3)						
1.3–3.5	1.025 (0.910–1.153)	0.688	0.999 (0.873–1.143)	0.989	0.995 (0.870–1.139)	0.947
≥3.5	0.741 (0.651–0.843)	<0.001*	0.842 (0.720–0.986)	0.033*	0.838 (0.716–0.980)	0.027*
Smoking						
Former	1.405 (1.235–1.597)	<0.001*	1.007 (0.871–1.164)	0.924	1.003 (0.867–1.159)	0.971
Current	1.177 (1.028–1.348)	0.018*	1.188 (1.016–1.390)	0.031*	1.189 (1.016–1.391)	0.031*
Alcohol use	0.841 (0.758–0.932)	0.001*	1.173 (1.038–1.327)	0.011*	1.172 (1.037–1.325)	0.011*
Hypertension	2.429 (2.188–2.696)	<0.001*	1.014 (0.890–1.155)	0.833	1.027 (0.901–1.170)	0.693
Diabetes	2.618 (2.256–3.037)	<0.001*	1.291 (1.099–1.518)	0.002*	1.318 (1.120–1.550)	0.001*
Depression	2.339 (2.016–2.714)	<0.001*	2.222 (1.888–2.616)	<0.001*	2.236 (1.900–2.633)	<0.001*
Vaginal deliveries	1.708 (1.464–1.994)	<0.001*	1.413 (1.107–1.803)	0.006*	1.415 (1.109–1.805)	0.005*
Cesarean deliveries	0.674 (0.578–0.786)	<0.001*	0.919 (0.745–1.135)	0.434	0.921 (0.746–1.137)	0.444
Macrosomia	1.331 (1.152–1.537)	<0.001*	1.166 (0.997–1.363)	0.054	1.162 (0.993–1.360)	0.061
Hysterectomy	2.365 (2.105–2.658)	<0.001*	1.189 (1.040–1.358)	0.011*	1.191 (1.042–1.361)	0.010*

Notes: Adjusted covariates: Model 1: Unadjusted model; Model 2: Adjusted for age, race, education level, BMI, Poverty-to-income ratio, hypertension, diabetes, smoking, alcohol consumption, depression, vaginal delivery, cesarean delivery, macrosomia, and hysterectomy; Model 3: Model 2+Adjusted for eGFR.*p<0.05.
Abbreviations: 95% CI: 95% confidence interval; BMI: Body mass index; eGFR: Estimated glomerular filtration rate; OR: Odds ratio.

association with UUI suggests its actionable value as a clinical flag. In patients, particularly the elderly or those with comorbidities, detected hypoalbuminemia should prompt clinicians to initiate a broader assessment encompassing geriatric and nutritional evaluations, where UUI can be considered as part of the clinical profile. This positions SA not merely as a correlate but also as a tangible target within a holistic management approach.

In our subgroup analyses, the association between SA and UUI did not reach statistical significance within certain subgroups (*e.g.*, participants with depression, diabetes, or a history of macrosomia). Notably, test results for interaction across these subgroups were also non-significant. This apparent discrepancy does not imply a biological contradiction but potentially reflects differences in statistical power, a common occurrence in subgroup analysis.[18] It is important to clarify that interaction tests and within-subgroup tests address distinct questions. An interaction test evaluates whether the effect size differs meaningfully between subgroups—that is, whether effect modification is present. This is a higher-order test that typically requires substantial sample sizes to detect modest interaction effects.[19] In contrast, a within-subgroup test examines whether the association within a specific subgroup is statistically different from zero. The most plausible explanation for our findings is the limited sample size in the aforementioned subgroups, leading to insufficient power. Thus, the most consistent interpretation is twofold: (i) our study lacked sufficient evidence to conclude that the SA–UUI association differs across subgroups (non-significant interaction) and (ii) within certain smaller subgroups, we also lacked adequate power to detect a statistically significant association, even if one exists.

UUI is a typical urological condition that impairs women's quality of life and may increase their psychological stress.[20] Consistent with previous studies,[21,22] the prevalence of UUI increased with age, obesity, smoking, hypertension, depression, and vaginal deliveries. Vaginal delivery can lead to pelvic trauma and perineal nerve damage, which can lead

to UI.[23] Changes in some health indicators in the body may indicate the onset of UI. Brown et al. [24] found no relationship between hemoglobin A1c, an important biochemical marker of diabetes, and UUI. In contrast, macroalbuminuria was related to a higher risk of UUI. Not only can UUI severely impair the quality of life, but the complex treatment can also increase the financial burden. Therefore, timely prediction and prevention of UUI by changes in physical indicators have an important role. We tried to analyze the relationship between SA and UUI, aiming to achieve this goal.

The main manifestation of overactive bladder syndrome is a sense of urgency to urinate, which is often accompanied by UUI. UUI may be associated with increased coupling of the bladder-forcing muscles, and enhanced coupling of the unstable bladder may lead to diffuse activity, a sense of urgency, and ultimately, involuntary contractions.[25] Studies[26] have shown that inflammation and spinal cord injury are important molecular mechanisms of UUI and that inflammation reduces the activation threshold of bladder afferent nerves. Prolonged inflammation has a detrimental effect on the bladder and can lead to bladder fibrosis, reduced bladder compliance, and, eventually, incontinence.[27] After spinal cord injury, C-fiber mechano-sensitivity increases, and a spinal reflex circuit activated by C-fiber afferents occurs, which may be a positive feedback mechanism that loses control of the higher centers of the brain and eventually results in UI.[28] SA may improve recovery from spinal cord injury and may have neuroprotective effects.[29] It also binds nitric oxide and prostaglandins and regulates the inflammatory response.[30] In our study, individuals with high SA levels had a decreased incidence of UUI. The association between low SA and UUI may be mediated by both muscular and structural pathways. Low SA, frequently a proxy for reduced muscle mass (sarcopenia), can directly diminish the contractile strength and endurance of pelvic floor and urethral sphincter muscles, predisposing individuals to UUI.[31] Beyond its role in muscle health, SA is critical for maintaining oncotic pressure and supporting tissue repair. Deficiency may therefore weaken the urethral mucosa and surrounding connective tissue, impairing their supportive function.[32,33] In clinical practice, SA represents a sentinel biomarker that synthesizes information on nutrition, chronic inflammation, and overall disease burden, rendering it a powerful and actionable alert for heightened UUI risk.

SA impacts the pharmacokinetics of numerous drugs and is the primary transporter of fatty acids.[34] It is also used to treat a variety of medical and surgical conditions, including liver disease, shock, acute respiratory distress syndrome, and as a nutritional support. It can also be used as a short-term plasma replacement for critically ill patients, which can effectively expand circulating blood volume.[9,35] Close monitoring of SA levels is essential for the management of many diseases, and maintaining concentrations >40 g/L is an indicator of treatment in dialysis patients.[36] Eggs, milk, and fish are rich in albumin. Studies have shown that UI was associated with depressive symptoms and low intake of dairy products, meat, and fish.[37,38] However, as of now, the relationship between albumin supplementation and UUI has not been confirmed by studies. Based on our findings, we are led to further theorize that moderate amounts of albumin supplementation may reduce the risk of UUI development, but this still requires confirmation by several prospective studies.

The large sample size and intricate NHANES design are the key benefits of this study. The correlation between SA and UUI in women was identified by post-weighted analysis of a representative sample. SA was tested through strict quality control procedures. There was also an adjustment for major potential confounding factors in order to yield more accurate results. However, this study has certain limitations. First, this is a cross-sectional study, which may be potentially biased. Second, UUI was defined by self-reporting, which may be subject to recall bias. Third, the data set of our current study does not include standard frailty assessment scales (such as the Fried phenotype) or detailed nutritional assessment indicators. We can only partially control this confounding factor by adjusting for age, BMI, and major chronic diseases. Finally, we were unable to assess the extent of UUI and the current treatment modality.

5. Conclusion

In this study, SA was found to be negatively associated with the risk of UUI in US women. Although the direction of the causal relationship is still uncertain, SA, as a clinically modifiable indicator, may help identify high-risk individuals and provide a reference for future exploration of the role of nutritional intervention in the prevention and management of UI. However, further research is required to verify our findings and identify potential causes. Overall, this is a well-designed epidemiological study addressing an understudied aspect of female UUI.

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Conflict of interest

The authors declare that they have no conflicts of interest.

Author contributions

Conceptualization: Weiguo Ma
Formal analysis: Bihui Zhang
Investigation: Bihui Zhang
Methodology: Wangli Mei, Bihui Zhang, Mingming Xu
Writing – original draft: Wangli Mei, Mingming Xu, Hang Zhou
Writing – review & editing: Weiguo Ma

Ethics approval and consent to participate

This study used publicly available, de-identified data from the National Health and Nutrition Examination Survey (NHANES). NHANES protocols were approved by the National Center for Health Statistics (NCHS) Research Ethics Review Board, and written informed consent was obtained from all participants.

Consent for publication

All participants in NHANES signed written consent and were approved by the National Health Statistics Research Ethics Review Board, and data are available on the official website. Therefore, no additional ethical review was conducted.

Data availability statement

The NHANES database (https://wwwn.cdc.gov/nchs/nhanes/Default.aspx) contains all the data used in this study. All the original data can be obtained from the public database. More detailed information can be acquired from the corresponding author upon reasonable request.

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Appendix

Table A1. Subgroup analysis for the association between serum albumin and urge urinary incontinence

Variable	OR[a]	95% CI	*p*-value	*p* for interaction
Age group				0.691
20–39	0.739	0.567–0.963	0.025*	
40–59	0.774	0.608–0.986	0.038*	
≥60	0.639	0.515–0.793	<0.001*	
BMI				0.363
<25	0.578	0.436–0.765	<0.001*	
25–30	0.733	0.564–0.953	0.020*	
≥30	0.774	0.633–0.947	0.013*	
Race				0.851
Non–Hispanic White	0.720	0.583–0.890	0.002*	
Non–Hispanic Black	0.800	0.605–1.059	0.120	
Other Hispanic	0.657	0.430–1.006	0.054	
Other races	0.684	0.514–0.911	0.009*	
Level of education				0.974
Less than high school	0.650	0.505–0.837	0.001*	
High school	0.687	0.512–0.922	0.012*	
Higher than high school	0.725	0.598–0.878	0.001*	
Poverty-to-income ratio				0.134
<1.3	0.620	0.493–0.780	<0.001*	
1.3–3.5	0.693	0.548–0.875	0.002*	
≥3.5	0.693	0.523–0.917	0.010*	
Smoking				0.519
Never	0.734	0.617–0.874	0.001*	
Former	0.662	0.490–0.894	0.007*	
Current	0.686	0.495–0.950	0.023*	
Alcohol use				0.591
Yes	0.706	0.592–0.843	<0.001*	
No	0.718	0.580–0.888	0.002*	
Hypertension				0.694
Yes	0.672	0.554–0.814	<0.001*	
No	0.739	0.607–0.900	0.003*	
Diabetes				0.437
Yes	0.810	0.584–1.124	0.207	
No	0.682	0.587–0.792	<0.001*	
Borderline	0.511	0.193–1.354	0.177	
Depression				0.093
Yes	0.951	0.664–1.362	0.783	
No	0.674	0.581–0.781	<0.001*	
Vaginal deliveries				0.353
Yes	0.723	0.618–0.847	<0.001*	
No	0.526	0.366–0.757	0.001*	
Cesarean deliveries				0.807
Yes	0.609	0.441–0.841	0.003*	
No	0.715	0.558–0.916	0.008*	
Macrosomia				0.765
Yes	0.731	0.513–1.041	0.083	
No	0.683	0.579–0.805	<0.001*	
Hysterectomy				0.417
Yes	0.629	0.486–0.816	<0.001*	
No	0.724	0.617–0.849	<0.001*	

(Cont'd...)

Table A1. ***(Continued)***

Notes: [a]Adjusted for age, race, education level, BMI, Poverty-to-income ratio, hypertension, diabetes, smoking, alcohol consumption, depression, vaginal delivery, cesarean delivery, macrosomia, and hysterectomy, except the subgroup variable. *$p<0$.

Abbreviations: 95% CI: 95% confidence interval; BMI: Body mass index.