Original Article

Urinary Abnormalities Among Asymptomatic Adolescents in Rural Tamil Nadu

Abstract

Background: The utility of screening for chronic kidney disease in children and adolescents remains controversial. Since it is difficult to screen all the children, we aimed to look into at-risk children who will benefit from asymptomatic urine analysis. **Materials and Methods:** The study was done on 2201 students between 10 and 18 years of age (fifth to twelfth grade) from the rural schools of central Tamil Nadu. Anthropometric measurements were taken, and urine analysis was done in the schools with ten parametric dipsticks. Anthropometry was classified using the World Health Organization's AnthroPlus software. **Results:** Dipstick urinalysis was done on 2121 adolescents, and 10.18% showed an abnormality. The most common abnormality was the presence of red blood cells in urine at 4.2%, followed by leukocyturia at 3.7% and proteinuria at 2.4%. Leukocyturia was more common among females (7.8% versus 0.7% in males). Children with wasting were found to have 1.83 times higher risk for proteinuria (p-value 0.025). **Conclusion:** Children with Body Mass Index Z-Scores < 2, especially females, may benefit from selective urinary screening.

Keywords: *Urine analysis, Chronic kidney disease, Underweight*

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Introduction

Testing for chronic kidney disease (CKD) among adults with CKD risk factors is generally accepted as an effective health intervention. However, the utility of screening for CKD in children and adolescents is controversial.[1] Japanese, Taiwanese, and Korean investigators favor it, while those from North America and Europe virtually reject it.[2] These East Asian countries mentioned above have a well-established routine screening of school children at prespecified ages, which has been running for decades, and have reported some reduction of end-stage renal disease (ESRD) among children after starting the screening programs.[3] Data from Western countries show a low incidence of abnormalities, and major pediatric professional bodies like the American Academy of Pediatrics have recommended against routine urine screening of children.[3] The critical areas of concern are: (i) uncertainty about whether early detection in childhood will lead to a decrease in ESRD incidence and (ii) the cost-effectiveness of such screening programs. We aimed to look for any specific set/group of asymptomatic children who may benefit from urine analysis.

Materials and Methods

This is a school-based cross-sectional observational study. Institutional ethical clearance was obtained before starting the study. The study was done on 2201 students from rural schools from 10 to 18 years of age (fifth to twelfth grade). After consulting school authorities, dates were fixed for school visits. Informed consent forms were obtained, including a questionnaire with each student's relevant past and present medical history, which were to be filled out at home with input from parents. All students with completed consent forms were examined during the school visit.

From the available reports from South India, the prevalence of urinary abnormalities was 7.8%. For a precision of 20%, the sample size for urine analysis was 1169.

All children who consented to urine examination in the age group of 10 to 18 were included in the study. Girls with menstrual bleeding on examination day, children with significant local infection or bleeding from the genital/periurethral area, and children who are known to have renal or urinary disorders and are being treated for these conditions were excluded.

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Data collection

The height and weight were measured following the standard procedure. Urine collection containers were given to the subjects for collecting midstream clean catch urine after ensuring they understood the instructions for collecting the sample. Urinalysis was initially done in the schools with dipsticks (URS 10™ of Teco diagnostics).[4] (Positivity criteria- Leukocytes 1+, >75 cells; Nitrite- Positive; Urobilinogen->16 micromol/l, 1+; Protein- >1+ means 0.3 g/L; Blood->1+,25cells/µL or above; Ketone- >1+ small 15 mg/dL or 1.5 mmol/L; Bilirubin- >small; Glucose- >= 1+/250 mg/dL or 15mmol/L; PH - 5.0–8.5; Specific Gravity- 1.005–1.030).

Data analysis

Data was entered in Epidata (version 3.0) and transferred to SPSS 12.0 for analytical studies. Anthropometry was classified using the World Health Organization's (WHO's) Anthroplus software and Z-scores were calculated. For the urine dipstick, specific cut-offs were used [Table 1]. Standard deviation, p-value, and relative risks odds ratio, 95 % confidence interval (CI), were calculated using SPSS. Graphs, bar diagrams, and scatter plots were derived using Microsoft Excel and SPSS. P-value < 0.05 was taken as significant.

Results

Out of 2201 children, urine analysis was done on 2121 children. Eighty children were excluded (75 with menstrual bleeding, 4 with periurethral infections, and 1 urine sample missing). Table 1 shows the baseline parameters of the screened population.

Two hundred and sixteen adolescents had abnormal findings on the first urine analysis. Seven children with urinary abnormalities did not have anthropometry measurements and were excluded. Among 2112 children with complete data, 209 had abnormal urinalysis.

Hematuria (88, 4.1%) and leukocyturia (79, 3.7%) were the most common abnormalities [Table 2]; 2.4% were found to have proteinuria. Ten (0.47%) had nitrituria. Three children had ketones, and two had glucose in their urine. Leukocyturia was more common among females (7.8% versus 0.7% in males), whereas the prevalence of RBCs was equal in both sexes. Prevalence was 5% in early adolescence compared to 6% in late adolescence.

Table 1: Baseline parameters

Parameters	Total (2201)	Male (1212)	Female (989)
Age	14 ± 1.75	14 ± 2	13.87 ± 1.89
Weight (kg)	38.5 ± 9.958	39.18 ± 10.691	37.69 ± 8.934
Height (cm)	150.24 ± 12.27	152.18 ± 13.448	147.90 ± 10.204
BMI	16.91 ± 3.25	16.55 ± 7.4	17.13 ± 4.3
Systolic BP (mm Hg)	108.96 ± 13.29	109.22 ± 17.32	11.07 ± 25.54
Diastolic BP (mm Hg)	63.46 ± 10.99	63.81 ± 28.9	66.2 ± 34.54

BP: Blood pressure, BMI: Body mass index

Ten children in the normal BMI group and nine in the low BMI group had more than one abnormality [Tables 3, 4], the risk for children with low BMI (underweight and severely underweight) to have any urinary abnormality was 10.7%, similar to 9.8% in children with normal BMI. The relative risk of proteinuria in the low BMI group was 1.8 (p= 0.025), 8.1% of children had atleast one urinary abnormality and high blood pressure, but it wasn't statistically significant [Table 5].

Discussion

Our study shows the presence of urinary abnormality in sufficient number of children as to consider screening in specific populations. Other studies have also reported similar findings. For example, a study from Lebanon among 870 students showed hematuria (1.5%), nitrituria 0.45% and proteinuria 0.1%, and found abnormalities in females more frequently than males.[5] On the other hand in our study proteinuria and hematuria was higher than theirs, and nitrituria was similar. An Indian study from Bangalore by Iyengar *et al.*[6] in 1597 children also found RBCs as 5.8% and proteinuria as 1.9%, with 7.8% having at least one abnormality; In late adolescence, 14–18 years (9.8%), compared to early adolescence, 10–13 years (5.18%). On reevaluation, the prevalence of urinary abnormalities decreased from 7.8% to 1.9%, but then only 54.5% of children were reevaluated. We could reevaluate only 76 out of the initial 216 positive children, and 31 out of these 76 had persistent urinary abnormality (hematuria and proteinuria). Reevaluated samples showed a reduction in overall positivity from 10.18% to 4.15 %, which remains much higher than the Bangalore series. This could be because they looked for only proteinuria and hematuria, whereas we included white blood cells (WBCs), nitrites, and glucose. They were reevaluated three months later which was a limitation of our study.

A study from Tokyo in a population of 560,000 children studied over a period of 13 years showed the prevalence of proteinuria and hematuria among elementary school children to be 0.08% and 0.4%, respectively. In junior high school students, the corresponding prevalence was 0.37% and 0.94%, respectively.[7] This study also showed hematuria as the commonest abnormality. However, the limitation of this approach is its oversensitivity; asymptomatic abnormalities are ten times greater in frequency than glomerulonephritis. Therefore, serial monitoring is mandatory in children with hematuria.

In a Singapore study, a similar observation was highlighted by Yap *et al.*[8] In our cohort, hematuria was higher in the low BMI group (4.9%) than normal BMI (3.8%), though the difference was not statistically significant. Another large study on about 5000 subjects from Pakistan by Jafar *et al*.[9] did not find any correlation between body weight or BMI

Table 2: Gender distribution of urinary abnormalities

Sex	Urinary abnormalities						Any one abnormality	P Value
	Leukocytes	Protein	Glucose	RBCs	Nitrites	Ketone		
Males	8 (0.7%)	21 (1.7%)	1 (0.1%)	44 (3.6%)	7 (0.6%)	1 (1.7%)	70 (5.7%)	<0 .001
Females	71 (7.8%)*	30 (3.3%)	1 (0.1%)	44 (4.8%)	3 (0.3%)	2 (0.2%)	139 (15%)*	

*Statistically significant; there is a significantly higher likelihood of females having leukocytes in urine than males. RBC: Red blood cells

Table 3: Relationship between BMI for age and urinary abnormalities

BMI n = 2112	Urinary abnormalities (n = 209)						
	Leukocytes	Protein	RBCs	Ketone	Glucose	Nitrites	Any one finding
Low* n = 751	22 (2.9%)	26 (3.4%)	37 (4.9%)	1 (0.1%)	0	3 (0.3%)	80 (10.7%)
Normal n = 1200	50 (4.1%)	23 (1.9%)	46 (3.8%)	1 (0.08%)	2 (0.16%)	6 (0.5%)	118 (9.8%)
High* n = 161	6 (3.7%)	1 (0.62%)	3 (1.86%)	1 (0.62%)	0	1 (0.62%)	11 (6.8%)

*BMI according to WHO classification, low as < 2 SD underweight and severe underweight; high as > 2 SD overweight and obesity. BMI: Body mass index; RBC: Red blood cells.

Table 4: Correlation of specific urinary abnormalities with BMI

BMI	Proteinuria			Hematuria			Leukocyturia		
	+ve	–ve	P-value RR 95% CI	+ve	–ve	P-value RR 95% CI	+ve	–ve	P-value RR 95% CI
Low	26 (1.3%)	725 (37.3%)	0.025 1.8	37 (2%)	714 (36%)	0.147 1.3	22 (1%)	729 (37%)	0.175 0.69
Normal	23 (1.17%)	1177 (60. 3 %)	1.004–2.41	83 (4%)	1154 (58%)	0.834–2.024	50 (3%)	1150 (59%)	0.416–1.155

Children with wasting were found to have a 1.83 times higher risk for proteinuria (p-value 0.025). For other abnormalities, there was no significant correlation with BMI. BMI: Body mass index, CI: Confidence interval, RR: Relative risk

Table 5: Relationship between high blood pressure (BP) and urinary abnormalities

Blood pressure	Urinary abnormalities					
	Leukocytes	Protein	Glucose	RBCs	Nitrites	Any one finding#
Normal BP	60 (4%)	40 (2.7%)	1 (0.1%)	64 (4.3%)	10 (0.7%)	115 (10.4%)
High BP*	16 (3.3%)	7 (1.4%)	1 (0.1%)	17 (3.5%)	0 (0%)	39 (8.1%)

*High BP = Prehypertension + hypertension stage 1 and 2. RBC: Red blood cells. All the children in whom urinary abnormality was detected did not undergo BP examination. There were only 154 children with documented BP and urine analysis abnormality. So, there is disparity in the total number. #: anyone positive abnormality

and proteinuria and raised doubt about when proteinuria and poor growth (low BMI) could be two manifestations of underlying renal disease.

RBCs in urine could be a pointer to glomerulonephritis, and early detection of nephritis has the potential advantage of early therapeutic intervention. Tubulopathies usually present with growth failure as an early manifestation, and they are generally not associated with albuminuria (which dipstick detects). But some tubulopathies may have albuminuria as well due to either a defect in the podocyte protein (as with Dent disease) or due to glomerulosclerosis secondary to ischemic event following dehydration. Glomerulopathies are diseases with significant albuminuria as an early manifestation. They will usually have apparent clinical evidence of CKD other than proteinuria [edema, anemia, hypertension (HTN), rising creatinine, etc.] by the time significant growth failure manifests.

Our study has several limitations. One urine sample positive for protein does not mean significant proteinuria unless it is >/ = 2+; it needs to be correlated with specific gravity and follow-up urine tests are required to exclude transient proteinuria (concentrated urine, first morning sample, post menstrual blood, etc.). Our testing was only done using dipsticks and we could not retest these participants with abnormal findings using more sophisticated laboratory methods to confirm the presence of the abnormalities.

In conclusion, our study shows a significant prevalence of urinary abnormalities in adolescence. These findings need to be confirmed in more rigorous studies and will likely inform approach to screen adolescents for kidney disease.

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Conflicts of interest

There are no conflicts of interest.

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