

The Epidemiology of Urolithiasis in an Ethnically Diverse Population Living in The Same Area

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Purpose: Little is known about whether migrants retain the risk of urolithiasis seen in their indigenous populations. We sought to evaluate the risk of renal colic between different ethnic groups among a diverse population in London.

Materials and Methods: Data on a cohort of 100 consecutive patients presenting to our emergency department with acute renal colic over a 6 month period was collected retrospectively. Data was extracted from electronic patient record review, trust data and the 2011 census. Risk ratios were calculated and comparisons between groups were made with Chi-Squared test using SPSS.

Results: The odds of renal colic among Turkish (odds ratio (OR) 6.57, 95% confidence interval (CI) 3.31–13.04, $P < .001$), Bulgarian (OR 4.94, 95% CI 1.82–13.44, $P = .001$), Romanian (OR 4.53, 95% CI 2.10–9.77, $P < .001$), Indian (OR 2.42, 95% CI 1.17–4.98, $P = .013$) and Pakistani (OR 2.25, 95% CI 1.38–3.67, $P = .001$) patients were significantly higher than the population average. The odds of colic among Black-Caribbean (OR 0.27, 95% CI 0.07 – 1.07, $P = .045$), Black-African (OR 0.27, 95% CI 0.07–1.07, $P = .046$), White-British (OR 0.44, 95% CI 0.30 – 0.66, $P < .001$) patients were significantly lower than the general population.

Conclusion: This study suggests that migrants from countries known to have higher incidence of urolithiasis tend to retain this increased risk once in London. Such ethnic groups may benefit from targeted intervention to reduce the incidence of stone disease. Further research is needed with greater numbers in a range of populations to confirm this hypothesis.

Keywords: Epidemiology; Ethnicity; London; Urolithiasis

INTRODUCTION

Urolithiasis is the third commonest urological disease behind urinary tract infections and prostatic pathology⁽¹⁾. Worldwide, the prevalence of urolithiasis varies from 2 to 20%^(1,2,7-13,15,16,19). The causes of this variation in the burden of urinary stone disease are largely unknown. Possible contributory factors include a combination of genetic and environmental factors including diet, climate and socioeconomic status. Studies examining the effect of climate on urolithiasis have shown that the incidence is higher among populations living in warmer climates than those in colder climates⁽²⁾. Higher incidence and prevalence rates are also seen in affluent developed countries compared to poorer developing nations⁽³⁾, which may be due to differences in diet with wealthier populations eating higher levels of salt, protein, calcium and purines. The observation of familial clustering of urolithiasis suggests a genetic basis to its occurrence⁽⁴⁾. The quest to identify specific genetic variants responsible for heritability of the most common form of urolithiasis, idiopathic calcium oxalate urolithiasis, has focused on genes involved in calcium metabolism⁽⁴⁾. Many genetic vari-

ants have been identified that convey increased risk of developing kidney stones suggesting that it is due to the interaction of multiples genes and their interplay with dietary and environmental risk factors. Specific mutations have been identified in rarer forms of urolithiasis including Dent's Disease, Familial Hypomagnesemia with Hypercalciuria and Nephrocalcinosis, Hyperoxaluria and Cystinuria⁽⁴⁾. The knowledge of these mutations has meant that not only is earlier diagnosis and treatment in these individuals preventing renal failure but it is also providing clues for identifying possible genetic variants responsible for polygenic forms of the urolithiasis. Other factors known to predispose to urinary stone disease include medical conditions such as diabetes, hypertension, hyperparathyroidism, metabolic syndrome, gout and chronic UTIs⁽⁵⁾. Drugs such as the antiretrovirals indinavir and atazanavir or the immunosuppressive, sulfasalazine, are known to increase the risk of stone formation⁽⁵⁾. Little is known about the occurrence of urolithiasis among migrants within a population. Unanswered questions include whether migrants retain the risk of their native population, or take on the risk of the indigenous population, and how the relative risk is among

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Table 1. Descriptive statistics of ethnicity among local population and renal colic population.

Ethnicity	Population N (1000s)	Population %	Stone population N	Stone population %	Mean age Years	Min	Max
White	168	64	44	44	52.88	22	91
Pakistan 26.3	10	20	20	45.23	27	101	
Caribbean	18.8	7	2	2	48.00	44	52
Black African	18.8	7	2	2	47.50	47	48
Indian	9.1	3	8	8	42.50	23	56
Polish	8.2	3	1	1	66.00	66	66
Romanian	4.3	2	7	7	35.29	22	56
Turkish 3.9	1	9	9	38.78	25	75	
Lithuanian	3.2	1	3	3	38.00	28	45
Bulgarian	2.2	1	4	4	37.75	30	45

different ethnic groups within a mixed population. In an ethnically diverse population, such as East London, such questions have implications for targeting intervention to modify lifestyle factors among a mixed population, or allocating resources to particular ethnic groups. The aim of the present study was to assess the relative risk of urolithiasis by ethnicity in the local population. Our aim was to define the ethnic variation in the stone population, and in the local population, and use this to calculate the odds of urolithiasis among different ethnic groups.

MATERIALS AND METHODS

Setting

We performed a retrospective cohort study of all patients diagnosed with renal colic presenting at the Emergency Department of a busy London district general hospital between July and December 2012. The Emergency department at our institution serves an ethnically diverse population of 350,000 patients in the London borough of Waltham Forest⁽⁶⁾. Ethnicity was defined as a category of people who share the same cultural heritage and a commitment to the ideas, norms and material things that constitute that heritage⁽²⁾. Details of the size and ethnicity of the Waltham Forest population was derived from 2011 UK census data and pop-

ulation statistics held by Waltham Borough council⁽³⁾.

Cases

Cases were identified from hospital electronic records. Demographic data and laboratory test results were collected from electronic records and patient notes. The findings of radiological investigations were derived from the PAC system. Information on patients' ethnicity was taken from hospital electronic records. Where ethnicity was not specified, patient names were entered into an internet search engine of ethnicity.

Statistical analysis

Following data tabulation, descriptive statistics were calculated using Microsoft Excel. Risk ratios were calculated, comparisons for ethnic groups were made with Chi-Squared test and one-way ANOVA, using SPSS. Statistical significance was defined as $P < .05$.

RESULTS

100 consecutive patients were identified as having presented with acute renal colic during the study period. The mean age at presentation was 42 years (range 18-98) and the male:female ratio was 2.5 (72:28). Urinary tract calculi were identified in 79 patients. For diagnosis, X-ray KUB was carried out in 97 patients (96%), 72.3 (71%)

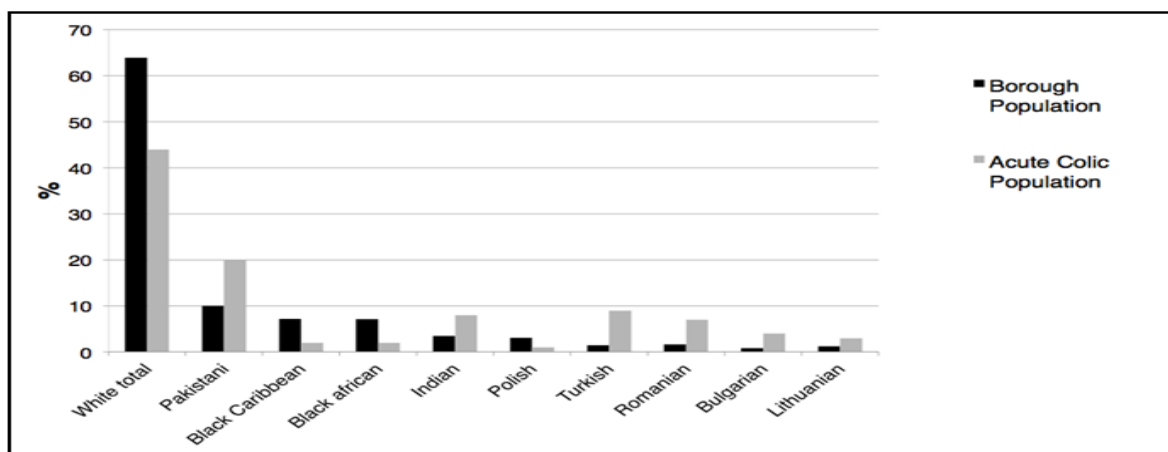


Figure 1. Prevalence of different ethnic groups among local borough population (black bars) and renal colic patients (grey bars).

patients had an intravenous urogram, and 64 (63.4%) had a non-contrast low dose computed tomography (CT) KUB. 36 (35.6%) patients had all three investigations, 24 (23.7%) patients had an X-ray and an intravenous urography (IVU), 25 (24.8%) patients had an X-ray and a CT KUB, 1 (1%) patient had an IVU and a CT KUB, 2 (2%) patients had just an X-ray KUB, 2 (2%) just a CT and 1 (1%) had just an IVU. Unilateral ureteric obstruction was present in 55 patients with a left:right ratio of 0.9 (26:29), with bilateral calculi in one patient.

Table 1 and **Figure 1** present data on the ethnic groups of the local population and of patients presenting with acute renal colic. The majority of patients with colic were of white ethnic origin (44%) with others of Pakistani (20%), Turkish (9%), Indian (8%), Romanian (7%), Bulgarian (4%), Lithuanian (3%), Black Caribbean (2%), Black African (2%) and Polish (1%) ethnicity. The majority of the local population were white (64%), with other groups including Pakistani (10%), Black Caribbean (7%), Black African (7%), Indian (3%), Polish (3%), Romanian (2%), Turkish (1%), Lithuanian (1%) and Bulgarian (1%) ethnic origin. Data on the average age of the stone population in each ethnic group is displayed in **Table 1**. There was no statistically significant difference between the groups on ANOVA analysis ($P = .126$).

Figure 2 present data on the odds ratio of having colic vs. not having colic for each ethnic group. The odds of Turkish (odds ratio (OR) 6.57, 95% CI: 3.31–13.04, $P < .001$), Bulgarian (OR 4.94, 95% CI: 1.82–13.44, $P = .001$), Romanian (OR 4.53, 95% CI: 2.10–9.77, $P < .001$), Indian (OR 2.42, 95% CI: 1.17–4.98, $P = .013$) and Pakistani (OR 2.25, 95% CI: 1.38–3.67, $P = .001$) ethnic groups presenting with colic were significantly higher than their representation in the local population (**Figure 2**). The odds of being Black-Caribbean (OR 0.27, 95% CI: 0.07–1.07, $P = .045$), Black-African (OR 0.27, 95% CI: 0.07–1.07, $P = .046$), White (OR 0.44, 95% CI: 0.30–0.66, $P < .001$) were significantly less likely among the acute renal colic population compared to the local borough population (**Figure 2**). The odds of Lithuanian (OR 2.51, 95% CI: 0.8–7.93, $P =$

.10) or Polish (OR 0.31, 95% CI: 0.04–2.25, $P = .22$) patients being present in the acute renal colic population compared to the Waltham Forest borough population were not statistically significant (**Figure 2**).

Discussion

The results of this study show that migrants of South Eastern European and Southern Asian ethnicity who live in Waltham Forest are more likely to have urolithiasis compared to individuals of Caribbean, African or White British ethnic origin living in the same borough. These findings are consistent with previous research on the epidemiology of urolithiasis^(1,2,7-13,15,16,19). The results of the present study suggest that migrants from Turkey are more likely to present with acute renal colic than people of other ethnicities. This would support research that shows Turkey to have one of the highest prevalence rates in the world. A nationwide survey of 1500 individuals from across Turkey in 1991 concluded that Turkey had a prevalence of urolithiasis of 14.8%⁽⁷⁾. (**Table 2**) A higher quality cross sectional study in 2011 which surveyed 2468 individuals in Turkey refined this figure to 11.1% but it remains amongst the highest prevalence rates in the world⁽¹⁾. A recent review of 34 separate studies detailing the incidence and prevalence of kidney stones across a number of countries reported that other regions with a high prevalence of urolithiasis include North East Thailand (16.9%) and Taiwan (9.6%)⁽⁸⁾. These countries make up part of the Afro-Asian stone-forming belt which is characterised by a higher prevalence of urolithiasis compared to adjacent countries within their continents⁽⁹⁾. The Afro-Asian stone belt includes Sudan, Egypt, Saudi Arabia, Iran, Pakistan and India. The results from the present study suggest that migrants from India and Pakistan retain this increased risk of developing a urolithiasis after having moved to a new country. This theory is supported by research carried out amongst migrant workers in Saudi Arabia which found that migrants from India and Pakistan were more likely to present with renal colic than local workers⁽¹⁰⁾. As well as an Afro-Asian stone forming belt, there is

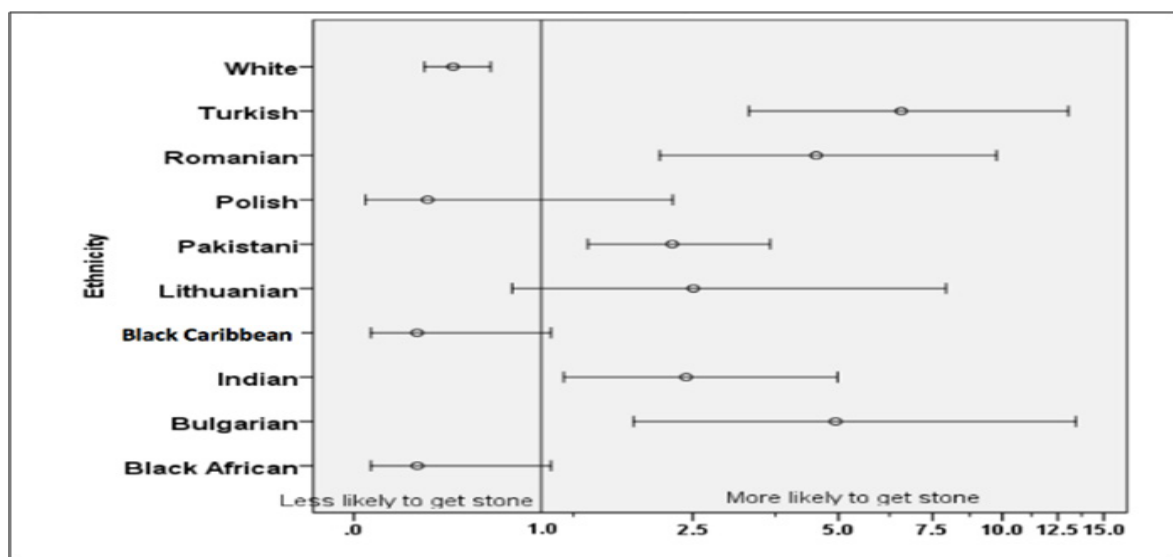


Figure 2. Forest plot for odds ratio of acute colic by ethnic group compared to general population.

Table 2. Review of the literature on the prevalence of urolithiasis for ethnic groups in their own countries.

Ethnicity	Prevalence (%)	Author
White	3.8-5.9	Hesse et al. [11] Stamatelou et al. [7]
Pakistan	4-20	López et al. [9]
Caribbean	No estimate	-
Black African	1.7	Stamatelou et al. [7]
Indian	4-20	López et al. [9]
Polish	No estimate	-
Romanian	No estimate	-
Turkish	11.1-14.8	Musulmanoglu et al. [1] Romero et al. [8]
Lithuanian	No estimate	-
Bulgarian	No estimate	-

also a South Eastern stone belt in the United States⁽⁹⁾ where the prevalence of urolithiasis is estimated to be 9.2%⁽¹¹⁾ compared to 5.2% in the rest of the county⁽⁷⁾. These figures were calculated from examination of the United States National Health and Nutrition examination survey by Stamatelou. Stamatelou's analysis of this nationwide survey of 16,115 individuals also revealed that African Americans had a lower prevalence of urolithiasis (1.7%) compared to individuals of White ethnicity (5.9%). This finding is supported by another study by Akoudad that suggest that African Americans have a lower risk of urolithiasis than white individuals⁽¹²⁾. A review of peer-reviewed journal articles by Romero et al. found prevalence rates for urolithiasis ranging from between 2 and 20% worldwide⁽⁸⁾. However, there is no mention in the literature on the prevalence or incidence for renal colic for five ethnic groups included in this study^(1,2,7-13,15,16,19). Evidence is lacking on urolithiasis epidemiology for Polish, Romanian, Bulgarian, Lithuanian and Black Caribbean ethnic groups and needs further research. The majority of patients in our study were men (male to female ratio of 2.5), which is in agreement with previous reports of gender prevalence in stone disease⁽¹³⁾. More recent studies, however, have suggested that the male to female ratio in urolithiasis is decreasing, possibly because of changing lifestyle factors such as diet⁽¹⁴⁾. Lieske et al. found that over the past 30 years the male to female ratio has dropped from 3.1 to 1.3⁽¹⁵⁾. In a critical review on the epidemiology of urolithiasis, Rodgers⁽²⁾ reviewed 33 papers comparing stone occurrence between ethnic groups. Over a third of the papers compared Black South Africans with White South Africans while five studies compared urolithiasis prevalence between White and African American groups. The remaining papers compared stone prevalence in a diverse selection of ethnic groups from across the globe. He identified three different types of study in his review in order to explain why urolithiasis varies by ethnicity. "Weak" studies described differences in stone occurrence between ethnic groups of patients without attempting to explain the differences,

"soft" studies speculated on possible reasons for the different prevalence rates such as undefined environmental, socio-economic, dietary, genetic and hormonal factors. "Hard" studies accounted for differences with empirically measured lithogenic risk factors. Rodgers would classify this study as weak. While the results show that there is increased chance of being Turkish, Bulgarian, Romanian, Indian and Pakistani in the acute colic population compared to the local population in Waltham Forest, no attempt has been made to investigate why other than to suggest that ethnicity is likely to play a part in the pathogenesis of urolithiasis. The measurement of lithogenic risk factors among ethnic groups presenting with acute colic could be measured in future work.

Limitations

The prevalence and incidence of urolithiasis cannot be accurately derived from our study data as acute colic represents only a fraction of the stone burden in the population. This is likely to be an underestimate of stone burden because some stones are asymptomatic so there will be no presentation to the emergency department. Furthermore, the retrospective nature of data collection and small sample size means our conclusions may not be generalizable to other centers that may have a different migrant population and environment. A potential strength of this study is that by taking a population from one geographical location, environmental factors such as socio-economic situation and climate are broadly similar across the study population. Therefore, any differences seen in the results are more likely to reflect differences in ethnicity i.e. cultural heritage. Other potential confounding factors not accounted for are weight, body mass index, diet, occupation, medication (atazanavir for the treatment of HIV), predisposing medical conditions (Bone disease, Diabetes, Cardiovascular disease, Gout, Vitamin D receptor (VDR) genotypes, Obesity, Hypertension, Menopause, Pregnancy), family history of stone disease, or time since migration, which are known to affect the incidence of urolithiasis⁽¹⁶⁾. Furthermore, patterns of migration change over time, which could affect the average length of time particular ethnic groups have lived in the UK. This could introduce a bias if there is an effect on stone disease, for example, up until the 2001 census, Ireland, India and Pakistan had been the most common countries of birth of non-British residents in the UK. However, in 2011 India, Poland and Pakistan were the most common⁽¹⁷⁾. Therefore, on average, the Indian and Pakistani born population might have been living for longer in the UK than those from Poland, which might have an effect on their stone prevalence. Future research with a larger, prospective study that includes data on diet, occupation, type of stone and urinary characteristics might better account for these factors. The results of this study may provide evidence with which healthcare interventions can be targeted more effectively. For example, patient education on stone prevention could be targeted to particular ethnic groups. Treating stones is costly, in the United States it cost \$3.79 billion in 2007⁽¹⁸⁾, so identifying ethnic groups within our local borough who may benefit most from further research and education could be of benefit in both economic and health terms. The results of this study may be of use in emergency departments where the ethnicity of patients could be

used to help assess risk of urolithiasis in patients presenting with acute abdominal or loin pain. Furthermore, educating general practitioners and local community leaders on preventative measures in areas where there is a higher stone prevalence might help to reduce the number of patients presenting with acute renal colic. Additionally, relatives of individuals who have urinary tract calculi should be made aware of the genetic inheritability so that they can make informed of lifestyle changes that could reduce their risk of urolithiasis. The findings from this paper add further weight to previously held thoughts on the epidemiology of urolithiasis. In particular it supports the theory that individuals of Turkish ethnicity have a higher risk of urolithiasis compared to other ethnic groups and may retain this risk following migration. This paper also adds data on stone occurrence in five ethnic groups which is lacking in the current literature. In a world where migration is becoming increasingly common, this paper could provide a useful starting for future studies on the epidemiology of urolithiasis in migrants.

Conclusions

The cause of urolithiasis is multifactorial. Ethnicity is one factor of many that influences the likelihood of a person developing urolithiasis. Investigating an ethnically diverse population living in the same area could prove interesting in eliminating differences in environmental factors such as climate that influence the pathogenesis of urolithiasis. However, how migrant populations retain preexisting environmental factors, such as diet, is variable so using ethnicity as a proxy for genetic factors may not be reliable.

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