Urol Res (2009) 37:305–310
DOI 10.1007/s00240-009-0215-3

ORIGINAL PAPER

Incidence of upper urinary tract stone during 15 years in Tajima area, Japan: a hospital-based study

Takeshi Takahashi · Akifumi Yamane · Kosuke Okasho · Takeshi Yoshikawa · Harutake Sawazaki · Syodo Wataru · Yoji Taki · Hideo Takeuchi

Received: 4 June 2009 / Accepted: 8 September 2009 / Published online: 25 September 2009

Abstract Time trend of incidence of upper urinary tract stone during 15 years was evaluated by hospital-based cohort study in Tajima area, northern part of Hyogo prefecture, Japan, which has only two general hospitals with Department of Urology. Due to isolation in terms of traffic network and geographic circumstances, almost all patients with urinary stone in Tajima area are referred to the two hospitals. During the period 2005–2007, patients of the two hospitals with radiologically proven upper urinary tract stone were included in this study. The survey included the age and gender, location of stones, history of urinary stone, treatment received, and stone composition, if available. Annual incidence of upper urinary tract stone was estimated using the data of population census of Japan 2005 and compared with the data of Tajima during 1991–1993. 1,305 patients were included in this study. Age-adjusted incidence (±95% CI) was 157 (±22.4) for men, and 57 (±12.6) for women, compared with 141 (±20.7) for men, and 63 (±13.4) for women during 1991–1993. In total, 30.7% of patients received interventional treatment including shock wave lithotripsy, endoscopic lithotripsy and open surgery, whereas 25.3% in 1991–1993. Calcium oxalate/phosphate stone was 89.6%, struvite stone was 4.5%, cystine stone was 1.0%, uric acid stone was 4.0%, and others were 1.0%. In Tajima area, incidence of upper urinary tract stone has not changed during 15 years.

Keywords Urolithiasis · Epidemiology · Hospital-based study · Imaging study

T. Takahashi (✉) · K. Okasho · T. Yoshikawa · H. Sawazaki · Y. Taki · H. Takeuchi
Department of Urology, Toyooka Hospital, Tobera 1094, Toyooka, Hyogo 668-8501, Japan
e-mail: jazzy@kuhp.kyoto-u.ac.jp

A. Yamane · S. Wataru
Department of Urology, Yoka Hospital, Yoka, Hyogo, Japan

Introduction

Since early 1970s, reports have suggested that the incidence and prevalence of urinary stone in westernized societies have been rising [1, 2], presumably related to diet and lifestyle changes. Using data derived from the Unites States National Health and Nutrition Examination Survey Dataset (NHANES), Stamatelou et al. [3] demonstrated that prevalence, defined as a history of urinary stone disease, of urinary stone disease increased from 3.8 to 5.2% during 10–15 years since 1976. In other countries such as Germany, population-based questionnaire study showed that rise in prevalence from 4.0 to 4.7% between 1979 and 2000 [4]. On the other hand, Mayo Clinic utilized their cohort study project since 1979 in examining the incidence, defined as the rate of first episode of urinary stone in lifetime, and its updated data showed incident stone rates in men have declined from 155 to 105 per 100,000 per year (0.1%) in 2000 during 30 years, whereas rates for women have slightly increased from 43 to 68 [5]. Of note, in NHANES study and German study, the data were obtained from self-reported questionnaire survey of healthier and younger volunteers estimating "prevalence", while Mayo Clinic study is hospital-based study of a geographically defined population estimating "incidence". Although there is a difference in methodology of data collection, these data suggest that continuing trend of increase in the rate of urinary stone disease until 2000 might have changed.

Tajima area, Northern part of Hyogo prefecture on Honshu Island northwest of Kyoto is a small rural area of Japan (Fig. 1). Due to isolation in terms of traffic network and geographic circumstances, patients need specific medical attention exclusively visit two general hospitals namely, Toyo-oka Hospital and Yoka Hospital. Almost all patients with upper urinary tract stone are referred to the two hospitals since they are sole general hospital with Department of Urology and equipment for shock wave lithotripsy in Tajima area. Therefore, hospital-based survey of patients with urinary stone in the two hospitals could be estimated as incidence of urinary stone patients in Tajima area. Although population-based questionnaire has been commonly used methodology in the field of urinary stone epidemiology reported from all over the countries, reports of the incidence rates for urinary stone in a well-defined population are rare both in United States and other countries. To our knowledge, other hospital-based cohort study regarding incidence of upper urinary tract stone has not been reported recently, except for study of Mayo clinic.

In Japan, nation-wide epidemiologic survey of urinary stone has been conducted 10 years interval since 1955 and recent update showed dramatic increase of urinary stone incidence [21]. The data of Tajima area regarding incidence of urinary stone disease would serve as complementary data for nation-wide survey as data of 1/400 scale of Japan because Japan is quite uniform in terms of climate, race, lifestyle and dietary habit throughout the country compared with United States and other countries.

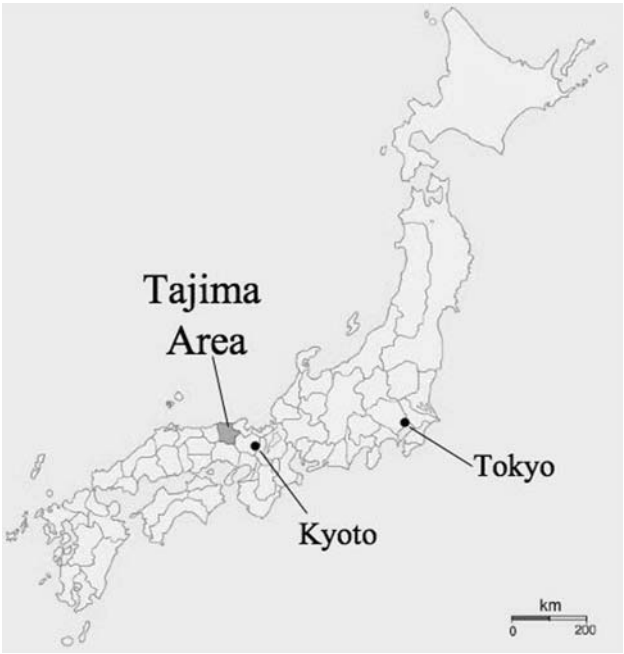

Fig. 1 Location of Tajima area on the map of Japan islands. This map was downloaded from Wikipedia (http://commons.wikimedia.org/wiki/File:Provinces_of_Japan-Tajima.svg), modified and used under GNU Free Documanetation License

We have previously reported hospital-based data of incidence of upper urinary tract stone during the period 1991–1993 [6]. We updated the data by survey during the period 2005–2007 using the same methodology as the previous report and examined the trends of incidence of upper urinary tract stone during 15 years in Tajima area.

Patients and methods

Tajima area

Tajima, northern half of Hyogo prefecture, is a rural area of Japan (Fig. 1), which has 2,133 km^2 area and has population of 253,914 in 2005 and in 277,327 in 1990. In Tajima, we have only two general hospitals with Department of Urology, Toyooka Hospital and Yoka Hospital, and four urologic offices with part-time urologist. ESWL was introduced to Toyooka in 1990 to Yoka in 2000.

A survey of patients covered by Government based National Health Insurance system in Tajima and surrounding area was conducted by SOGO System Research Institute (Kyoto, Japan). Outpatient of all hospitals and clinics of the area in June 1998 were included in the survey regarding residential area, diagnostic code, and hospital or clinic they visited. The survey showed 2.7% of all outpatients visited other hospitals out of Tajima area and for diagnositic code of diseases of genitourinary system (ICD-9 codes 580–629) [7], 3.3% of outpatients visited other hospitals. It would be reasonable to say that patients with upper urinary tract stone exclusively visit hospitals of Tajima area, Toyooka and Yoka Hospital.

Data collection

The data were collected using same methodology as the previously published data of 1991–1993 [6]. During the period 2005–2007, medical chart with diagnostic code related to upper urinary tract stone (ICD-9 code 592) [7] was reviewed. Patients with radiologically proven upper urinary tract stone (renal stone, ureteral stone or both), confirmed by excretory urography or CT scan, were included in this study. Patients with only hydronephrosis demonstrated on Ultrasonography which disappeared after a few days or weeks were included. Patients with a history of stone passage only without confirmation by imaging studies were excluded. Temporally residents and travelers were also excluded by checking the address on the medical chart. The survey included the age and gender, location of stones (renal pelvis, ureter or both), history of urinay stone, treatment received, and stone composition analyzed by infrared

spectrophotometry, if available. All patients were counted regardless of whether they have symptoms or not, of whether they were hospitalized or received treatment.

Data from the Population Census of Japan on 2005 were used for calculation of population of Tajima area and Japan similar to nation-wide survey in Japan. The annual incidence was calculated as the number of first-episode stone formers per 100,000 of the population of Tajima area of 2005. The annual total patient was calculated the number of first episode and recurrent stone formers together per 100,000 of the population of Tajima area of 2005. The age-related annual incidence during 2005–2007 for men and women was compared with that of nation-wide survey in Japan. Age-adjusted annual incidence and 95% confidence interval were calculated using direct method. The data were compared with the previously published data of 1991–1993 [6]. This study was approved by Institutional Review Boards of Toyooka Hospital (No HT05011).

Results

Age and sex-related incidence of upper urinary tract stone in Tajima area

The number of first episode stone formers met our criteria was 567 for men and 234 for women, 801 in total. One hundred and ninety-eight patients (19.8%) were excluded because confirmation on X-ray was not obtained.

Incidence, defined as presentation of an individual's first upper urinary tract stone, in Tajima area per 100,000 population per year during 2005–2007 was increased slightly to 105, compared with 93 during 1991–1993. Averaged annual incidence during 2005–2007 was 156 for men, 59 for women, campared with 131 for men and 60 for women. Age-adjusted incidence (±95% CI) was 157 (±22.4) for men, 57 (±12.6) for women during 2005–2007, compared with 141 (±20.7) for men, 63 (±13.4) for women during 1991–1993. Incidence was shown for men and women by decade of age in Table 1 and Fig. 2. Annual incidence of upper urinary tract stone has not changed during 15 years. Distribution pattern in age group is uniform.

Figure 3 shows ratio to total population in decade of age in Tajima area in 1990, Tajima area in 2005 and Japan in 2005. In Tajima, decrease of population in 20s and 30s, and increase in 60s over are observed both in men and women. Possibly due to counterbalance of these young and old generations, incidence was not changed by age adjustment. Incidence rate has a peak in 40–49 and gradually decrease with age in men. Among women, incidence rate has its peak in 50–59, then slightly decrease in 60–69 and 70–79.

Table 1 Annual incidence of upper urinary tract stone per 100,000 population for men and women by decade of age in Tajima during the year 1991–1993 and 2005–2007

Age	Men		Women	
	1990	2005	1990	2005
0–	2	3	0	0
10–	2	13	19	8
20–	115	99	55	17
30–	175	235	60	74
40–	212	246	81	70
50–	231	216	106	88
60–	199	207	97	84
70–	125	167	71	90
80–	54	104	20	43
Total	131	156	60	59

Treatment and stone composition

Patients treated with shock wave lithotripsy alone, combination of shock wave lithotripsy and endourology (percutaneous nephro-uretero-lithotripsy and transurethral lithitripsy), endourology alone, and open surgery were 18.0, 5.4, 7.0 and 0.1%, respectively. In total, 30.7% of patients received interventional treatment, whereas 25.3% of the previous report 15 years ago. Analysis of stone composition was available for 483 patients (37%). Calcium oxalate/phosphate stone was 89.6%, struvite stone was 4.5%, cystine stone was 1.0%, uric acid stone was 4.0%, and others were 1.0%, whereas calcium oxalate/phosphate stone was 84%, cystine was 1.4%, uric acid was 13.6% in 1991–1993.

Discussion

According to an update of long-term hospital-based study of Mayo Clinic Rochester, Minnesota in the year 2000 [5], rising trend of incidence of upper urinary tract stone may be changing. Since 1970, incidence in Rochester has remained relatively flat and has declined for men whereas slightly increasing in women. Our data showed concordance to this report. Incidence of upper urinary stone in Tajima area has not changed dramatically during 15 years. Incidence rate is similar between two studies, 105 and 156 for men, 68 and 59 for women. We might have to note the difference in patient selection between two studies. Our data include patients without symptom and exclude patients with only stone discharge without confirmation on X-ray film or ultrasound, while Rochester study includes symptomatic patients regardless of confirmation on X-ray film. In our

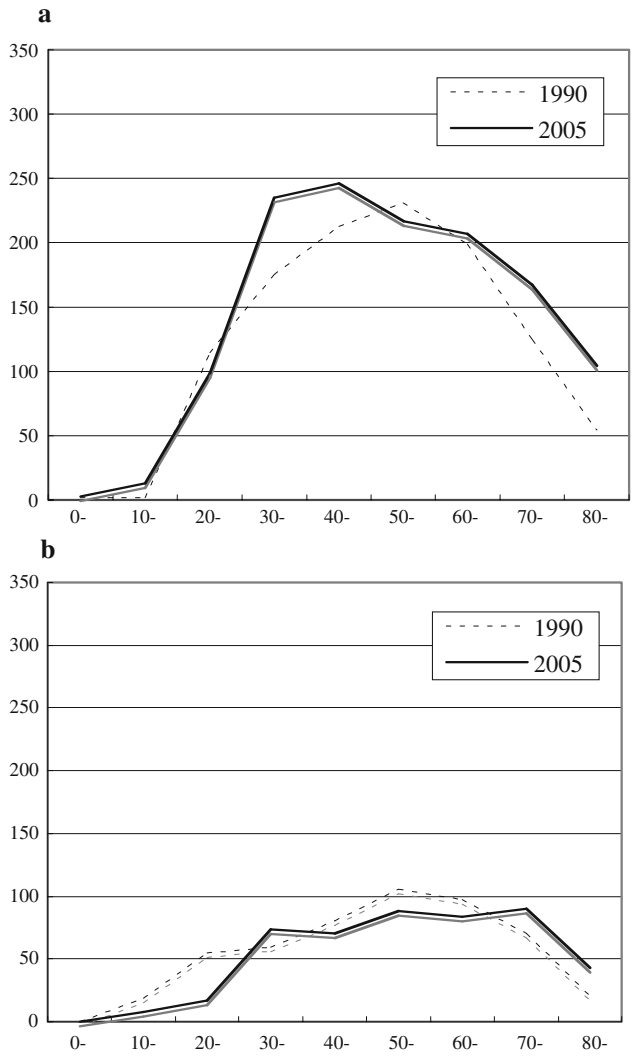

Fig. 2 Annual incidence of upper urinary tract stone per 100,000 population by decade of age in Tajima during the year 1991–1993 and 2005–2007. **a** For men, **b** for women. Annual stone patients and incidence has not changed during 15 years and distribution pattern in age group is uniform

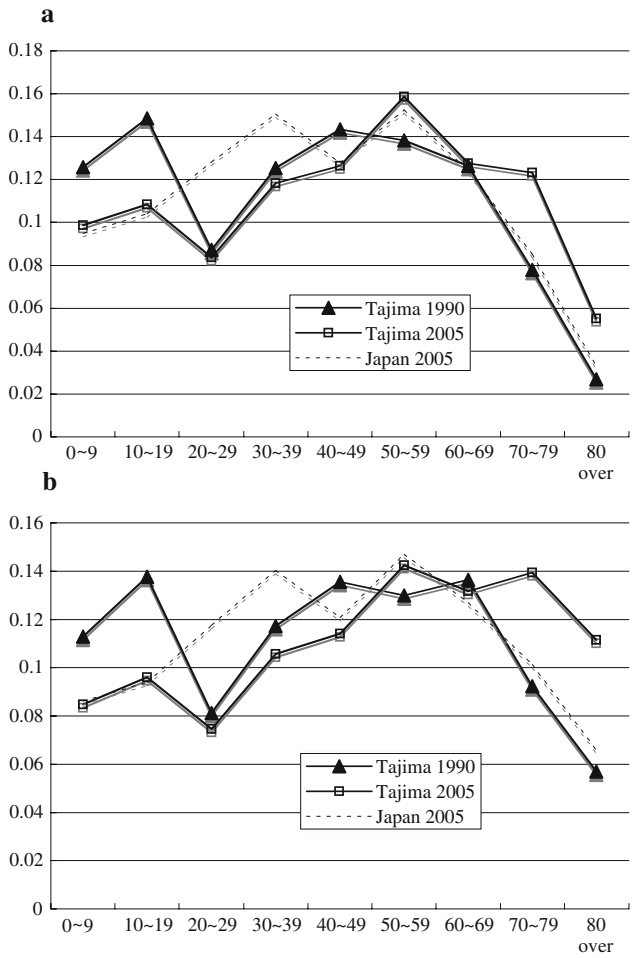

Fig. 3 Ratio to total population shown by decade of age of Tajima in 1990, Tajima in 2005 and Japan in 2005. **a** For men, **b** for women. Decrease of population in 20 and 30s, increase in 60s over is observed both in men and women in Tajima area. Possibly due to counterbalance of these young and old generations, incidence was not changed by age adjustment

study, the number of patients assigned to the two categories was about 20% of total patients.

Reported annual incidence of urinary stone in United States since 1970s varies from 43.2 up to 326 per 100,000 [1, 2, 7]. In worldwide, prevalence was reported 4.35–10.1% for men and 1.8–5.8% for women in Italy [8], Korea [9] and Argentina [10]. Unfortunately, there are differences in methodology among reports, hospital based versus population based, questionnaire versus medical record, which makes comparison difficult. Definition of incidence and prevalence is not consistent and bladder stone is included in some reports. Except for inclusion criteria of patients (radiologically proven vs. symptomatic), methodology used in Rochester study and ours is almost same. To our knowledge, other hospital-based cohort study regarding incidence of upper urinary tract stone has not been reported recently. It would be of interest that incidence rate of Rochester study is close to our data in 2–3 times larger cohort of different country and that rising trend was not shown during 10 years in neither of the two studies.

Traditionally, increasing incidence of upper urinary tract stone has been accounted for change in dietary habit and lifestyle [1, 2]. Since the Second World War, during full industrialization of Japan, lifestyle and dietary habits have been dramatically westernized. However, the change has been slow down these 10–20 years like other industrialized countries [11, 12]. We do not find any possible cause to increase incidence of urinary stone both in Tajima and in Japan. In addition, ratio of patients with interventional treatment was not changed since 1991 in Tajima. Analysis of stone composition showed similar result to that of our previous study, except slight decrease of uric acid stone.

Compared with nation-wide survey on 2005 [8], proportions of stone types were almost identical. These data would support the view that actual occurrence of urinary stone has not been changed these 15 years in Tajima and presumably in Japan. On the other hand, CT scan has become frequently used for diagnosis of upper urinary tract stone during 10 years [13–15]. In fact, usage of CT scan in our department and emergency unit increased two to threefold during 15 years. In this study, approximately 10% of patients were diagnosed only by CT scan and use of intravenous pyelography become less frequent (data not shown). It would be reasonable to say that the slight increase in incident stone rate in Tajima is a result of frequent use of CT scan rather than actual increase of stone disease.

Limitation of our study might be an underestimate of patients. Some of the patients might visit hospitals outside Tajima, although the leak is estimated less than 5%. In addition, patients diagnosed only by urologic office and physicians practicing in private clinics were not included in this study. However, 90.6% of physicians replied that they would refer all or selected patients to urologists on survey conducted on 1979. This tendency has not been changed even now, and it holds true to office urologists. Although there is a possible underestimate of patients, we believe that same methodology allows us to examine trend of incidence of upper urinary tract stone during these 15 years. There has been no significant change in traffic network, geographic condition and practice pattern of urology in Tajima area except for introduction of shock wave lithotripsy to Yoka Hospital.

Upper urinary tract stone disease shows geographic variability and racial difference [16–20]. Our data may demonstrate that the more sedentary lifestyle in Tajima contributes to a lower risk of stone formation compared to elsewhere in Japan, where diet and lifestyle are more stressful in this regard. The data furthermore show that there might be considerable differences from area to area in one country depending on different conditions of life. On the other hand, the most striking difference of Tajima with other part of Japan would be age distribution. Typical to rural part, ratio of age 20–29 in Tajima is lower and ratio of age above 50 is higher than that of Japan. However, incidence was not significantly changed by age adjustment possibly due to counterbalance of incidence rate between age 20–29 and 50–59, 60–69 (Fig. 2). Therefore, the results of this study serve as complementary data for Nationwide survey as data of 1/400 scale of Japan.

In Japan, nation-wide epidemiologic survey of urinary stone has been conducted 10 years interval since 1955 [21]. The updated data showed that there was dramatic increase of incidence of urinary stone, up to 192.0 on 2005 from 117.5 on 1995 in men, to 79.3 on 2005 from 46.1 on 1995 in women [22]. Although our data show that incidence of upper urinary tract stone has not changed in Tajima area, it might not hold true to other part of Japan. However, the nation-wide survey of Japan is based on the data of 35% of the 1,218 enrolled hospitals. Total number of patients in Japan was estimated from actual count of patients using a formula contains bed number of the institutions as follows: number of total patients in Japan = number of patients enumerated × number of beds in the enrolled hospitals/number of beds in the respondent hospitals. It would be possible that the dramatic increase of incident stone rates in 2005 might contain artifact due to reduction of bed number of hospitals caused by policy of Ministry of health and welfare of Japan during recent 10 years.

In summary, in Tajima area, incidence of upper urinary tract stone has not been changed these 15 years although slight increase was observed.

References

1. Curhan GC (2007) Epidemiology of stone disease. Urol Clin North Am 34:287–293
2. Trinchieri A (2006) Epidemiological trends in urolithiasis: impact on our health care systems. Urol Res 34:151–156
3. Stamatelou KK, Francis ME, Jones CA, Nyberg LM, Curhan GC (2003) Time trends in reported prevalence of kidney stones in the United States: 1976–1994. Kidney Int 63:1817–1823
4. Hesse A, Brandle E, Wilbert D, Köhrmann KU, Alken P (2003) Study on the prevalence and incidence of urolithiasis in Germany comparing the years 1979 vs. 2000. Eur Urol 44:709–713
5. Lieske JC, Peña de la Vega LS, Slezak JM, Bergstralh EJ, Leibson CL, Ho KL, Gettman MT (2006) Renal stone epidemiology in Rochester, Minnesota: an update. Kidney Int 69:760–764
6. Takeuchi H, Yoshida H, Isogawa Y, Taki Y (1999) Prevalence of upper urinary tract stones in Tajima, north Hyogo, Japan. Hinyokika Kiyo 45:165–168 (in Japanese)
7. ftp:ftp.cdc.gov/pub/Health_Statistics/NCHS/Publications/ICD9-CM/2008/DIsEASES/TABULAR
8. Trinchieri A, Coppi F, Montanari E, Del Nero A, Zanetti G, Pisani E (2000) Increase in the prevalence of symptomatic upper urinary tract stones during the last ten years. Eur Urol 37:23–25
9. Kim H, Jo MK, Kwak C, Park SK, Yoo KY, Kang D, Lee C (2002) Prevalence and epidemiologic characteristics of urolithiasis in Seoul, Korea. Urology 59:517–521
10. Pinduli I, Spivacow R, del Valle E, Vidal S, Negri AL, Previgliano H, Farías Edos R, Andrade JH, Negri GM, Boffi-Boggero HJ (2006) Prevalence of urolithiasis in the autonomous city of Buenos Aires, Argentina. Urol Res 34:8–11
11. Katanoda K, Kim HS, Matsumura Y (2006) New Quantitative Index for Dietary Diversity (QUANTIDD) and its annual changes in the Japanese. Nutrition 22:283–287
12. Matsumura Y (2001) Nutrition trends in Japan. Asia Pac J Clin Nutr 10(Suppl):S40–S47
13. Abramson S, Walders N, Applegate KE, Gilkeson RC, Robbin MR (2000) Impact in the emergency department of unenhanced CT on diagnostic confidence and therapeutic efficacy in patients with suspected renal colic: a prospective survey. 2000 ARRS President's Award. American Roentgen Ray Society. AJR Am J Roentgenol 175:1689–1695
14. Cullen IM, Cafferty F, Oon SF, Manecksha R, Shields D, Grainger R, McDermott TE, Plunkett P, Meaney J, Lynch TH (2008)

Evaluation of suspected renal colic with noncontrast CT in the emergency department: a single institution study. J Endourol 22:2441–2445
15. Chen MY, Zagoria RJ (1999) Can noncontrast helical computed tomography replace intravenous urography for evaluation of patients with acute urinary tract colic? J Emerg Med 17:299–303
16. Chen YK, Lin HC, Chen CS, Yeh SD (2008) Seasonal variations in urinary calculi attacks and their association with climate: a population based study. J Urol 179:564–569
17. Brikowski TH, Lotan Y, Pearle MS (2008) Climate-related increase in the prevalence of urolithiasis in the United States. Proc Natl Acad Sci U S A 105:9841–9846
18. Maloney ME, Springhart WP, Ekeruo WO, Young MD, Enemchukwu CU, Preminger GM (2005) Ethnic background has minimal impact on the etiology of nephrolithiasis. J Urol 173:2001–2004
19. Dall'era JE, Kim F, Chandhoke PS (2005) Gender differences among Hispanics and Caucasians in symptomatic presentation of kidney and ureteral stones. J Endourol 19:283–286
20. Mente A, Honey RJ, McLaughlin JR, Bull SB, Logan AG (2007) Ethnic differences in relative risk of idiopathic calcium nephrolithiasis in North America. J Urol 178:1992–1997
21. Yoshida O, Terai A, Ohkawa T, Okada Y (1999) National trend of the incidence of urolithiasis in Japan from 1965 to 1995. Kidney Int 56:1899–1904
22. Yasui T, Iguchi M, Suzuki S, Kohri K (2008) Prevalence and epidemiological characteristics of urolithiasis in Japan: national trends between 1965 and 2005. Urology 71:209–213