Simple Renal Cysts: Prevalence, Associated Risk Factors and Follow-Up in a Health Screening Cohort

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Purpose: To investigate the prevalence of simple renal cysts in an adult health-screening cohort, and to evaluate clinical characteristics, associated risk factors and the natural course.

Materials and Methods: Between April and November 2008, a thousand individuals diagnosed with simple renal cyst by ultrasonography in a check-up program were chart-reviewed for demographic-clinical characteristics and cyst features. Follow-up was done via electronic patient records. Univariate and multivariate analyses to evaluate the relationship of outcomes and correlation analysis were done to measure the degree of association between parameters.

Results: The prevalence was 7.7%. There were 123 cysts in 77 patients, followed for 3.5 years (mean). Individuals with cysts were older ($P < .01$). Prevalence rates were 2.7% in individuals younger than 40 years and 23.9% in older than 60. The cysts were predominantly (94.8%) detected in males and most (63.6%) were solitary. No relation with Body Mass Index and total cholesterol levels was found but serum creatinine values were significantly increased in individuals with cysts ($P < .01$). There was no difference in the diagnosis of hypertension and microscopic hematuria in patients with renal cysts, however diabetes/hyperglycemia were more common and increasing age correlated with higher number of cysts (all $P < .05$). Follow-up revealed that the number of cysts were increased and/or the same in 86.5%; the sizes of cysts were larger and/or the same in 78.4% of patients, while in 14% of patients the cyst disappeared.

Conclusion: In a cohort of adults undergoing a health-screening, the prevalence of simple renal cyst was found 7.7% by ultrasonography. Renal cysts were more common in males and elders, and associated with increased levels of serum creatinine and diabetes.

Keywords: kidney diseases, cystic; complications; epidemiology; etiology; prevalence; Turkey.

INTRODUCTION

Simple renal cysts are the most common types of acquired renal cysts. The majority are detected incidentally at the time of radiological imaging for non-renal conditions and do not have associated clinical symptoms. The prevalence of simple cysts differs according to sex and increases with age.[1-3] Clinical observations have revealed that most are unilocular, and since they arise from the cortex, they may distort the renal contour. Although most simple cysts probably remain stable in size and feature, some may enlarge with time and occasionally cause subtle flank discomfort and fullness on physical examination.

Intervention for simple renal cysts is seldom warranted. Although renal cysts are generally regarded as of minor clinical significance, detection and awareness of these lesions may entail anxiety in patients. Besides, recent studies have associated simple cyst incidence with hypertension, atherosclerotic vascular diseases and renal dysfunction.[4-9] Usually, renal cysts are typical "incidental" findings in imaging studies for various medical purposes. Likewise, "check-up" programs which aim for early detection of chronic conditions and malignant diseases represent a way of discovering this kidney pathology. Patients may naturally be concerned about its relevance to general health, natural course and need recommendations on how to deal with this finding.

In the present study we aimed to investigate the prevalence of simple renal cysts in a cohort of adults who went through a "health-screening", and to evaluate their clinical characteristics, associated risk factors and the natural course in our population.

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Table 1. Demographic and clinical characteristics of the cohort.

Variables	Total (n = 1000)	Cyst (-) (n = 923)	Cyst (+) (n = 77)	Univariate *P* Value	Multivariate OR (95% CI), *P* Value
	Mean ± SD	Mean ± SD	Mean ± SD		
Age, year	42.76 ± 10.89	41.97 ± 10.51	52.26 ± 10.91	[a].001**	1.10 (1.07-1.14), *P* < .001**
Gender (Male); n (%)	637 (63.7)	564 (61.1)	73 (94.8)	[b].001**	6.61 (2.08-20.99), *P* = .001**
BMI, kg/m^2	26.71 ± 4.41	26.65 ± 4.48	27.45 ± 3.28	[a].078	0.98 (0.91-1.06), *P* = .673
Creatinine, mg/dL	0.76 ± 0.17	0.75 ± 0.17	0.87 ± 0.16	[a].001**	8.61 (1.08-68.34), *P* = .042*
Total Cholesterol, mg/dL	95.14 ± 40.04	195.05 ± 39.95	196.23 ± 41.39	[a].804	-----
Hypertension, n (%)	55 (5.5)	49 (5.3)	6 (7.8)	[c].306	-----
Diabetes mellitus n (%)	96 (9.6)	82 (8.9)	14 (18.2)	[b].014*	1.43 (0.68-3.01), *P* = .348
Microhematuria, n (%)	50 (5.0)	49 (5.3)	1 (1.3)	[c].170	-----

Abbreviations: BMI, Body Mass Index; SD, standard deviation; OR, odds ratio, CI, confidence interval.
a, Student t-test; b, Yates' continuity correction test; c, Fisher's exact test.
*P < .05; **P < .01.

MATERIALS AND METHODS

Study Population

The study was performed retrospectively by reviewing the electronic charts of 1380 individuals (905 men, 475 women; mean age, 38.74 years; age range, 18–77 years) who presented for a health check-up program between April and November 2008.

Inclusion criteria: Among them, 1000 patients who had an abdominal ultrasonographic evaluation as part of a routine screening were included in this study. This study focused on simple renal cysts (category I according to Bosniak classification) diagnosed by ultrasonography (USG).

Procedures and Evaluations: All cases underwent an abdominal USG by staff radiologists. The presence and characteristics of simple renal cysts were reported. The number, site (lower, middle or upper part of kidney), and maximum diameter of cysts were recorded. Patient records were also reviewed for evaluation of potential risk factors. These parameters included age, sex, Body Mass Index (BMI; kg/m^2), history of diabetes and hypertension, blood pressure measurement. For the purposes of this study hypertension was defined as a systolic blood pressure of > 140 mmHg, a diastolic blood pressure of > 90 mmHg, or current use of antihypertensive medication. Biochemical variables included in analysis were serum total cholesterol, fasting glucose and serum creatinine levels. Results of urine analysis were recorded and microscopic hematuria was defined as > 3 red blood cells per high-powered field. Patients with renal cysts were followed from electronic records for a mean of 3.5 (range: 1-6) years and sequential changes in number and size of the cysts were documented.

Statistical Analysis

Analyses were performed by using NCSS (Number Cruncher Statistical System) 2007 & PASS (Power Analysis and Sample Size) 2008 Statistical Software® program (Utah, USA). Means, medians, ranges, and frequencies were recorded as descriptive statistical parameters. Univariate analyses were performed by Fisher's exact test, Student's *t*-test, and Yates' Continuity Correction test (Yates' chi-squared test). Spearman's correlation analysis was conducted to measure the degree of association between parameters. Multivariate analysis of risk predictors for the presence of renal cysts was assessed by logistic regression. *P* values < .01 and < .05 were considered statistically significant.

RESULTS

The study group was comprised of 36% female (n = 363) and 64% male (n = 637) individuals with a mean age of 42.76 years. A total of 77 patients (7.7%) were diagnosed with simple renal cysts.

Table 1 compares the demographic and clinical features of individuals with and without simple cysts. Of total, 5.5% had a history/diagnosis of hypertension and 9.6% had a history/diagnosis of diabetes. The mean total cholesterol level was 195.14 mg/dL (range: 80 to 475 mg/dL). Urine analyses showed microscopic hematuria in 5% of the cohort. The mean serum creatinine was 0.76 mg/dL (range: 0.34 to 1.5).

The overall prevalence of simple cysts was 7.7% (77/1000). There were a total of 123 cysts in these 77 patients. The mean largest diameter of renal cysts was

Table 2. Descriptive characteristics of all 123 cysts in a total of 77 individuals.

Cyst	no.	%
Right side	24	31.1
Left side	38	49.4
Bilateral	15	19.5
Solitary	49	63.6
Multiple	28	36.4
Lower pole	31	25.2
Mid	65	52.8
Lower pole	26	21.1
Parapelvic	1	0.8

27.86 mm with a range of 5 to 66 mm. The mean number of cysts per individual was 1.59 cysts (range 1-7). In majority of patients (63.6%) a solitary renal cyst was detected. Of patients with multiple cysts, 3.9% had more than five cysts.

Table 2 summarizes the descriptive characteristics of all 123 simple cysts with respect to laterality, number and localization.

Individuals with simple renal cysts were significantly older than those without cysts ($P < .01$). When the cohort was sorted in age groups, the prevalence rates emerged as 2.7% in individuals younger than 40 years, 10% in ages between 40-60, and 23.9% in older than 60 (**Figure 1**).

The cysts were predominantly (94.8%) detected in

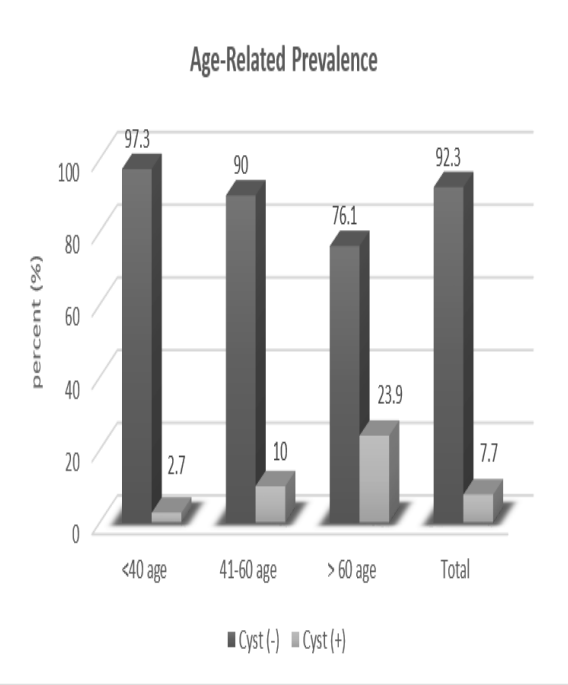

Figure 1: Age-related prevalence of renal cysts

Table 3. Evaluation of clinical characteristics according to number of renal cysts.

Variables	Cyst (+) (n = 77)	
	d_r (95% CI)	*P* Value
Age, year* Number of cysts	0.290 (0.055-0.495)	.010*
BMI, kg/m2* Number of cysts	-0.061 (-0.302-0.203)	.637
Serum creatinine, mg/dL* Number of cysts	0.058 (-0.311-0.237)	.614

Abbreviations: BMI, Body Mass Index; CI, confidence interval. d, Spearman's correlation coefficient; *$P < .05$.

male individuals. Simple renal cysts were observed in 11.45% of the men and 1.10% of the women in our cohort. Thus, the male-to-female ratio was 10.41. The higher prevalence of renal cysts in male gender was statistically significant ($P < .01$). Analysis revealed a statistically significant increase in the mean serum creatinine values of patients with simple renal cysts ($P < .01$). Multivariate logistic regression analysis showed that older age, male gender and a higher serum creatinine level were significant independent predictors for the presence of renal cysts ($P < .001$, $P = .001$, $P = .042$, respectively) (**Table 1**).

There were no statistically significant differences in BMI values and total cholesterol levels in individuals with or without renal cysts. No significant difference was found in the incidence of hypertension and microscopic hematuria in either group ($P > .05$). However, in patients with renal cysts, history/diagnosis of diabetes and presence of hyperglycemia were significantly more common ($P < .05$) (**Table 1**).

In patients with renal cysts, statistical analysis revealed a significant but weak positive correlation of increasing age with the number of cysts ($P < .05$) (**Figure 2**). BMI and serum creatinine parameters did not correlate with the number of cysts ($P > .05$) (**Table 3**). Of the 77 patients who had simple renal cysts, only 43 were available for follow-up for a mean 3.5 years from electronic-chart review. In the following 1 to 6 years, four of these patients had abdominal magnetic resonance imaging (MRI) and the rest had USG results that could be utilized for further evaluation of the previously diagnosed cysts. In six patients no renal cyst was found in further evaluations. Overall, 7 cysts were previously documented in these patients with a mean age of 43.67 years (range: 34-61). The mean diameter of the "vanished" cysts was 10.79 mm (range: 9-13.5). In others, the number of cysts was found to be increased in 15, the same in 17, and decreased in 5 patients. During the follow-up of 37 patients, the diameters of cysts were increased in 14, decreased in 8, and the size remained

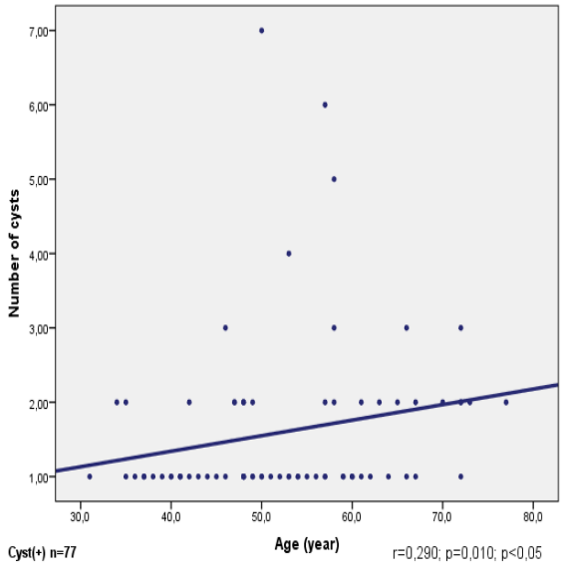

Figure 2: Relation of age to the number of renal cysts (Spearman's Correlation Coefficient $P < .05$)

the same in 15 patients.

DISCUSSION

In the current study, the prevalence of simple renal cysts was 7.7% in an adult health-screening cohort. Simple cysts were found as more common in males and elderly individuals in our study. The results of several published series report the prevalence of simple renal cysts in a range from 5% to 40%.[2,10-16] Incidence of simple renal cysts between birth and age 18 is only 0.2 percent. By contrast, autopsy series have revealed that 50% of patients older than 50 years have grossly recognizable renal parenchymal cysts.[3] Studies which discovered higher prevalence rates (19.9 – 41%) have mostly assessed incidental computerized tomography (CT) findings.[1,10,11] Superior imaging quality of CT or MRI improves the detection of small cystic lesions and therefore may explain higher rates found in some studies. Yet, most of the published prevalence studies have utilized USG in diagnosis due to its non-invasive characteristics and feasibility.

Aside from dependence on the technical qualities of the imaging modality used, the prevalence rates may also alter according to the screened population. There are several prevalence studies from different parts of the world where varied patient databases were used (**Table 4**). These results suggest that there may be geographically determined variations in the prevalence rates.[4,12-18] Additionally, cysts are seen more frequently in "renal patients" as opposed to "non-renal" subjects. Marumo and colleagues reported the incidence of renal cysts as 32.6% for ages 60 years or older in patients referred for asymptomatic microscopic hematuria.[19] A study from Nigeria showed a 15.4% prevalence rate of cystic kidney disease in adult patients from a Nephrology Unit.[20] In a group of 684 outpatients from an internal medicine clinic who had USG for various reasons, 13.7% were diagnosed with simple renal cysts.[21]

The prevalence of simple cysts is well known to correlate with demographic factors. Renal cysts are more frequent in men and the incidence correlates with advancing age.[1,3] Furthermore, cysts are observed more in number and larger in size in older individuals.[10,12,15] The prevalence rates should therefore be gaged by age groups, since any cohort comprising a greater proportion of older individuals would render higher average rates. Statistical analysis of our results confirm these previously established characteristics concerning age and gender. Although the overall prevalence was 7.7% in our cohort, the age-specific rate raised from 2.7% in younger than 40 year-olds to 23.9% in individuals older than 60 years (**Figure 1**). Our study group was composed of people who underwent routine health check-up; and 45% of them were younger than 40 years, and

Table 4. Simple renal cyst prevalence studies from various parts of the world.

Author (year)	Region	Prevalence (%)	Number	Age Range	Cohort
Nko'o Amvere et al. (1991)[17]	Cameroon	3.08	1527	0-82	In-patients
Pedersen et al. (1993)[18]	Denmark	5.2	686	30-70	Volunteers
Yasuda (1993)[14]	Japan	14.0	30316	8-92	In-patients
Pal et al. (1997)[16]	India	5.06	1500	8-86	In-patients
Terada et al. (2004)[13]	Japan	9.9	17914	18-92	Check-up
Mosharafa et al. (2005)[12]	Middle-East	4.2	8551	20->80	Check-up
Chin et al. (2006)[4]	Korea	7.8	6603	15-89	Check-up
Chang et al. (2007)[15]	Taiwan	10.7	577	20-94	Check-up
Present study (2008)	Turkey	7.7	1000	18-77	Check-up

merely 7.1% were older than 60 years. While confirming the high prevalence of simple renal cysts in elderly individuals, the current results also reveal particular information on the prevalence of this pathology in younger people. We found a significant predominance of male sex in occurrence of simple renal cyst. Though the published studies usually report high male to female ratios, we observed an even greater gender disparity in the renal cyst prevalence in our study group (male to female ratio of approximately 10:1 in the present study). This disproportion is uncommon and may be associated with the relatively younger median age of our cohort compared to previous epidemiological studies.

The detection of a solitary lesion in two-thirds of all the individuals with cysts and the correlation of increasing number of cysts with older age in the present study population is in parallel with the descriptive findings in previous epidemiological studies.[12-15]

The causal and temporal relationship of renal cysts with hypertension and renal dysfunction remain controversial. Serum creatinine, hypertension and atherosclerotic diseases are among the main implicated risk factors in the occurrence of simple renal cysts.[4-9,12,13] Chin and colleagues have concluded that presence and characteristics of cysts were not related to decreased glomerular filtration rates.[4] Their results also suggested that number, size and locations of cysts were related to hypertension. In another study, Hong and colleagues, analyzing the data of 29,666 patients, confirmed the association of presence and characteristics of simple renal cysts with a significantly increased incidence of hypertension.[5] Lee and colleagues furthermore assessed the time-dependent relationship between cysts and incident hypertension, and came to a conclusion that after adjusting for confounding factors, renal cysts still significantly increased the risk of hypertension.[6] Others have additionally observed an increased incidence of renal cysts in patients with abdominal aortic aneurysms and dissection, signifying a commonality of connective tissue degeneration.[7-9] However, pathogenesis of simple renal cysts still remains unsubstantiated. The connection of renovascular and arterial pathologies with simple renal cysts can merely be coincidental to age-related changes in renal tubules and ducts. While origins and evolution of renal simple cysts still need to be explored, the only established link is senility.[1]

We observed a significant increase in the mean serum creatinine values of individuals with renal cysts. Comparable outcomes have previously been reported in several investigations on non-renal screening cohorts.[4] The mechanism that links kidney cysts to age and renal function is unknown but it is likely that irregular tubular growth may lead to cystic changes. While renal cysts may be an early sign of renal impairment, older-age should be regarded as a confounding factor for the correlation of higher creatinine with renal cysts.[22] Nevertheless, in the current study, it would be injudicious to derive any association of simple renal cysts with renal parenchymal dysfunction because there was no correlation of cyst number to higher creatinine levels. Moreover, contrary to a common belief that simple cysts cause microscopic hematuria, we did not observe any increased incidence of microscopic hematuria in individuals with cysts. Our results also showed a higher incidence of hypertension in the group with simple renal cysts, but statistical analysis failed to reveal a non-random association. There was also no difference in the BMI, and total cholesterol levels of individuals with and without renal cysts. However there was a significantly increased proportion of individuals with a history and/or diagnosis of diabetes among individuals with simple renal cysts. Evidently, our results do not allow us to simply deduce a correlation of simple renal cysts with a group of risk factors relating to metabolic syndrome.

The natural history of simple renal cysts appears to be exceedingly benign. In addition to our prevalence study, we traced our patients with cysts. Chart review allowed us to obtain information on 43 of 77 patients with cysts, for a mean period of 3.5 years. In 6 patients, subsequent USG examinations did not show any renal simple cysts. The patients whose cysts "disappeared" in follow-up did not have any distinguishing demographic feature but the average sizes of these cysts were remarkably smaller than the overall mean largest diameter. The reasons for the disappearance or shrinkage are unclear, but might include bleeding into the cyst or spontaneous rupture of the cyst into the perirenal space or the collecting system.[24] A study found that in children, diameter of renal cysts increased in 49%, decreased in 10%, unchanged in 31%, and disappeared in 10% when followed-up for a mean 2.9 years.[25] Since the present study lacks any large numbered prospective data of follow-up, we did not attempt to analyze the changes in lesion diameter. When the data was assessed on patient-basis, we found that the number of cysts increased or stayed the same in 86.5%; the sizes of cysts were larger or the same in 78.4% of patients. In their study of 61 patients with a mean follow-up period of 9.9 years, Terada and associates concluded that the majority of simple renal cysts continued to increase in size and number, but some may involute and disappear over time. The cysts they followed had an average increase

of 1.6 mm in size and 3.6% rate of enlargement, which appeared to decrease with age.[23]

The main limitation of the current study lies in the retrospective chart-review format. We also acknowledge that the small number of our cohort makes it difficult to explain the lack of any significant change in cyst features in the follow-up data. Measurement reliability of USG should also be taken into account. A prospective fashion of follow-up would give more insight on the natural course of cyst dimensions and spontaneous disappearance of these lesions. We also believe that lower median age of our check-up cohort might have influenced the striking gender difference in the prevalence rate.

CONCLUSIONS

In a cohort of adults evaluated for a health-screening program, the prevalence of simple renal cyst was found to be 7.7% by ultrasonography. Simple renal cysts were more common in males and elders, and associated with increased levels of serum creatinine and diabetes in our study.

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CONFLICT OF INTEREST

None declared.

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