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Research Article

Exploring the Relationship Between Urolithiasis and Hypertension: A Cross-Sectional Study

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Abstract

Background: Urolithiasis and hypertension are prevalent and clinically significant conditions in the Middle East, both influenced by shared metabolic and environmental risk factors. Understanding the potential association between them is important for guiding prevention strategies. ***Objective***: To explore the relationship between urolithiasis and hypertension in a sample of Iraqi adult patients. ***Methods***: A cross-sectional observational study was conducted at Al-Kindy Teaching Hospital, Baghdad, from September 2024 to March 2025. Participants included 237 patients with confirmed urinary tract stones and 244 controls confirmed to be stone-free, matched for age and sex. Exclusion criteria included secondary hypertension, chronic kidney disease (stage 3 or higher), pregnancy, and metabolic or hormonal disorders likely to alter the blood pressure. Blood pressure status was determined via history and repeated measurements. BMI and demographic data were collected. Statistical analysis included chi-square, Mann-Whitney U, and logistic regression models. ***Results***: Hypertension was significantly more prevalent in the urolithiasis group than in the controls. Patients with urolithiasis also had significantly higher BMI. However, after adjusting for age and BMI, urolithiasis was no longer significantly associated with hypertension (OR=0.63; 95% CI: 0.39–1.01; p=0.056), while both age and BMI remained significant predictors of hypertension (p<0.001). ***Conclusions***: Although a higher prevalence of hypertension was observed among patients with urolithiasis, this association was not statistically significant after adjusting for age and BMI. These findings suggest that shared risk factors, particularly obesity, may mediate the observed relationship.

Keywords: Body Mass Index, Hypertension, Renal stones, Risk factors, Urolithiasis.

استكشاف العلاقة بين حصوات المسالك البولية وارتفاع ضغط الدم: دراسة مقطعية

الخلاصة

الخلفية: تُعد حصوات المسالك البولية وارتفاع ضغط الدم من الحالات الشائعة والهامة سريريًا في الشرق الأوسط، حيث يتأثر كلاهما بعوامل خطر أيضية وبيئية مشتركة. يُعد فهم العلاقة المحتملة بينهما أمرًا بالغ الأهمية لتوجيه استراتيجيات الوقاية. **الهدف:** هدفت هذه الدراسة إلى استكشاف العلاقة بين حصوات المسالك البولية وارتفاع ضغط الدم لدى عينة مقطعية من المرضى البالغين. **الطرائق:** أجريت دراسة رصدية مقطعية في مستشفى الكندي التعليمي ببغداد، في الفترة من سبتمبر 2024 إلى مارس 2025. شمل المشاركون 237 مريضًا مصابين بحصوات في المسالك البولية، و244 مريضًا من مجموعة الضبط، وتأكد خلوهم من الحصوات، مع مراعاة العمر والجنس. وشملت معايير الاستبعاد ارتفاع ضغط الدم الثانوي، وأمراض الكلى المزمنة (المرحلة الثالثة أو أعلى)، والحمل، والاضطرابات الأيضية أو الهرمونية التي يُحتمل أن تُغير ضغط الدم. تم تحديد حالة ضغط الدم من خلال التاريخ المرضي والقياسات المتكررة. كما جُمعت بيانات مؤشر كتلة الجسم والبيانات الديموغرافية. **النتائج:** كان ارتفاع ضغط الدم أكثر انتشارًا بشكل ملحوظ في مجموعة حصوات المسالك البولية مقارنةً بالمجموعة الضابطة (38% مقابل 26%، (P= 0.008). كما كان لدى مرضى حصوات المسالك البولية مؤشر كتلة جسم أعلى بشكل ملحوظ، (P= 0.026). ومع ذلك، بعد تعديل العمر ومؤشر كتلة الجسم، لم يعد حصوات المسالك البولية مرتبطة بشكل كبير بارتفاع ضغط الدم (OR = 0.63; 95% CI: 0.39–1.01; P=0.056)، بينما ظل كل من العمر ومؤشر كتلة الجسم مؤشرين مهمين لارتفاع ضغط الدم، (P<0.001). **الخلاصة:** على الرغم من ملاحظة ارتفاع معدل انتشار ارتفاع ضغط الدم بين مرضى حصوات المسالك البولية، إلا أن هذا الارتباط لم يكن ذا دلالة إحصائية بعد تعديل العمر ومؤشر كتلة الجسم. تشير هذه النتائج إلى أن عوامل الخطر المشتركة، وخاصة السمنة، قد تتوسط العلاقة المرصودة.

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INTRODUCTION

Urolithiasis is a fairly common condition in the Middle East, with the chance of having clinically silent stones at 3.4%, and the lifetime expectancy of having symptomatic urolithiasis is 50 times higher compared to that in the West [1,2]. Urolithiasis poses a significant burden on healthcare facilities since it is responsible for a large proportion of the urology surgical procedures, with increasing cost over the last few years [3]. Urinary stones can result from a combination of variable hereditary, environmental, and metabolic factors [4]. Hypertension, on the other hand, is prevalent in the Middle East, with an overall prevalence in adults of more than 24% that tends to affect older individuals more than young people [5]. The multifactorial nature of hypertension gives genetic, environmental, metabolic, and developmental determinants a key role in the development of hypertension [6]. Due to the complex multifactorial risk factors for both hypertension and urolithiasis, along with their relatively high prevalence, it is crucial to investigate the relationship between them. The aim

of this study is to investigate the relationship between these two conditions.

METHODS

Study design and sample selection

This cross-sectional observational study was conducted in Al-Kindy Teaching Hospital in Baghdad. The study involved two groups: the first group included patients attending the urology outpatient clinic in the hospital and diagnosed with a current renal or ureteric stone confirmed by ultrasonography of the abdomen or computerized tomography scan (CT scan). The control group was recruited from patients who attended the outpatient clinics of the hospital for causes other than hypertension and urolithiasis and were confirmed to be stone-free by abdominal ultrasonography or CT scan of the abdomen with no history of urinary tract stones. Participants were recruited consecutively using a convenient sampling method over 7 months (from September 2024 to March 2025). Efforts were made to match the number in both groups.

Inclusion and exclusion criteria

For both groups, eligible participants were required to be at least 18 years old and sign informed consent before inclusion. Participants with incomplete records, known causes of secondary hypertension (e.g., corticosteroid use, endocrine or metabolic abnormality, renal artery stenosis, etc.), chronic kidney disease stage 3 or higher, or pregnant women were excluded. In addition, participants with conditions that may affect body weight (e.g., bariatric surgery, medications, hormonal or metabolic disorders, etc.) were excluded. In addition, patients with vesical stones without evidence of upper urinary tract stones were also excluded.

Data collection and outcome measurement

Data were collected from the participant using direct interview, history taking, clinical examination, and revision of the investigations. Collected data included demographic data, history of urinary tract stones, current presence of urinary tract stones, height, and weight. The participant is considered hypertensive if he is diagnosed with hypertension and is taking treatment or lifestyle measures to reduce his blood pressure. For those who are not diagnosed with hypertension, blood pressure measurement was taken, and if it is elevated, another measurement is taken at least 24 hours later or in the next follow-up visit. If both readings are high (more than 140/90), then the patient is considered to have hypertension. If either reading is within normal, the participant is considered normotensive.

Ethical consideration

The study was conducted in compliance with the Helsinki Declaration and its later amendments. Written consents were obtained from all the participants. The study was approved by The Scientific Unit and the Medical Ethics Committee of Al-Kindy College of Medicine during its 11th meeting on April 29, 2025.

Statistical analysis

Data was entered initially into Microsoft Excel and transferred to Statistical Package for Social Sciences (SPSS) V25 for analysis. The Shapiro-Wilk test is used to test the normality of distribution. Medians and interquartile ranges are used to present continuous variables, and frequencies and percentages are used for categorical variables. Chi-square is used to examine the association between categorical variables. The Mann-Whitney U test is used to analyze the association between continuous variables. A *p*-value of less than 0.05 is considered statistically significant.

RESULTS

Data were collected from a total of 269 patients with urinary tract stones; among these, 32 patients were excluded (7 patients had only vesical stones, 2 were pregnant ladies, 1 patient had a history of gastric sleeve surgery, 1 patient had thyroid dysfunction, 5 patients had grade 3 CKD or higher, 6 patients had incomplete records, and 9 patients missed the second visit for blood pressure measurement). The valid patients who were included were 237 patients. In the control group, 270 participants were recruited, of whom 25 were excluded (13 participants missed the second visit for blood pressure measurement, 7 participants had incomplete records, 3 were on steroids, 1 had a history of bariatric surgery, and 2 had thyroid dysfunction). The valid participants who were included as the control group were 244, making a total of 481 participants. The sex distribution of the two groups was comparable, with no statistically significant difference, as shown in Table 1.

Table 1: Sex distribution of patients with urinary tract stones and the control group

		Sex		Total	*p*-value
		Female	Male		
Urolithiasis	Yes	93	144	237	0.305*
	No	107	137	244	
Total		200	281	481	

*Chi-Square test.

In the same way, the ages of the two groups were also comparable, with no statistically significant difference. However, there was a slight difference between the two groups regarding their body mass index, as patients with urinary tract stones had a higher BMI compared to the control group, with a *p*-value of 0.026 (Table 2). The ages of the two groups were also comparable, with no statistically significant difference (Table 2). However, there was a slight difference between the two groups regarding their body mass index, as patients with urinary tract stones had a higher BMI compared to the control group, with a *p*-value of 0.026.

Table 2: Age and BMI of the urolithiasis patients and the control group

	Urolithiasis Patients		Control		*p*-value*
	Medians (interquartile ranges)	Range	Medians (interquartile ranges)	Range	
Age	40(28)	18-89	40(25.75)	18-92	0.612
BMI	28.54(4.325)	17.84-49.67	27.525(5.02)	17.8-45.79	0.026

*Mann-Whitney U test.

On direct analysis, patients with urinary tract stones were found to have a significantly higher prevalence of hypertension compared to the control group (*p*-value = 0.008), as shown in Table 3.

Table 3: The association between hypertension and urolithiasis

		Hypertension		Total	*p*-value
		Yes	No		
Urolithiasis	Yes	89(38)	148(62)	237	0.008*
	No	64(26)	180(74)	244	

Values were expressed as frequency and percentage. *Chi-Square test.

In a multivariable logistic regression model, both age and body mass index (BMI) were significantly associated with the outcome (both with *p*-values < 0.001). Each one-year increase in age increases the odds of hypertension by 9% (odds ratio = 1.09). Also, each one-unit increase in BMI increases the odds of hypertension by 18% (odds ratio = 1.18). On the other hand, when adjusted for age and BMI, urolithiasis reduces the odds of hypertension (odds ratio = 0.63); however, this association did not reach statistical significance ($p = 0.056$) (Table 4). These findings suggest that urolithiasis is associated with an increased risk of hypertension; however, when adjusted for age and body mass index, the association loses its statistical significance.

Table 4: Association of urolithiasis, age, and BMI with hypertension in multivariate analysis

Variable	B (Standard error)	Odds ratio (95% CI)	*p*-value*
Urolithiasis	–0.465(0.243)	0.63(0.39–1.01)	0.056
Age (per year)	0.085(0.009)	1.09(1.07–1.11)	<0.001
BMI (per unit)	0.168(0.028)	1.18(1.12–1.26)	<0.001

*Logistic regression.

DISCUSSION

The aim of this study was to explore the association between urolithiasis and hypertension. On initial assessment of the participant, the study found that on average, patients with urolithiasis have a BMI higher than that of the control group. The study showed a significantly higher prevalence of hypertension among patients with urolithiasis compared to controls. However, after adjusting for age and BMI, the association between urolithiasis and hypertension lost its statistical significance, suggesting that age and BMI are stronger predictors of hypertension in this population. This study's findings regarding the patients' higher BMI compared to the control group were consistent with those of Taylor et al., who found that individuals with obesity and weight gain are at higher risk for urinary tract stone formation [7]. Likewise, a systematic review by Carbone *et al*. found a consistent relationship between obesity and urinary tract stone formation [8]. A prospective study by Kittanamongkolchai *et al*. found that urinary tract stone formers are more likely to develop hypertension on follow-up. Yet, the same study showed similar baseline prevalence of hypertension between patients with urinary tract stones and their BMI- and age-matched controls [9]. These findings differ from the results of the current study, which showed a higher point prevalence of hypertension among those with urinary tract stones. The difference is probably owed to the fact that the current study does not match the BMI on recruitment, which results in a higher BMI in urolithiasis patients and the associated higher prevalence of hypertension, as the association between the higher BMI and hypertension is well documented [10]. The complex mechanisms underlying urolithiasis, obesity, and hypertension are complex and multifactorial [9,11]. Interestingly, in our study, the association between urolithiasis and hypertension became non-significant after adjusting for age and BMI. This suggests that age and body composition may act as confounders or mediators in this relationship. BMI, in particular, is a known risk factor for both hypertension and urolithiasis. Elevated BMI contributes to changes in urine composition, thereby promoting stone formation [8]. At the same time, the increase in body fat is associated with hypertension through mechanisms that may involve sympathetic nervous system activation and renin-angiotensin-aldosterone system dysregulation [11]. The strengths of this study are that it recruits a well-matched control group from the same location, and it adjusts its findings for major confounding factors. However, it was limited by its cross-sectional design, which limits its capability to anticipate causality. Also, some exclusions due to missing data and loss to follow-up may have introduced selection bias. Furthermore, the absence of analysis of stone composition and data about the duration of hypertension may influence the association.

Conclusion

Patients with urolithiasis exhibit a higher prevalence of hypertension compared to non-stone formers. However, this association fails to maintain statistical significance when adjusted for age and BMI. These findings magnify the importance of managing shared risk factors such as obesity in patients with urolithiasis. Prospective studies are needed to further elucidate the causal relationships between these two common conditions.

Conflict of interests

The authors declared no conflict of interest.

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Data sharing statement

Supplementary data can be shared with the corresponding author upon reasonable request.

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