Screening for Asymptomatic Renal Disease among School Children from Chennai City, India

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Abstract

Background: Urinary screening tests are vital for premature detection of renal diseases in asymptomatic school children and adolescents.

Objectives: The purpose of the study was to identify school children aged from 6 to 18 years with asymptomatic renal disease by urinalysis.

Materials and Methods: Two schools were selected from Chennai city and children between the ages 6 and 18 years attending these schools were included in the study. Children with past history of any renal or medical illness, acute febrile illness, and children with congenital malformations were excluded from the study.

Results: A total of 1000 school children between the ages of 6 and 18 years were screened for asymptomatic renal disease by performing urinalysis. A significant number (10.9%) of school children were positive for asymptomatic renal disease. Males constituted 55.6% of the total participants. Hypertension either systolic or diastolic was observed among 0.3% of participants. The prevalence of proteinuria, pyuria, and hematuria was found to be 4.3%, 5.2%, and 2.5%, respectively. The urinary abnormality was significantly more common in males (14.7%) compared to females (6.1%).

Conclusions: Urinary screening plays a pivotal role in the identification of occult renal diseases in asymptomatic children. Urinary screening is, therefore, useful in early detection and also provides a structural work up for a further plan that may lead to prevention, diagnosis, and management of renal diseases.

Key words: Asymptomatic, Children, Hematuria, Hypertension, Proteinuria, Pyuria, Urinalysis

INTRODUCTION

Chronic renal disease in children has received little medical attention. This condition may be too overt for early detection. Mass urine screening tests in school are the simplest and least expensive way to detect urinary abnormalities which may suggest the presence of a chronic renal disease. A major question for renal medicine in developing countries is how to define strategies that can identify early enough those subjects who are at risk of developing a renal disease in later life. Most epidemiological data on kidney disease originates from data available on end stage renal disease; little information is available on the prevalence of kidney disease. The epidemiological studies that have been performed provide evidence that end stage renal disease represents the tip of the iceberg.[1]

The incidence of end stage renal disease in children ranges from 5 to 6 per million children under the age of 15 years in Europe, Australia, and Japan, to 10 to 11 per million children in the United States of America.[2] The prevalence and incidence of renal disease in developing countries are not well known.[3,4] This lack of knowledge is an obstacle to the adoption of preventive measures which may be of great value in a social and economic environment where treatment of end stage renal disease are not available to the vast majority of population. Hence, screening of

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healthy children is useful in the detection of various kidney diseases.

The goal of a screening program is to recognize a disease in its preclinical phase so that intervention is possible.[5] For screening to be beneficial, it should fulfill certain criteria.[6]

The simplest and least expensive way of screening the apparently healthy subject is urinalysis.[7,8] Several studies have been made using reagent strips documenting their effectiveness in detecting urinary abnormalities at a relatively low cost. Mass screening helps to design population-oriented preventive measures that will limit the need for dialysis and transplantation. Prevention is more important in our setting given the shortage of financial resources and the fact that dialysis centers, equipment, and trained personnel are simply not available to the general population. Hence, this study was planned.

Aim of the Study
To identify School Children aged from 6 to 18 years with asymptomatic renal disease.

MATERIALS AND METHODS

Children between the ages 6 and 18 years attending schools in Chennai city during the period June 2007-August 2008 were included in the study. Children with past history of any renal or medical illness, acute febrile illness, and children with congenital malformations were excluded from the study.

Two schools were selected for conducting the study. One was from a semi-urban location (Iyyapanthangal, Chennai, Government school) and other from an urban location (Shenoy Nagar, Chennai, Government School). A school health program was organized in each of these schools for 7-10 days, respectively. After obtaining informed consent from parents and teachers, students, who met inclusion and exclusion criteria, were selected for the study. A thorough physical examination was done including recording of weight, height, and Blood pressure (BP). Aseptic precaution was explained to the participants for collection of urine sample, and then midstream urine was collected in a clean plastic container. Urine was examined by dipstick for color, turbidity, pH, specific gravity, albumin, and glucose. After centrifugation 3000 rpm/min for 5 min sample was examined microscopically for red blood cell (RBC), white blood cell, casts, and bacteria. Students and school authorities were informed about abnormal urinary findings and were advised follow-up in the hospital for further evaluation. Children whose urine examination showed any one of the following were considered to have urinary abnormality suggestive of a renal disease. Albumin $\geq 2+$, pus cells ≥ 5 cells/hpf, and RBC ≥ 5 cells/hpf. The study population was divided into two groups, one with urinary abnormality and the other without. These two groups were compared using the statistical methods. Data collected was analyzed using the statistical methods such as Chi-square test and Students *t*-test.

RESULTS

A total of 1000 students, who fulfilled the inclusion and exclusion criteria between the ages 6 and 18 years were enrolled in the study. Students <10 years constituted 35.3%, while only 7.3% were between 17 and 18 years of age (Figure 1); this is because the less number of students were enrolled in the higher secondary classes. Among 1000 students screened 55.6% were males, and 44.4% were females (Figure 2). The age versus sex distribution shown in Figure 3 reveals more males compared to females in the age groups >12 years. Male students constituted 20.6% compared to 6.6% females in the age group 13-14 years. Parameters like distribution of age/sex versus weight and height centiles does not achieve any significance. In our study, 2 children had systolic BP of above 95th centile and they belonged to the age group of 13-14 years and the child with diastolic hypertension was in the age group of 11-12 years (Figures 4 and 5). Three samples
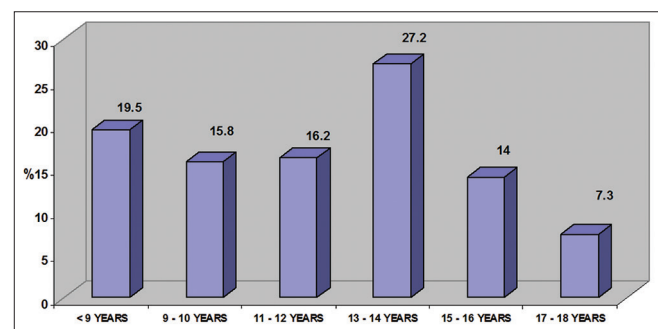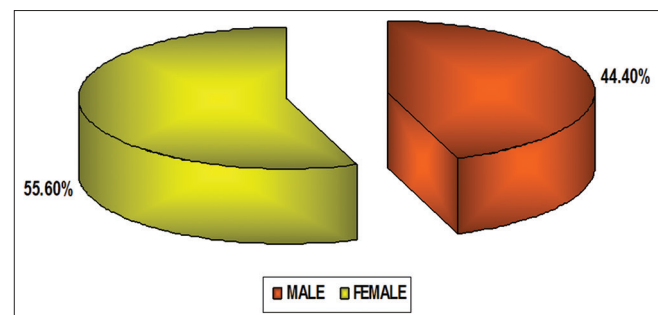

Figure 1: Age distribution

Figure 2: Sex distribution

were positive (0.3%) for glycosuria and 4.3% of children showed significant proteinuria (urine albumin ≥2+, $P = 0.00$), which is significantly seen in males compared to females (Table 1). Pyuria and hematuria were detected in 5.2% ($P = 0.00$) and 2.5% ($P = 0.00$) of children, respectively, with significant male predominance (Tables 2 and 3). The participants were then divided into two groups, one group having any one of the above mentioned urinary abnormalities and the other group without any abnormalities. In our study, among 1000 participants, 10.9% (109) met the criteria for urinary abnormality and the percentage of children with urinary abnormalities increased as age progressed ($P = 0.00$, Figure 6). Urine abnormalities were more prevalent and significant in males compared to females ($P = 0.00$, Figure 7). Urine abnormalities were detected in all 3 children with
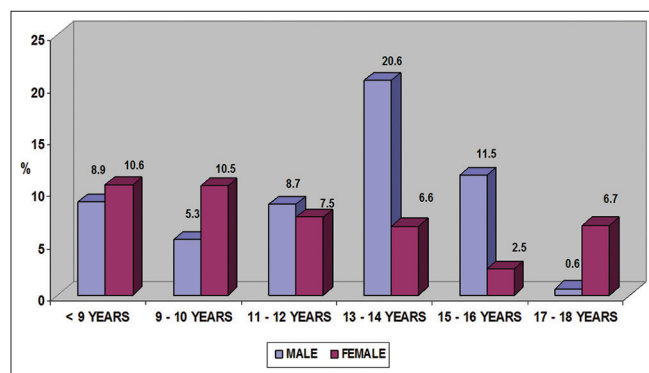
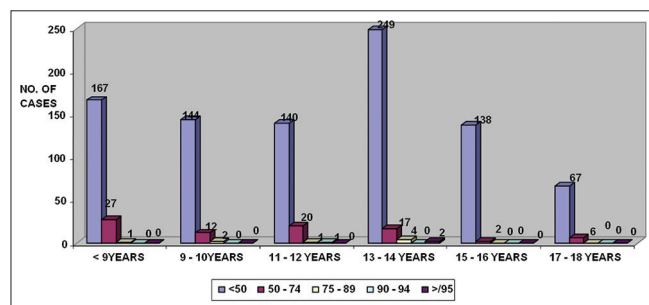hypertension and were significant (Table 4). There was no significance attained between weight (<3rd) and height (<3rd) centiles against urinary abnormalities. Among the 52 children who had pyuria, 75% (39) of these children had isolated pyuria without significant proteinuria or hematuria, and these children, could be cases of urinary tract infection and the remaining 70 children with one or more urinary abnormality, could be cases of asymptomatic renal disease, who need further work up and follow-up to prevent progression to chronic renal failure.

Figure 3: Age and sex distribution

Figure 4: Age group and systolic blood pressure
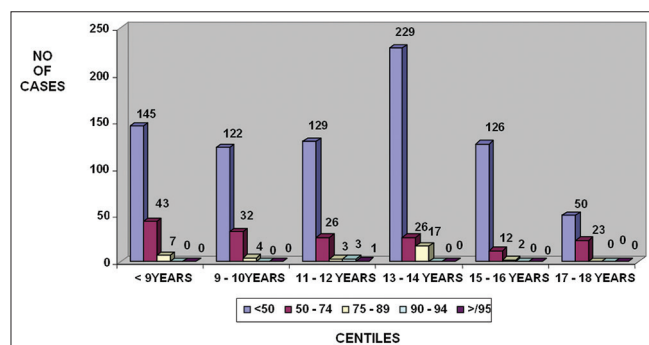
Figure 5: Age group and diastolic blood pressure

Table 1: Urinary albumin according to sex

Albumin/ sex	n (%)		
	Female	Male	Total
Nil	422 (95)	477 (85.8)	899 (89.9)
Trace	7 (1.6)	17 (3.1)	24 (2.4)
1+	2 (0.5)	32 (5.8)	34 (3.4)
2+	11 (2.5)	27 (4.9)	38 (3.8)
3+	2 (0.5)	3 (0.5)	5 (0.5)
Total	444 (100)	556 (100)	1000 (100)

Table 2: Urinary pus cells according to sex

Pus cells/ sex	n (%)		
	Female	Male	Total
Nil	1 (0.2)	1 (0.2)	2 (0.2)
Occasional	135 (30.4)	63 (11.3)	198 (19.8)
1-2	281 (63.3)	341 (61.5)	623 (62.3)
3-4	16 (3.6)	109 (19.6)	125 (12.5)
>5	11 (2.5)	41 (7.4)	52 (5.2)
Total	444 (100)	556 (100)	1000 (1000)

Table 3: Urinary RBC according to sex

RBC/sex	n (%)		
	Female	Male	Total
Nil	376 (84.7)	228 (41)	604 (60.4)
Occasional	8 (1.8)	48 (8.6)	56 (5.6)
1-2	49 (11)	237 (42.6)	286 (28.6)
3-4	5 (1.1)	24 (4.3)	29 (2.9)
>5	6 (1.4)	19 (3.4)	25 (2.5)
Total	444 (100)	556 (100)	1000 (100)

RBC: Red blood cell

Table 4: Relationship of BP and urinary abnormality

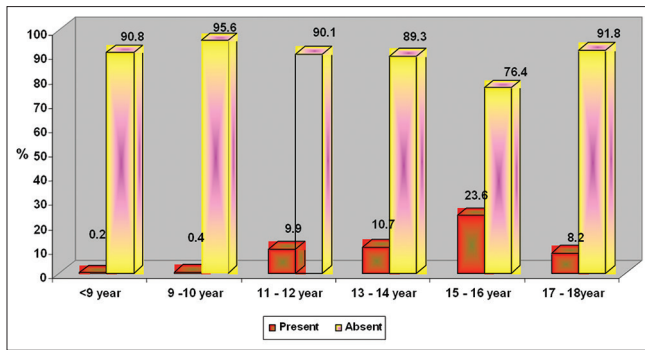| BP centile	n (%)			
	Systolic BP		Diastolic BP	
	Present	Absent	Present	Absent
<90	107 (10.7)	890 (89.3)	108 (10.8)	888 (89.2)
90-94	0 (0)	1 (100)	0 (0)	3 (100)
≥95	2 (100)	0 (0)	1 (100)	0 (0)
Total	109	891	109	891
P value	0.000		0.014	

BP: Blood pressure

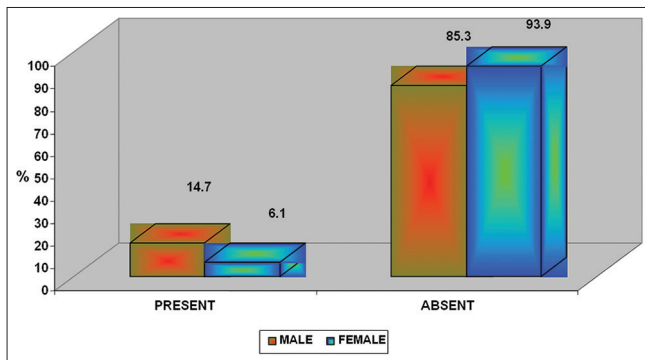**Figure 6: Age distribution and urine abnormality**

Figure 7: Sex distribution and urine abnormality

DISCUSSION

Urinary screening test has been used to identify asymptomatic renal disease in children progressing to chronic kidney disease. Dipstick urinalysis is the most common test used for detecting urinary abnormalities in these children. In Asia, Japan was the first country to start a national urinary screening program for school children aged 6-14 years on an annual basis in 1973[9] Taiwan initiated a national program in 1990[10] covering children from 6 to 15 years old, while Korea's program began in 1998 for children from 6 to 18 years.[11] The process of screening was similar in all the studies. Urine collected from the children was tested using urine dipstick. Those children with proteinuria and/or hematuria underwent a second urinary screen. Those with persistent abnormalities were then referred to a pediatrician or nephrologist for further investigations. There is no such urinary screening program available in India. In our study, we did not do the second screening for children being tested positive in the initial screening.

Hypertension and proteinuria are the factors that contributed to progressive renal deterioration in children with chronic kidney disease, as validated by several studies.[12-14] The primary reduction in nephrons leads to secondary damage of the remaining nephrons due to the consequences of adaptive increases in glomerular

pressure and flow. Glomerular capillary hypertension is normally associated with enhanced transglomerular protein overload. Therefore, early detection of chronic kidney disease, with appropriate management of the risk factors for progression, may slow the development of end-stage renal failure in children.

In our study, the prevalence of urinary abnormalities was 10.9% (109) among the 1000 children subjected for urinary screening. This high prevalence may be explained by the fact that only a single urine sample was screened. This prevalence may be considerably lesser if repeat screening was undertaken. A lower prevalence rate of 0.12%-3.56% was reported by studies from Egypt,[15] Iran,[16] Malaysia,[17] and Japan[9] and all these studies initially had little higher prevalence and dropped to these range on further evaluation. In contrast, a higher prevalence (9.6-30.3%) has been reported in the first urinary screening by authors[18-20] from different geographic regions of the world. Variation in the detection rate of urinary abnormalities on screening in these studies may be due to varying ethnic backgrounds and the prevalence of renal diseases in these populations.

In our study, the prevalence of urinary abnormalities was significantly higher in the older age group, and this was in concordance with other studies.[21-23] In the current study, the male to female ratio was 14.7:6.1 in detection of urinary abnormalities. Lin *et al.*[10] found abnormalities in more males than females, whereas other authors demonstrated urinary abnormalities to be more common in females.[24,25] However, Vehaskari and Rapola.[26] found that the prevalence of abnormalities was not age or gender dependent.

Proteinuria was found in 4.3% of children, and significant proteinuria (urine albumin >2+) is more common seen in boys who are in concordance with Aladekoma *et al.*[4] Hematuria was seen in 2.5% of children with significant male predominance. Several studies demonstrated increased prevalence of hematuria as the age of the study population increased.[3,27] Carel *et al.* found hematuria to be more common in females than males in his urine screening of adult population while Hanif *et al.*[28] found there is no significant difference between two sex in the prevalence of hematuria. 5.2% children had significant pyuria with male preponderance in accordance with studies done by Hanif *et al.*[28] and Plata *et al.*[18]

In the current study, the prevalence of hypertension was found to be 0.3% (>95th centile) which includes both systolic and diastolic BP. This finding was similar to the study conducted by Anand and Tandon.[29] All the 3 children, who had hypertension, were in the age group of 11-14 years and they also had urinary abnormality, which indicates that these children were suffering from some renal disease.

Urine screening in school children is a non-invasive and viable test for early detection of silent renal diseases. Until now, there is no clear consensus statement about urinary screening program to be done for children and adolescent with asymptomatic renal disease in developing countries. Mass urinary screening programs are well recognized in some Asian countries (Japan, Korea, and Taiwan), but this is not the case for North America and Europe because of concern about cost-effectiveness. Sekhar *et al.* analyzed the cost-effectiveness of urinary screening programs, found them to be an ineffective procedure for primary care providers, and supported the recommendations of the American Academy of Pediatrics guidelines.[30] A major question for pediatric nephrologists in developing countries is what strategy should be adopted that can detect silent renal diseases that may manifest later in life. The limitations of our study were that an early morning urine sample was not collected. Repeat evaluation was not done. Further evaluation for the etiology of urinary abnormalities could add significance to the screening of urinary abnormalities in these children.

CONCLUSION

We concluded that urine screening is the simple and feasible method for diagnosis of urinary abnormalities in asymptomatic children which requires periodic re-evaluation to minimize the progression to chronic renal disease, as treatment of end stage renal disease is a difficult option in our setting due to lack of financial resources and inadequate infrastructure.

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