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Urine analysis with dipstick test in asymptomatic 7-year-old children

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Abstract:

INTRODUCTION: The incidence of renal failure in children is increasing worldwide, and most renal diseases do not show clinical symptoms for the patient. Moreover, given the importance of screening for patient identification and prevention planning that result from screening, the present study was performed.

METHODS: This cross-sectional study was performed on 292 children aged 7 years who referred to Neyshabur health centers during 2017–2018. In addition, sampling was clustered. The first urine sample was taken in the morning, and the dipstick test was performed. Data were analyzed using SPSS software version 11.5 and Mann–Whitney, Chi-square, and Pearson's tests.

RESULTS: Of the 292 children, 142 (48.6%) were male and 150 (51.4%) were female. All the boys had been circumcised. The children were 7-year-old. Urinary tract problems were present in 31 (10.61%) children. Urinary problems were observed in 163 children (55.82%) considering crystalluria. Some children had more than one type of urinary disorder. Pyuria was the most common disorder in 13 (8.7%) of the studied children, and proteinuria was the least common. Nitrite and hemoglobin were not found in the urine of the studied children. There was a statistically significant relationship between gender and white blood cell count ($P < 0.001$), crystalline oxalate ($P = 0.004$), and specific gravity ($P = 0.009$). There was also a statistically significant relationship between urinary-specific gravity and pH ($P < 0.001$).

CONCLUSION: Asymptomatic urinary problems may be identified by screening tests in school-aged children. Therefore, it is necessary to determine the exact cause of the obtained abnormal results and determine whether or not they are related to renal disease in order to reduce the number of people with untreated renal diseases in future.

Keywords:

Dipstick urine analysis, renal failure in school-aged children, urine analysis screening

Introduction

Urinary tract infection (UTI) is a term used for a wide range of clinical disorders ranging from asymptomatic bacteriuria to kidney and sepsis infection. The infection involves either the lower parts of the urethra as bladder infection (cystitis) or the upper part of the urethra as kidney infection (pyelonephritis).[1] The prevalence of UTIs in females is generally higher. However, in the first years of children's lives, these infections occur more frequently in boys, with infestations in childhood occurring between 3% and 5% in girls and 1% in boys,[2] with approximately 150 million UTIs per year. As a result, these infections are among the main causes of hospital admission as well as the imposition of medical costs on these centers.[3]

Considering frequency, childhood UTIs are the most common types of infections after respiratory and gastrointestinal infections, and have severe and various complications including chronic renal failure, hypertension, scar in renal tissue, and disorders of the urinary tract. Therefore, these infections require timely diagnosis and appropriate treatment.[4] On the other

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hand, the incidence of renal failure in children is increasing worldwide. Most kidney diseases do not cause clinical symptoms, and kidney problems are usually asymptomatic;[5] hence, a urine test for the early detection of kidney disease may be helpful.[6]

Early diagnosis of kidney disease in children can lead to effective interventions and reduce the number of end-stage renal disease cases. In Korea, Taiwan, and Japan, screening has shown to lead to early detection and effective treatment.[7] In a study conducted on 2000 children of 5–6 years old, Kaplan found that 9% of the samples were abnormal in the first test. This was reduced to 1.5% by repeated urinalysis. Due to the expensive of performing a urinalysis, they have not considered the cost-benefit of multiple tests and only recommended once in 5–6-year old children.[8]

It is recognized that the pattern of kidney disease around the world is different due to the influence of socioeconomic factors,[9] and it is one of the most important causes of referral of children in developing countries.[10]

Urinalysis test with tape test was used because one of the aims of this study is to evaluate the analysis of simple, low-cost, but powerful, urine detection technique in asymptomatic individuals. Thus, with this screening, we can mention parents of the urinary problems before they go through irreversible stages to prevent its progression by identifying and then treating it. Moreover, "prevention is better than cure" slogan can be actualized. It is worth mentioning that the accuracy of this test is 99%.[8]

For positive specimens in the laboratory, microscopic evaluation was made to rule out false causes, and in positive cases, repeated testing was performed to rule out the transient causes of hematuria. Given the importance of screening for patient identification and prevention planning as one of the outcomes of screening, the prevalence of this problem among children[7-10], lack of this type of kit in studies conducted in Iran, lack of funding for sampling across all age groups, and easier access to first-grade students, the researchers conducted this study.

Methods

This was a cross-sectional study carried out in Neyshabur in 2017 and 2018. The sample size was 250, and 292 children were included in the study. After submission of the project to the vice-president for Research Affairs in Neyshabur University of Medical Sciences and obtaining approval from the Neyshabur Department of Medical Ethics Committee (codified with ir.nums.rec. 1396.22), in coordination with the Department of Education and explaining the importance of research to parents and obtaining their written consent and agreement, sampling was done by stratified cluster sampling. In this way, the districts and schools were selected by cluster sampling method, followed by stratified sampling. In view of the gender proportion and school type, simple random sampling method was chosen to select first-grade schools. Inclusion criteria included boy and girl students, aged 7 years, studying in Neyshabur schools, and exclusion criteria included acute fever disease, severe sports activity, and using drugs that could lead to false-positive or false-negative results in urine sample. Data collected from children and their parents included details regarding medications such as analgesics, anticonvulsants, antibiotics, antimalarials, laxatives, hypnotics, rifampicin and chlorpromazine, cephalexin and tetracycline triamine (triamterene), warfarin, aspirin, erythromycin and co-trimoxazole, Vitamin C, L-dopa, and phenyl pyruvic acid (PKU).

Initially, checkups and examinations for all children were completed. The checklist included temperature control and determination of height, weight, and blood pressure. Then, the first urine sample was taken in the morning and was tested using a dipstick test at the Shafa Laboratory (near the Department of Education). For positive specimens in the laboratory, microscopic evaluation was made to rule out false causes, and in positive cases, repeat testing to rule out the transient causes of hematuria was performed.

Parameters such as proteinuria, glycosuria, and hematuria were examined by urine test strip, and the presence of red blood cell (RBC) and white blood cell (WBC) in urine was checked by light microscopy.

On examination by urinary analysis tape of glucose <1+ glycosuria equivalent, protein +1< proteinuria equivalent, and WBCs >5 in the strong microscopic field (WBCs >5 high-power field [HPF]) were considered equivalent to pyuria, and RBCs ≥5 in the strong microscopic field (RBCs >5 HPF) were considered equivalent to hematuria. It is important to note that the criteria for determining the severity of proteinuria or glycosuria by using the urinary analysis tape are visual acuity of change in the color of marker.

In this study, ethical approval related to human research had been included: obtaining authorization from the vice-president for research affairs, submitting a letter to the relevant educational and health centers, providing sufficient explanations to the research units for obtaining written consent from the child's parents, assuring the research units about the confidentiality

of data, generally presenting the results of the tests to the parents, and participants can leave the research at any time. The research data were analyzed using SPSS software version 11.5 (Chicago, IL, USA, 2002, made by IBM Corporation in California, USA). At first, Kolmogorov–Smirnov and Shapiro–Wilk tests were used for the statistical analysis of the normal distribution of quantitative variables in order to use parametric or nonparametric tests for homogeneity of the study variables based on normality or abnormality. Finally, all abnormal variables were analyzed using nonparametric tests (Mann–Whitney, Chi-square, and Pearson's tests) and descriptive statistics. Variables with $P < 0.05$ were considered nonnormal.

Results

Of the 292 children, 142 (48.6%) were boys and 150 (51.4%) were girls. All the boys had been circumcised. The children were 7 years old. Urinary problems were present in 163 children (55.82%) (regarding crystalluria). Some children had more than one type of urinary disorder [Tables 1 and 2].

In the entire study, excluding gender, pyuria was the most common complication that occurred in 13 (8.7%) children. When classified according to gender, WBC rejection was seen in 13 (8.7%) female children and no pyuria was observed in males ($P < 0.001$). Microscopic hematuria, which was the most common disorder, was observed in 7 (4.9%) male children and in one (0.7%) female child. There was no statistically significant difference between the two sexes ($P = 0.053$) [Table 2]. Moreover, a statistically significant relationship was observed between oxalate crystal ($P = 0.004$) and urinary-specific gravity ($P = 0.009$) [Table 2].

Blood (Blood +) was present in 21 (7.2%) children. Nitrite and bilirubin were not found in any of the children studied. Other problems and abnormal findings are summarized in Table 3.

There was also a statistically significant relationship between urine-specific gravity and pH ($P < 0.001$), but no statistically significant difference ($P > 0.05$) between urine-specific gravity and RBC and WBC [Table 4].

RBCs were also positive in 2 (11.1%) of those who had bacteriuria. In addition, RBCs were positive in 2 patients (1.9%) those with pH <5.5 and in 6 children (4.1%) those who had a specific gravity >1015 had positive RBC, in 8 (44.4%) those with pyuria, bacteriuria was positive, and in 5 (4.8%) of those with pH >5.5 were positive pyuria. Moreover, 13 (17.5) children who had positive pyuria had a specific gravity >1015.

Table 1: The number (percentage) of abnormal urine results by dipstick

Urine dipstick results	Number (%)
Positive results	163 (55.82)
Negative results	129 (44.18)
Total	292 (100)

Table 2: Comparison of abnormal results by sex

Variable	Males, *n* (%)	Females, *n* (%)	Intergroup test result
WBC			
>5	0 (0.0)	13 (8.7)	df=1, $P<0.001$, χ^2
Crystalline oxalate			
Negative	119 (83.3)	141 (94.0)	df=4, $P=0.004$, χ^2
Rare	3 (2.1)	1 (0.7)	
Few	10 (7.0)	7 (4.7)	
Moderate	9 (6.3)	0 (0.0)	
Many	1 (0.7)	1 (0.7)	
RBC			
>5	6 (4.2)	1 (0.7)	df=1, $P=0.053$, χ^2
Mean special weight of urine	7.05±0.59	6.11±0.49	$P=0.009$, Mann-Whitney

WBC=White blood cell, RBC=Red blood cell

Table 3: Other abnormal items in examined 7-year-old children

Variable	Negative (%)	Positive (%)
Protein	291 (99.7)	1 (0.3)
Glucose	290 (99.3)	2 (0.7)
Bilirubin	292 (100)	0 (0)
Ketone	291 (99.7)	1 (0.3)
Nitrite	292 (100)	0 (0)
Hemoglobin	292 (100)	0 (0)
Blood	271 (92.8)	21 (7.2)
Bacteria	274 (93.8)	18 (6.2)

Table 4: Relationship between pH, red blood cell, white blood cell, and special weight of urine

Variable	Special weight of urine	
	Correlation coefficient	Significance level with Pearson (*P*)
pH	−0.549	<0.001
RBC	0.086	0.143
WBC	0.070	0.232

WBC=White blood cell, RBC=Red blood cell

Discussion

In the present study, urinary problems including crystalluria were present in 55.82% of children. Some children had more than one type of urinary disorder. Very low proteinuria and hematuria were the most common disorders in boys, and pyuria was the most common disorder in girls. However, in all studies, by ignoring sex, pyuria was the most common complication. Given that we excluded all drugs that affect false positivity or false negativity, as well as the fact that this test is not a confirmation of the disease but it is used for screening

and will be confirmed by subsequent tests, we did not distinguish between false positives and false negatives, and they have not been studied in other studies.

Early detection and prevention of renal disease progression is a way to prevent renal failure; it is important to note that most kidney diseases are asymptomatic until the disease has progressed; therefore, mass screening helps determine the prevalence of kidney disease in asymptomatic children.[11] In our study, 55.82% of children had urinary tract problems, which is not similar to other studies. In addition to hematuria and proteinuria prevalence, we examined other disorders such as pyuria and crystalluria in order to examine the prevalence of kidney stone that was not investigated in other studies in Neyshabur children.

In a study on 2000 cases, Kaplan found that 9% of the samples in the first test were abnormal, decreasing to 1.5% by repeated urinalysis. Due to the expensive of performing a urinalysis, they have not considered the cost-benefit of multiple tests and recommended only one screening at age 6–5.[8] We also did the test once.

In a cross-sectional study in 2010, Hajar *et al*. investigated the prevalence of blood in the urine of primary school students through dipstick testing. Among all students, hematuria was the most common disorder with a prevalence of 1.5%.[12] However, in our study, pyuria was the most common abnormal finding. Nevertheless, hematuria in boys was the most common abnormal finding. Hematuria was also less common in Egypt, Nigeria, and Singapore,[13] but in studies in Egypt and Nigeria, proteinuria was the most common abnormal urinary finding.[14,15] This difference may be due to cultural factors and lack of hygiene and environmental factors such as contamination of water or heavy use of water.

Ashraf *et al*. from the University of Sudan in 2015 performed a large screening on 486 primary schoolchildren and examined the prevalence of hematuria and proteinuria; the female-to-male ratio was equal. Nearly 6.2% of them had proteinuria and 9.4% had hematuria, which was statistically significant. Therefore, routine screening was recommended. In our study, 4.9% had hematuria and 0.3% had proteinuria, which may be due to the need for urine testing as a screening method in children and because the possibility of kidney stones is high.[5]

In 2011, Bazie and Magzoub measured asymptomatic proteinuria and hematuria in 213 children in a village in Sudan. In their study, 11.7% of children had hematuria and 11.7% had proteinuria, all of whom had normal renal function. The researchers concluded that screening at school age is essential. As mentioned above, in our study, hematuria was the most prevalent disorder in boys and proteinuria was the least prevalent regardless gender,[16] which may be because the screening was performed at age 7 in both sexes. In addition, this study considers the primary school-age range.

In Bolivia, abnormal urinary findings were found in 30.3% of children under the age of 5 years, which is similar to our study.[17] In a study in Malaysia, 1.9% of the studied children had abnormal urinary findings, much lower than ours.[18] Proteinuria has been reported among 3.5% of Nigerian children; asymptomatic proteinuria can lead to renal failure,[19] whereas in our study, proteinuria was reported in only 0.3% of the studied children, which may be due to the participant age difference in our study vs Lin study and due to the late screening in most countries and because of socioeconomic differences. In Taiwan, it was reported that 0.3% of the studied children indicated abnormal urinary findings, which is strongly influenced by socioeconomic factors.[20]

Screening in asymptomatic children who have positive urine tests can help prevent kidney problems.[21-25]

Limitations

One of the limitations was the inability to detect false positives and false negatives, so we excluded all drugs that affect false positive or false negative. Also this test is not a confirmation of the disease, but it is used for screening agent. Moreover, the positive cases were strongly recommended for follow-up by complementary tests. In addition, considering the lack of material resources to fund the project costs, the tests were performed only on 7-year-old children.

Conclusion

Asymptomatic urinary problems are usually identified by screening tests in school-age children, and this early diagnosis can prevent progressive kidney disease; therefore, performing urinary screening in children seems to be necessary. By reducing the number of people with incurable kidney diseases in future, the amount of disabilities and costs incurred on the system can be decreased.

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Conflicts of interest

There are no conflicts of interest.

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