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Platinum Priority – Stone Disease

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Use of the National Health and Nutrition Examination Survey to Calculate the Impact of Obesity and Diabetes on Cost and Prevalence of Urolithiasis in 2030

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Abstract

Background: The prevalence of urolithiasis and its risk factors such as obesity and diabetes have increased over time.
Objective: Determine the future cost and prevalence of kidney stones using current and projected estimates for stones, obesity, diabetes, and population rates.
Design, setting, and participants: The stone prevalence in 2000 was estimated from the National Health and Nutrition Examination Survey (NHANES) 1988–1994 and 2007–2010. The cost per percentage prevalence of stones in 2000, calculated using Urologic Diseases in America Project data, was used to estimate the annual cost of stones in 2030, adjusting for inflation and increases in population, stone prevalence, obesity and diabetes rates.
Outcome measurements and statistical analysis: The primary outcome was prevalence and cost of stones in 2030. The secondary outcomes were the impact of obesity and diabetes on these values, calculated using odds ratios for stones by body mass index and diabetes status.
Results and limitations: The annual cost of stone disease in 2000, adjusted for inflation to 2014 US dollars, was approximately $2.81 billion. After accounting for increases in population and stone prevalence from 2000, the estimated cost of stones in 2007 in 2014 US dollars was $3.79 billion. Future population growth alone would increase the cost of stone disease by $780 million in 2030. Based on projected estimates for 2030, obesity will independently increase stone prevalence by 0.36%, with an annual cost increase of $157 million. Diabetes will independently increase stone prevalence by 0.72%, associated with a cost increase of $308 million annually by 2030. NHANES data, however, capture patient self-assessment rather than medical diagnosis, which is a potential bias.
Conclusions: The rising prevalence of obesity and diabetes, together with population growth, is projected to contribute to dramatic increases in the cost of urolithiasis, with an additional $1.24 billion/yr estimated by 2030.
Patient summary: Obesity, diabetes, and population rates will contribute to an estimated $1.24 billion/yr increase in the cost of kidney stones by 2030.
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1. Introduction

An assessment of the National Health and Nutrition Examination Survey (NHANES) II and III datasets revealed that the prevalence of kidney stones in US adults rose significantly, from 3.2% in 1976–1980 to 5.2% in 1988–1994 [1]. This trend has persisted, with the latest NHANES data revealing an estimated 8.8% prevalence of stone disease [2].

The concomitant rise in comorbid conditions associated with stone disease, including obesity and type 2 diabetes mellitus, has been proposed as a possible explanation for this rise in stone prevalence. In US adults, the prevalence of obesity increased from 30.5% in 2000 to 35.7% in 2010 [3], and the age-adjusted prevalence of diabetes rose from 4.5% in 1995 to 8.2% in 2010 [4]. Both conditions have been linked to an increased risk of uric acid and calcium oxalate stone formation by a variety of proposed pathophysiologic mechanisms [5–11].

Several studies have verified the positive association between body size and risk of stone formation [2,12–15]. In addition, obese first-time stone formers have been shown to have an increased incidence of stone recurrence and a decreased time to recurrence compared with nonobese first-time stone formers [16].

The associations between obesity, diabetes, and nephrolithiasis have been well established and the pathophysiologic mechanisms are currently being studied, but the impact of these comorbid conditions on cost and prevalence of stone disease has yet to be explored. In 2000 the total annual expenditure for urolithiasis was estimated at $2.1 billion, representing a 50% increase from estimates in 1994 [17]. The effect of obesity and diabetes on nephrolithiasis is likely to escalate the financial burden of this increasingly common condition. The aim of the present study was to calculate the effects of population, obesity, and diabetes on future costs of nephrolithiasis, specifically in the year 2030, using current and projected prevalence estimates of obesity, diabetes, population, and stone disease.

2. Methods

This study was exempt from review by our institutional review board because it does not include patient data.

2.1. Prevalence of stone disease in 2000

Because cost estimates for urolithiasis in the United States have been reported for the year 2000, the cost and estimated prevalence of stone disease from that year were used to derive the cost per unit percentage prevalence that could then be applied to a year for which we had prevalence but no cost data. Since no available national prevalence data spanned the year 2000, the prevalence of stones for that year was estimated by calculating the mean stone prevalence for the 1988–1994 [1] and 2007–2010 [2] NHANES data sets. NHANES is a nationally representative, multistage probability survey assessing the health and nutritional status of the noninstitutionalized US population. Since there are more women than men in the United States, the stone prevalence was corrected for gender distribution (Table 1) [18].

2.2. Cost per percentage prevalence of stone disease in 2014 US dollars

The estimated cost for the diagnosis and management of nephrolithiasis for the year 2000 was obtained using data from the Urologic Diseases in America Project [17]. This cost was divided by the estimated lifetime prevalence for stone disease in 2000 to determine the cost per unit percentage prevalence of stones for that year. Year 2000 costs were then converted to 2014 US dollars using an inflation calculator based on the US Consumer Price Index to provide contemporaneous values (Table 1).

2.3. Population estimates

Using the US Census Bureau's Population Estimates Program, which estimates yearly population in the United States from current data on births, deaths, and migration to update the most recent decennial census, the total US population, as well as the percentage of men and women, was determined for 2007 [18], a year for which the most current stone prevalence has been published [2]. An estimate of cost increase based on the increase in population was then determined using the prevalence of stone disease from 2007–2010 NHANES data [2], adjusting

Table 1 – Lifetime kidney stone prevalence and total annual cost of stone disease, adjusting for population rates and gender distribution

	Stone disease prevalence, %		
	Men	Women	Total population
NHANES 1988–1994 [1]	6.3	4.1	5.2
NHANES 2007–2010 [2]	10.6	7.1	8.8
Year 2000 (estimated)	8.5	5.6	7.0*

Calculated values	Total annual cost
Cost of stone disease in the United States in 2000 (UDA data [17])	$2 067 400 000
Estimated cost per 1% stone prevalence in 2000	$2 067 400,000/0.0700505 = $295 129 942
Estimated cost per 1% stone prevalence, in 2014 dollars**	$295 129 942 × 1.358 = $400 786 461
Estimated cost of stone disease in 2000 in the United States, in 2014 dollars**	$2 067 400 000 × 1.358 = $2 807 529 200
Estimated cost of stone disease in 2007 in the United States,^ in 2014 dollars**	($2 807 529 200 × 1.07) × 1.26 = $3 791 000 000
Estimated cost of stone disease in 2030 in the United States,^^ in 2014 dollars**	($2 807 529 200 × 1.29) × 1.26 = $4 570 000 000

NHANES = National Health and Nutrition Examination Survey; UDA = Urologic Diseases in America.
* Average, adjusted for gender distribution of US population in 2007: 49.30% men and 50.70% women [18].
** Adjusted for 35.8% inflation from 2000 to 2014.
^ Adjusted for the increases in population [18] and stone prevalence [2] between 2000 and 2007.
^^ Adjusted for the increase in population from 2000 to 2030 [19].

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