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Research Article

Trend of Incident Kidney Stone Disease in a Large Managed Care Organization 1997-2007

Tang J[1,2]*, Holmen J[3], Keniston A[2] and Chonchol MB[1]

[1]Division of Renal Disease and Hypertension, University of Colorado School of Medicine, USA

[2]Department of Medicine, Denver Health and Hospital Authority, USA

[3]Homer Warner Center for Informatics Research, Intermountain Healthcare, USA

***Corresponding author:** Tang J, Division of Renal Disease and Hypertension, University of Colorado School of Medicine, Aurora, CO 80045, USA, Tel: +1 303 602 5047; Fax: +1 303 602 5055; Email: Jie.tang@ucdenver.edu

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Abstract

Objective: Recent trend of incident kidney stone disease in the U.S. population is not clear. We aim to determine the incidence trend through time in an integrated healthcare system serving a defined geographical region.

Methods: Incident kidney stone rates were obtained using the Intermountain Healthcare Data Warehouse. Intermountain Healthcare is a healthcare organization that serves over 2 million Utah residents. Incident stone formers were defined as patients having first ever diagnosis of kidney stone disease and were identified by ICD9 codes 592.0, 592.1 & 592.9 assigned from 1997 to 2007. Negative binomial regression analyses were used to examine the incidence trend.

Results: 53,045 incident stone formers were identified. Adjusted for age, gender, race and imaging use, there were no significant changes in kidney stone incidence rates from 1997 (0.49%) to 2007 (0.52%), p=0.2. For men, the age, race and imaging use adjusted incidence rates were stable from 1997 (0.67%) to 2007 (0.63%), p=0.9. For women, the adjusted incidence rates also did not change significantly from 1997 (0.35%) to 2007 (0.44%), p=0.3. Furthermore, the age, gender and imaging use adjusted incident rates did not change significantly in any of the race categories (non-Hispanic white, non-Hispanic black and Mexican Americans) from 1997 to 2007.

Conclusions: Incident kidney stone rates did not change from 1997 to 2007 in our study population from Utah. The causes of these findings remain to be determined.

Keywords: Epidemiology; Incidence rate; Kidney stone

Introduction

Kidney stone disease is highly prevalent in industrialized countries [1-4]. The risk of kidney stone varies by age, gender, lifestyle factors and geographical locations [1]. Kidney stone disease causes significant morbidity among those affected [5], and has a major economic impact on health care systems [6].

According to earlier reports, both the incidence and prevalence of kidney stone disease appear to be rising in the United States. In a 25-year study from 1950 to 1974, investigators reported a significantly increased annual age-adjusted incidence rate, especially for men, in Rochester Minnesota [7]. According to the data from the United States National Health and Nutritional Examination Surveys (NHANES), kidney stone prevalence also increased from 3.8% in 1976-1980 to 5.2% in 1988-1994 [1], and it continues to rise and reached 8.8% in 2007-2010 [8]. The similar trend has been observed in other countries. Recently, an analysis of the adult population in Iceland from 1985 to 2008 showed a significant rise in the incidence of kidney stone disease in both genders from 1985 to 2008 [9]. A literature review of kidney stone incidence trend from existing international studies suggested that kidney stone incidence was increasing globally, and these increases were seen across sex, race, and age [10]. However, thus far, no studies have examined the incident kidney stone disease among adult US population during the last decade. Therefore we aim to examine the trend of incident kidney stone disease in a large integrated healthcare delivery system from 1997 to 2007.

Material and Methods

Study population

We examined the kidney stone incidence rates among all adult Utah residents (age ≥18) registered in the Intermountain Health Care (IHC) Data Warehouse between 1997 and 2007. It includes a total of 59,420,017 person-years of follow-up. This sample population is representative of the state of Utah population based on the comparison with 2010 US census data [11]. IHC is a large healthcare organization whose headquarter is based in Salt Lake City, Utah and it serves 2.4 million residents in Utah and southern Idaho. It includes 22 hospitals, and over 150 clinics and physicians' offices. Its data warehouse incorporates comprehensive electronic health and administrative data. The population from southern Idaho was not included in this study. The institutional review board at Intermountain Healthcare System and University of Colorado approved the project.

Assessment of incident kidney stones

Incident stone formers were defined as patients having first ever diagnosis of kidney stone disease and identified by ICD9 codes 592.0, 592.1 & 592.9 assigned from 1997 to 2007.

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Table 1: Kidney stone incidence rates 1997-2007.

Year	All	Women	Men	NHW	NHB	MA
1997	0.49%	0.35%	0.67%	0.49%	0.28%	0.26%
1998	0.48%	0.36%	0.64%	0.48%	0.31%	0.32%
1999	0.45%	0.35%	0.57%	0.45%	0.27%	0.29%
2000	0.47%	0.36%	0.61%	0.47%	0.14%	0.31%
2001	0.49%	0.40%	0.61%	0.48%	0.25%	0.36%
2002	0.52%	0.42%	0.65%	0.51%	0.33%	0.35%
2003	0.52%	0.43%	0.63%	0.51%	0.32%	0.40%
2004	0.53%	0.44%	0.64%	0.52%	0.24%	0.38%
2005	0.53%	0.46%	0.62%	0.51%	0.24%	0.32%
2006	0.51%	0.44%	0.61%	0.51%	0.29%	0.33%
2007	0.52%	0.44%	0.63%	0.51%	0.21%	0.38%

NHW: Non-Hispanic White; NHB: Non-Hispanic Black; MA: Mexican American

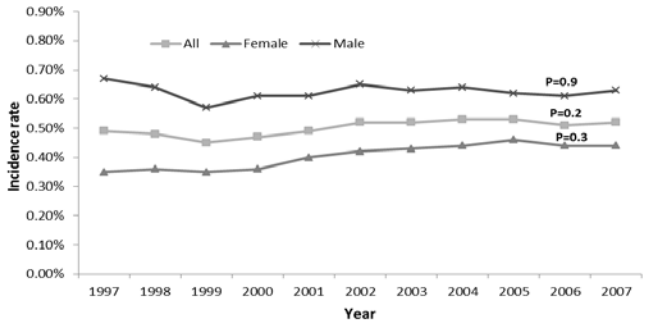

Figure 1: Kidney stone incidence rate trends from 1997 to 2007.

Imaging use

The abdominal imaging use has been attributed to the diagnosis of asymptomatic kidney stone cases. We tracked its use from 1997 to 2007 by the following CPT codes: 74150, 74160, 74170, 72192, 72193, 72194 (CT abdomen & pelvis with and without contrast), 76700, 76770, 76705 (ultrasound abdomen or kidney), and 87.7, 87.71, 87.72, 87.73, 87.74, 87.75, 87.76, 87.77, 87.78, 87.79 (X-ray of GU tract or pyelogram).

Data analysis

Patient populations in the IHC data warehouse from 1997 to 2007 were standardized to its 1997 population by age, gender and race. Age, gender and race-adjusted incidence rates for each calendar year were calculated by dividing the expected number of cases by the total patient population in that year. Negative binomial regression modeling was used to analyze the trend of kidney stone incidence rates over time after adjusting for age, gender, race and imaging use. All P-values are two-tailed. Data was analyzed using SAS Enterprise Guide 4.3 (SAS Institute, Inc., Cary, North Carolina).

Results

There were a total of 53,045 incident stone formers in the IHC Data Warehouse between 1997 and 2007. Adjusted for age, gender and race, kidney stone incidence rates were 0.49% in 1997 and 0.52% in 2007 (Table 1). This represented no significant change from 1997 to 2007 after additional adjustment for imaging use (p=0.2 for trend) (Figure 1).

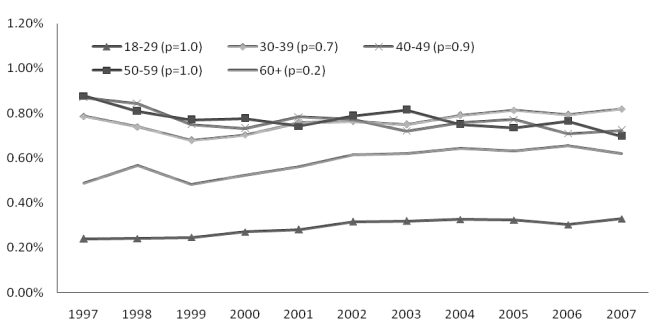

Figure 2: Kidney stone incidence rate trends among age groups from 1997 to 2007.

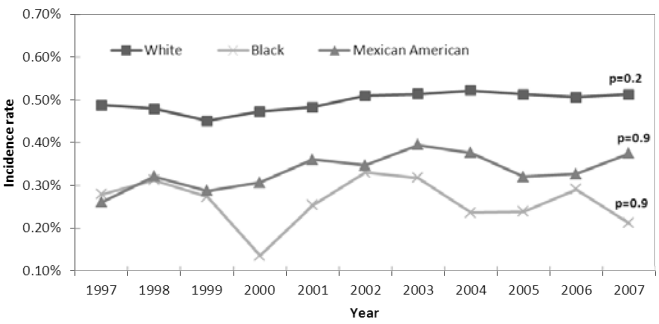

Figure 3: Kidney stone incidence rates across races 1997-2007.

Stratified by gender, age and race adjusted incidence rates for men were 0.67% and 0.63% in 1997 and 2007, respectively (Table 1). On average, incidence rates in men decreased by 0.6% per year (p=0.9 for trend after further adjustment for imaging use) (Figure 1). For women, age and race adjusted incidence rates were 0.35% and 0.44% in 1997 and 2007, respectively (Table 1). Incidence rates in women increased by 2.6% per year overall (p=0.3 for trend after adjustment for imaging use) (Figure 1). The incidence rate ratio of men to women decreased from 1.9 in 1997 to 1.4 in 2007. Incident stone rates in men peaked at ages 50-59 in 1997, and ages 30-39 in 2007. In women, incident rates were highest among ages 30-39 in both 1997 and 2007.

Stratified by age, gender and race adjusted incidence rates had no significant change from 1997 to 2007 among all age groups (Figure 2).

Stratified by race, age and gender adjusted incidence rates for non-Hispanic white (NHW) were 0.49% and 0.51% in 1997 and 2007, respectively (Table 1). Overall, incidence rates in NHW increased by an average of 0.4% per year (p=0.2 for trend after adjustment for imaging use) (Figure 3). The incident stone rates among NHW men peaked at ages 50-59 in 1997, and ages 40-49 in 2007, whereas the rates among NHW women peaked at ages 30-39 in both 1997 and 2007. For non-Hispanic blacks (NHB), the adjusted incidence rates were 0.28% in 1997 and 0.21% in 2007 (Table 1). There was no significant change from 1997 to 2007 (p=0.9 for trend after adjustment for imaging use) (Figure 3). The incident stone rates among NHB men peaked at ages 40-49 in both 1997 and 2007, whereas the rates among NHB women peaked at ages 60 and above in 1997 and at ages 50-59 in 2007. For Mexican Americans (MA), the corresponding adjusted rates were 0.26% and 0.38%, in 1997 and 2007 respectively (Table 1), which represented no significant change (p=0.9 for trend after adjustment for imaging use) (Figure 3). Like MA men, the incident stone rates

Table 2: Adjusted incidence rate ratio [95% Confidence Interval (CI)] of incident kidney stone disease in relation to time, age, gender and race.

Independent variable		No (cases)	Rate ratio	95% CI
Year	1997	3360	1.00	1.00 – 1.00
	2007	14891	1.13	0.95 – 1.34
Age	18-29	15207	1.00	1.00 – 1.00
	30-39	10002	1.91	1.73 – 2.11
	40-49	9742	2.01	1.82 – 2.23
	50-59	8174	2.05	1.84 – 2.28
	60+	9720	1.52	1.38 – 1.67
Gender	Women	23746	1.00	1.00 – 1.00
	Men	29021	1.77	1.65 – 1.89
Race	NHB	4471	1.00	1.00 – 1.00
	NHW	39040	1.98	1.60 – 2.45
	MA	18363	1.67	1.38 – 2.03

among MA women peaked at ages 50-59 and 40-49 respectively in 1997 and 2007. Finally, there were 23% of total cases under "other/undetermined" race category in 1997, and this same race category accounted for 20% of total cases in 2007.

Lastly, in Table 2 is depicted the adjusted incidence rate ratio (IRR) of incident kidney stone disease in relation to time, age, gender and race from negative binomial regression analyses. Compared to 1997, the IRR for incident stone disease in 2007 is 1.13 (95% CI 0.95-1.34). Compared to ages 18-29, older ages are associated with significantly increased risks of incident stone disease. Among all age groups, ages 50-59 have the highest risk (IRR 2.05, 95% CI 1.84-2.28). Compared to women, men have an IRR of 1.77 (95% CI 1.65-1.89). Finally, compared to NHB, NHW had an IRR of 1.98 (95% CI 1.60-2.45), whereas MA had an IRR of 1.67 (95% CI 1.38-2.03).

Discussion

To our knowledge, this is the first study examining the temporal trend of the incident kidney stone disease since year 2000 in a geographically defined US adult population served by an integrated healthcare delivery system.

In this study, we show a flat kidney stone incidence rates from 1997 to 2007 after adjusting for abdominal imagine use, both in men and women, regardless of age. Our result is consistent with an earlier report from Rochester MN [12], although in our study, we captured both symptomatic and asymptomatic cases. The result of our study is different from what has been observed in an adult population in Iceland. Edvardsson et al reported a significant rise in incident kidney cases from 1985 to 2008. However, the increase of stone incidence in their study was accounted for by the asymptomatic kidney stone cases, which coincided with a significant increase in the imagine use. Of note, the incidence rates in our study are more than those observed in Iceland. The differences in climate and diet might be the underlying causes.

Our study is not designed for the assessment of change in kidney stone prevalence rates. The kidney stone prevalence rate in 2007 was estimated at 6.15% (data not shown), which is consistent with a recent NHANES analyses by Scales and colleagues [8]. Interestingly, they reported a significant increase of kidney stone prevalence rates from 5.2% (1988-1994) to 8.8% (2007-2010). The causes for this rising prevalence trend are not clear. In addition to the increased imaging use which might increase the detection of asymptomatic kidney stones, whether there is any survival change over time among stone formers is not clear.

In addition to overall trend, we also examined stone incidence rates from people of different racial background. To our knowledge, this is the first study examining stone incidence trends in ethnic minorities, i.e., NHB and MA. Consistent with earlier stone prevalence study, we have shown a NHW racial predominance and the gap between NHW and other minority races remained the same since 1997. In all races, the incidence rates did not change significantly from 1997 to 2007 after adjusting for imaging use.

Finally, the rising stone incidence in women warrants further investigation. In fact, incidence rates in women increased more than men during the study period. This disproportional increase of stone incidences in women has also been noticed in earlier studies [12], and this increase in incidence occurred in all age groups (data not shown). Future studies of changes in diet and health habit among women will likely shed light on this important observation.

Our study has several limitations. First, we used the ICD 9 codes to capture incident kidney stone cases. In general, there is concern about the accuracy of data abstracted from billing records. However, Semins MJ and colleagues examined the use of administrative data for kidney stone disease, and demonstrated that ICD-9 coding is sufficiently valid [13]. Second, IHC data warehouse does not capture all the residents in Utah, though the study population is representative of the whole state population based on the comparison to 2010 U.S. Census Data. Third, the stability of IHC patient population from 1997 to 2007 was difficult to ascertain. Although there have been no significant changes in population demographics throughout the study period (data not shown). Fourth, we included both symptomatic and asymptomatic cases, in order to reflect the true kidney stone incidence trend. Although the results can be biased from increased using of imaging procedures during the study period, we adjusted imagine use in our final regression analyses. Fifth, IHC data warehouse does not contain dietary information, therefore unable to assess dietary impact on stone incidence trend. Finally, we do not have information regarding the type of kidney stone and urinary stone risk profiles among stone formers.

In conclusion, we show that kidney stone incidence rates have remained flat in a large health care organization from 1997 to 2007, regardless of gender and age. Future studies are needed to examine the underlying causes, including changes in dietary pattern.

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