

## ORIGINAL ARTICLE

# Prevalence and Clinical Characteristics of Simple Renal Cyst

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**Background:** We investigated simple renal cysts to understand the prevalence in healthy individuals and evaluate their clinical characteristics to determine whether or not there are any risk factors associated with simple renal cysts.

**Methods:** Abdominal sonography was performed in 577 individuals (317 men, 260 women; mean age, 48.84 years; age range, 20–94 years) who received health check-up in January to February 2005. Data including age, sex, renal sonographic findings (cyst number, site, diameter, renal stones), values of serum cholesterol, glucose and creatinine, urine analysis (proteinuria, hematuria, pyuria), and smoking habit were analyzed.

**Results:** The overall prevalence of simple renal cysts was 10.7%, ranging from 2.38% in the 2<sup>nd</sup> to 35.29% in the 7<sup>th</sup> or later decade of life. The prevalence increased with age ( $p < 0.001$ ). The mean age of individuals with cysts was significantly older than those without cysts ( $57.65 \pm 13.35$  vs.  $47.78 \pm 12.40$  years;  $p < 0.001$ ). Male-to-female ratio was 2.81 (15.14% vs. 5.38%;  $p < 0.001$ ). The majority of cysts were solitary (82.3%). Mean largest diameter of cysts was  $20.89 \pm 12.62$  mm. The mean size of cysts in every age group was not statistically different. Factors significantly associated with simple renal cysts were age (odds ratio [OR], 4.37;  $p < 0.001$ ), sex (OR, 0.32;  $p < 0.001$ ), serum creatinine (OR, 11.77;  $p = 0.001$ ), proteinuria (OR, 3.11;  $p = 0.004$ ), renal stone (OR, 2.47;  $p = 0.006$ ), and smoking (OR, 2.80;  $p < 0.001$ ). However, in multivariate analysis, except proteinuria, all of the above factors were significantly related to the occurrence of simple renal cysts.

**Conclusion:** The overall prevalence of simple renal cysts in healthy individuals was 10.7%. Age, sex, renal stone, serum creatinine, and smoking were found to be risk factors for the presence of simple renal cysts. [*J Chin Med Assoc* 2007; 70(11):486–491]

**Key Words:** abdominal sonography, prevalence, simple renal cyst

## Introduction

Simple renal cysts are common in adults, especially in the elderly population. The bulk of them are asymptomatic and incidentally found by renal imaging including computed tomography (CT) and ultrasonography. A few series reported varying prevalence in other countries.<sup>1–8</sup> Nevertheless, to the best of our knowledge, there was no study addressing the prevalence of simple renal cysts in Taiwan. Many individuals diagnosed with simple renal cysts often express the concern, “Will they cause any symptoms or harm the kidney?” Also, the association between simple renal cysts and some

parameters connected with senility or symptoms related to the urinary tract have not yet been clarified. Therefore, the aim of the present study was to investigate simple renal cysts to understand their prevalence in healthy individuals and evaluate their clinical characteristics to determine whether or not there are any risk factors associated with simple renal cysts.

## Methods

The study was performed retrospectively from January to February 2005. The studied population comprised

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577 individuals (317 men, 260 women; mean age, 48.84 years; age range, 20–94 years) who received health check-up at Taipei Veterans General Hospital. We focused on simple renal cysts diagnosed via abdominal ultrasonography. The diagnostic criteria of simple renal cysts by ultrasonography were as follows: (1) absence of internal echoes; (2) sharply defined, thin, distinct wall with a smooth and distinct margin; (3) good transmission of sound waves through the cyst with consequent acoustic enhancement behind the cyst; (4) spherical or slightly ovoid shape.<sup>9</sup> The number, site, and diameter of the simple renal cysts were recorded. We also collected data pertaining to age, sex, and presence of renal stones. In addition, the other parameters recorded in the study were as follows: (1) related to aging: serum cholesterol and glucose; (2) indicator of renal function: serum creatinine; (3) related to urinary tract: proteinuria, hematuria (> 2 red blood cells per high-powered field [hpf]), and pyuria (> 5 white blood cells/hpf); (4) smoking habit.

Statistical analysis including univariate and multivariate analyses were performed by Fisher's exact test, 2-tailed Student's *t* test, and logistic regression analysis;  $p < 0.05$  was considered statistically significant.

## Results

### *Age and sex distribution*

The overall prevalence of simple renal cysts was 10.7% (62/577), ranging from 2.38% in the 2<sup>nd</sup> to 35.29% in the 7<sup>th</sup> or later decade of life. Figure 1 shows that prevalence increased with age by decade. Incidence

increased dramatically after the 6<sup>th</sup> decade of life. Table 1 summarizes the demographic data of all the characteristics of simple renal cysts. Individuals with simple renal cysts were significantly older than those without cysts ( $p < 0.001$ ). Simple renal cysts were observed in 15.14% of the men and 5.38% of the women. Thus, the male-to-female ratio was 2.81.

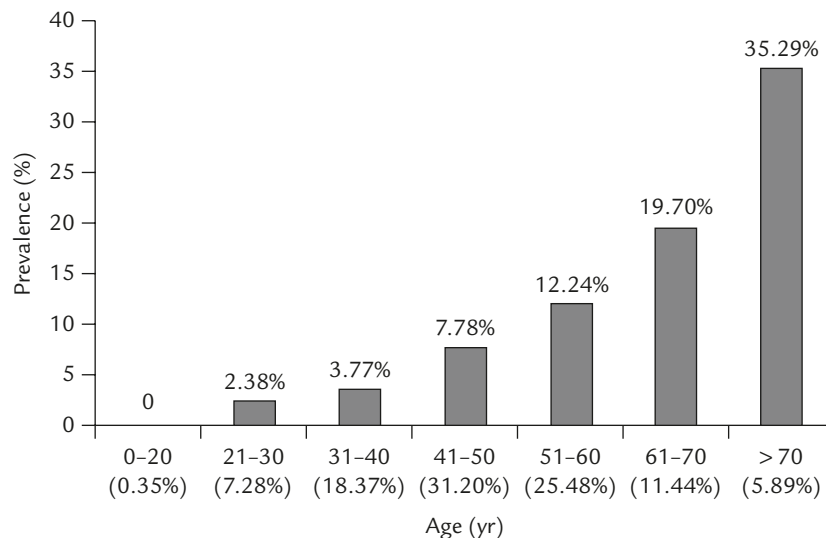
### *Renal sonographic findings*

The vast majority of simple renal cysts were solitary (82.3%). With regard to the distribution of the site of the cysts, right, left and bilateral kidneys were affected in 34, 20 and 8 individuals, respectively. The mean largest cyst diameter was  $20.89 \pm 12.62$  mm (range, 4–71 mm). Figure 2 shows that the mean cyst size in each age group was not statistically different.

Fifteen subjects had renal cysts and stones simultaneously. Ipsilateral coexistence of renal stones with cysts was found in 13 individuals (86.67%). We observed that the presence of renal stones was significantly associated with simple renal cysts in both univariate (odds ratio [OR], 2.47;  $p = 0.006$ ) (Table 2) and multivariate logistic regression analyses (OR, 2.15;  $p = 0.034$ ) (Table 3).

### *Parameters related to aging, renal function, and urinary tract*

In univariate analysis, factors strongly associated with simple renal cysts were increased serum creatinine (OR, 11.77;  $p = 0.001$ ) and proteinuria (OR, 2.47;  $p = 0.006$ ) (Table 2). Nevertheless, only serum creatinine was found to have a significant correlation with simple renal cysts in the multivariate analysis (Table 3).

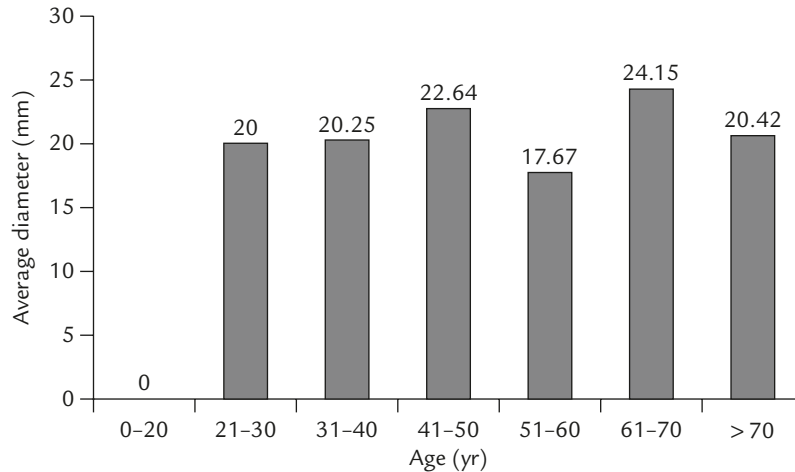


**Figure 1.** Age-related prevalence of simple renal cysts in 577 individuals. Proportion (%) of each decade in study population is indicated in parentheses.

**Table 1.** Clinical characteristics of simple renal cysts in 577 individuals

	With cyst(s) n (%)	Without cyst(s) n (%)	p
Cohort (total)	62 (10.7)	515 (89.3)	
Male	48 (15.1)	269 (84.9)	
Female	14 (5.4)	246 (94.6)	
Age, yr (mean ± SD)	57.65 ± 13.35	47.78 ± 12.40	<0.001*
Renal stones	15 (24.2)	59 (11.5)	0.008 <sup>†</sup>
Serum cholesterol (> 240 mg/dL)	11 (17.7)	91 (17.6)	0.727 <sup>†</sup>
Serum glucose (> 115 mg/dL)	8 (12.9)	44 (8.5)	0.244 <sup>†</sup>
Serum creatinine (> 1.5 mg/dL)	4 (6.5)	3 (0.6)	0.003 <sup>†</sup>
Urine analysis			
Proteinuria	10 (16.1)	30 (5.8)	0.006 <sup>†</sup>
Hematuria	8 (12.9)	59 (11.5)	0.678 <sup>†</sup>
Pyuria	6 (9.7)	46 (8.9)	0.815 <sup>†</sup>
Smoking	29 (46.8)	116 (22.5)	<0.001 <sup>†</sup>

\*Student's *t* test; <sup>†</sup>Fisher's exact test. SD = standard deviation.

**Figure 2.** Age-related cyst diameter in 577 individuals.**Table 2.** Univariate logistic regression analysis of simple renal cysts with predictive factors in 577 individuals

	OR	95% CI	p
Age (≥ 65 yr)	4.367	2.297–8.30	<0.001
Sex	0.319	0.172–0.593	<0.001
Renal stones	2.467	1.299–4.684	0.006
Serum cholesterol (> 240 mg/dL)	1.118	0.573–2.184	0.744
Serum glucose (> 115 mg/dL)	1.586	0.710–3.544	0.261
Serum creatinine (> 1.5 mg/dL)	11.770	2.571–53.890	0.001
Proteinuria	3.109	1.438–6.719	0.004
Hematuria	1.145	0.519–2.524	0.737
Pyuria	1.092	0.446–2.673	0.847
Smoking	2.801	1.631–4.812	<0.001

OR = odds ratio; CI = confidence interval.

**Table 3.** Multivariate logistic regression analysis of simple renal cysts with predictive factors in 577 individuals

	OR	95% CI	<i>p</i>
Age ( $\geq 65$ yr)	4.890	2.350–10.174	<0.001
Sex	0.380	0.174–0.832	0.015
Renal stones	2.146	1.061–4.342	0.034
Serum cholesterol (> 240 mg/dL)	0.732	0.336–1.594	0.432
Serum glucose (> 115 mg/dL)	0.834	0.322–2.157	0.708
Serum creatinine (> 1.5 mg/dL)	8.829	1.506–51.773	0.016
Proteinuria	1.753	0.688–4.465	0.240
Hematuria	1.618	0.670–3.909	0.285
Pyuria	1.828	0.615–5.435	0.278
Smoking	2.666	1.387–5.127	0.003

OR = odds ratio; CI = confidence interval.

**Table 4.** Comparison of the prevalence of simple renal cysts between males and females in smoking and non-smoking groups

	Smoking			Non-smoking		
	With cyst(s)	Without cyst(s)	Prevalence (%)	With cyst(s)	Without cyst(s)	Prevalence (%)
Male	28	109	20.4	20	160	11.1
Female	1	7	12.5	13	239	5.2
<i>p</i> *		1.000			0.027	

\*Fisher's exact test.

**Table 5.** Comparison of overall prevalence, male/female ratio and diagnostic tool among published studies

Author (year)	Prevalence (%)	Male:Female	Diagnostic tool
Terada et al <sup>1</sup> (2002)	11.9	2:1	US
Pal et al <sup>2</sup> (1997)	5.06	2.04:1	US
Laucks & McLachian <sup>3</sup> (1981)	24.0	–	CT
Caglioti et al <sup>4</sup> (1993)	17.2	–	US
Pedersen et al <sup>5</sup> (1993)	5.2	2.86:1	US
Tada et al <sup>6</sup> (1983)	19.9	2.72:1	CT
Ravine et al <sup>7</sup> (1993)	9.5	2.15:1	US
Carrim & Murchison <sup>8</sup> (2003)	41.0	1.4:1	CT
This study (2007)	10.7	2.81:1	US

US = ultrasonography; CT = computed tomography.

### Smoking habit

In both univariate and multivariate analyses, smoking was found to be a significant risk factor for simple renal cysts (Tables 2 and 3). In addition, the statistically significant difference in the prevalence of simple renal cysts between male and female was only noted in the non-smoking group (Table 4).

### Discussion

In the current study, the prevalence of simple renal cysts was 10.7% in the study population and 17.4% in the 5<sup>th</sup> or later decades of life. This result is consistent

with those of some other series.<sup>1,2,4,5,7</sup> Nevertheless, the prevalence of simple renal cysts varied from 5.2% to 41% compared with those reported by different series<sup>1–8</sup> (Table 5) because of sonographic resolution, different environmental exposure, and different ethnic background.<sup>7</sup> These data indicated that ultrasonography detected about half of renal cysts diagnosed via CT. Simple renal cysts were highly prevalent and deemed to correlate positively with advancing age. They occur in up to 50% of individuals over the age of 50 years.<sup>10</sup>

Numerous unsuspected simple renal cysts are detected owing to increasing utilization of ultrasonography and CT. Morphologically, simple renal cysts are individually oval to round. They may be single or

multiple. Histologically, simple renal cysts usually have a smooth outline bordered by a single layer of flattened cuboidal epithelium and are filled with clear or straw-colored fluid.<sup>11</sup> Simple renal cysts are acquired.<sup>3,5</sup> The origin of these cysts remains uncertain. In 1930, Hepler<sup>12</sup> pointed out the concept of renal infarction and tubular obstruction, which increased with age. Recently, the theory that simple renal cysts are derived from diverticula of the distal convoluted or collecting tubules was introduced.<sup>13</sup> These diverticula increase in number in senescent kidneys, probably as a result of the weakening of the tubular basement membrane.<sup>14</sup> This explains the relationship between senility and simple renal cysts.

A few published studies reported that the size and number of renal cysts tend to increase with age,<sup>2,3,7,15</sup> but our study failed to demonstrate this. That's perhaps owing to the limited case number, different diagnostic tools (e.g. CT *vs.* ultrasonography), sonographic resolution, and race. In our study, sex was significantly related to the occurrence of simple renal cysts. Similarly, the prevalence was higher in males compared with females in most cohorts.<sup>1,2,5-8</sup> The possible explanations may be as follows: first, simple renal cysts are thought to evolve from tubular diverticula, which are more common in subjects with urinary obstruction, especially in those with prostatism;<sup>16</sup> second, Carrim and Murchison stated that "cigarette smoking may be related to renal cysts either by causing renovascular diseases or by direct toxic effect, and more men than women smoke".<sup>8</sup> In the current study, smoking was indeed shown to be a risk factor for the occurrence of simple renal cysts (Tables 2 and 3). Nevertheless, the prevalence of simple renal cysts was significantly higher in men than in women among non-smokers, but there was no statistically significant difference in the prevalence of simple renal cysts between men and women among smokers (Table 4). Thus, unlike the inference of Carrim and Murchison, we found that the higher prevalence of simple renal cysts in males than females was not caused by smoking.

Mostly, simple renal cysts are asymptomatic and not harmful to renal function. In the present study, we investigated simple renal cysts to understand their prevalence in healthy individuals and evaluate their clinical characteristics to determine the risk factors associated with simple renal cysts. We found by univariate analysis that the factors significantly associated with simple renal cysts were abnormal serum creatinine and proteinuria. Serum cholesterol, glucose, hematuria and pyuria were not correlated with simple renal cysts. However, in the multivariate analysis, abnormal serum creatinine was still significantly related to the occurrence

of simple renal cysts. Significant association between abnormal serum creatinine (renal dysfunction) and simple renal cysts is likely owing to abnormal tubular growth.<sup>17</sup> Loss of nephrons increases the workload of the remaining tubules, presumably leading to stimulation of growth by the tubular hypertrophy.<sup>18</sup> This would increase the probability of aberrant growth that may lead to cystic changes in the kidney.<sup>16</sup>

Several investigations examined the correlation between simple renal cysts and clinical manifestations such as arterial hypertension, hematuria and flank pain.<sup>4,5,19</sup> The relationship between hypertension and simple renal cysts is controversial. Pedersen et al<sup>5</sup> reported that mean arterial blood pressure was significantly higher in individuals with simple renal cysts. They assumed that increased renin release due to renal ischemia caused by cyst expansion may cause the early hypertension. On the other hand, Cuxart et al<sup>19</sup> supposed that arterial hypertension accompanied by simple renal cysts was just owing to senility. With regard to the relationship between simple renal cysts and renal or urinary tract diseases such as hematuria, renal stones and flank pain, Caglioti et al<sup>4</sup> pointed out that tubular obstruction secondary to renal parenchymal disorganization may account for the higher prevalence of simple renal cysts in patients with renal and urinary tract diseases. In general, the association of most symptoms with simple renal cysts has so far been inconclusive and considered to be only coincidental.

Most simple renal cysts rarely produce symptoms and thus seldom require treatment unless the cyst becomes symptomatic or complicated. Treatments include needle cyst puncture without or with sclerosing agents (lipiodol, phenol, alcohol, bismuth phosphate), and percutaneous unroofing, laparoscopic unroofing (gaseous retroperitoneoscopic and gasless retroperitoneoscopy-assisted) and open unroofing of renal cysts.<sup>20,21</sup>

In summary, the overall prevalence of simple renal cysts in healthy individuals in the current study was 10.7%. Age, sex, renal stones, serum creatinine, and smoking may be risk factors for the presence of simple renal cysts.

## References

1. Terada N, Ichioka K, Matsuta Y, Okubo K, Yoshimura K, Arai Y. The natural history of simple renal cysts. *J Urol* 2002;167:21-3.
2. Pal DK, Kunda AK, Das S. Simple renal cyst: an observation. *J Indian Med Assoc* 1997;95:555-8.
3. Laucks SP, McLachlan SF. Aging and simple cysts of the kidney. *Br J Radiol* 1981;54:12-4.

4. Caglioti A, Esposito C, Fuiano G, Buzio C, Postorino M, Rampino T, Conte G, et al. Prevalence of symptoms in patients with simple renal cysts. *Br Med J* 1993;306:430-1.
5. Pedersen JF, Emamian SA, Nielsen MB. Simple renal cyst: relations to age and arterial blood pressure. *Br J Radiol* 1993;66:581-4.
6. Tada S, Yamagishi J, Kobayashi H, Hata Y, Kobari T. The incidence of simple renal cyst by computed tomography. *Clin Radiol* 1983;34:437-9.
7. Ravine D, Gibson RN, Donlan J, Sheffield LJ. An ultrasound renal cyst prevalence survey: specificity data for inherited renal cystic diseases. *Am J Kidney Dis* 1993;22:803-7.
8. Carrim ZI, Murchison JT. The prevalence of simple renal and hepatic cysts detected by spiral computed tomography. *Clin Radiol* 2003;58:626-9.
9. Glassberg KI. Renal dysgenesis and cystic disease of the kidney. In: Walsh PC, Retik AB, Vaughan ED, Wein AJ, Kavoussi LR, Novick AC, Partin AW, Peters CA, eds. *Campbell's Urology*, 8<sup>th</sup> edition. Philadelphia: WB Saunders, 2002:1925-95.
10. O'Leary MP. Kidney and urologic diseases. In: Graham SD, Jr. ed. *Glenn's Urologic Surgery*, 5<sup>th</sup> edition. Philadelphia: Lippincott Williams & Wilkins, 1998:1087-9.
11. Glassberg KI. Renal dysgenesis and cystic disease of the kidney. In: Wein AJ, Kavoussi LR, Novick AC, Partin AW, Peters CA, eds. *Campbell-Walsh Urology*, 9<sup>th</sup> edition. Philadelphia: WB Saunders, 2007:3305-58.
12. Hepler AB. Solitary cysts of the kidney. *Surg Gynecol Obstet* 1930;50:668-87.
13. Baert L, Steg A. Is the diverticulum of the distal and collecting tubules a preliminary stage of the simple cyst in the adult? *J Urol* 1977;118:707-10.
14. Darmady EM, Offer J, Woodhouse MA. The parameters of the aging kidney. *J Pathol* 1973;109:195-207.
15. Dalton D, Heiman H, Grayhack JT. The natural history of simple renal cysts: a preliminary study. *J Urol* 1986;135:905-8.
16. Baert L, Steg A. On the pathogenesis of simple renal cysts in the adult: a microdissection study. *Urol Res* 1977;5:103-8.
17. Al-Said J, Brumback MA, Moghazi S, Baumgarten DA, O'Neill WC. Reduced renal function in patients with simple renal cysts. *Kidney Int* 2004;65:2303-8.
18. Preisig PA, Franch HA. Renal epithelial cell hyperplasia and hypertrophy. *Semin Nephrol* 1995;15:327-40.
19. Cuxart PM, Matas SM, Sans LR, Garci CM, Ferrer SJ, Nadal VC. Prevalence of arterial hypertension, proteinuria and hematuria in patients with simple renal cysts. *Rev Clin Esp* 1993;193:368A.
20. Wang JH, Chang T, Yin JH. Percutaneous unroofing of renal cysts. *J Chin Med Assoc* 1992;50:406-10.
21. Ou YC, Yang CR, Chang YY, Kuo JH, Wu HC. The clinical experience of gaseous retroperitoneoscopic and gasless retroperitoneoscopy-assisted unroofing of renal cyst. *J Chin Med Assoc* 1997;59:232-9.