

The risk factors of urinary tract infection among elementary school students in Sleman District, Yogyakarta Special Region

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ABSTRACT

Urinary tract infection (UTI) is the second commonest bacterial infection in Indonesian children after respiratory tract infection. In order to establish early diagnosis of UTI, it is important to recognize the risk factors of UTI in children. The aim of this study was to evaluate the association between circumcision, personal hygiene, environmental sanitation, nutritional status, parents' educational level, socioeconomic status, constipation, and class attendance with incident of UTI and to determine its prevalence in elementary school students in Depok and Ngaglik Sub Districts, Sleman District, Yogyakarta Special Region. It was a case-control study using stratified random sampling. Controls were matched with case groups based on school grade and gender. An early screening of UTI using dipstick was conducted, and continued with urine culture to confirm microorganisms infection. The association between the risk factors and the incident of UTI was evaluated using a questionnaire for the students or their parents. Prevalence of UTI in elementary school students in Sleman District was 9.96% with pathogenic microorganisms namely *Klebsiella* (44.1%), *Echerichia coli* (31.2%), and *Pseudomonas* (24.7%). Circumcision (OR=8.00; 95%CI=2.115-193.91; p=0.039) was statistically significant as protective factor of UTI. Furthermore, poor personal hygiene (aOR = 4.314; 95% CI = 2.202-8.451; p = 0.000) and poor environmental sanitation (aOR = 2.481; 95% CI = 1.264-4.872; p = 0.008) were the high risk factors of UTI, whereas lower socioeconomic status and lower educational level of the parents were not significant risk factors of UTI. Other factors i.e. poor/fair nutritional status, constipation and class attendance were not risk factors of UTI. In conclusion, the prevalence of UTI in elementary school students in Sleman District is 9.96%. Circumcision is a protective factor of UTI, whereas poor personal hygiene and poor environmental sanitation are proven as risk factors of UTI.

ABSTRAK

Infeksi saluran kemih (ISK) merupakan infeksi bakteri paling umum kedua pada anak di Indonesia setelah infeksi saluran pernapasan. Untuk menegakkan diagnosis dini ISK, penting untuk mengetahui faktor risiko ISK pada anak. Penelitian ini bertujuan untuk mengkaji hubungan antara sirkumsisi, kebersihan individu, sanitasi lingkungan, status gizi, tingkat pendidikan orang tua, tingkat status sosioekonomi, konstipasi, kehadiran di kelas dengan kejadian ISK dan menentukan prevalensinya pada pelajar sekolah dasar di Kecamatan Depok dan Sayegan, Kabupaten Sleman, Daerah Istimewa Yogyakarta. Penelitian ini merupakan penelitian potong lintang menggunakan *stratified random sampling*. Kelompok kontrol disesuaikan dengan kelompok kasus berdasarkan kelas dan jenis kelamin. Skrining awal ISK dilakukan dengan *dipstik* dilanjutkan dengan kultur urin untuk memastikan mikroorganisme yang menginfeksi. Hubungan antara faktor risiko dan

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kejadian ISK dikaji dengan mengajukan daftar pertanyaan pada anak atau orang tuanya. Prevalensi ISK pada pelajar sekolah dasar di Kecamatan Depok dan Sayegan, Kabupaten Sleman adalah 9,96% dengan mikroorganisme patogen *Klebsiella* (44,1%), *Echerichia coli* (31,2%) dan *Pseudomonas* (24,7%). Sirkumsisi (OR=8,00; 95%CI=2,115-193,91; p=0,039) merupakan faktor pelindung nyata terjadinya ISK. Selain itu, kebersihan individu yang buruk (aOR = 4,314; 95% CI = 2,202-8,451; p = 0,000) dan kebersihan lingkungan yang buruk (aOR = 2,481; 95% CI = 1,264-4,872; p = 0,008) merupakan risiko tinggi terjadinya ISK. Sedangkan, derajat sosialekonomi dan pendidikan orang tua yang rendah bukan merupakan faktor risiko nyata terjadinya ISK. Faktor lain seperti status gizi buruk, konstipasi, kehadiran di kelas bukan merupakan faktor risiko terjadinya ISK. Dari hasil penelitian ini dapat disimpulkan, prevalensi ISK pada pelajar di sekolah dasar di Kabupaten Sleman adalah 9,96%. Sirkumsisi merupakan faktor pelindung terjadinya ISK, sedangkan kebersihan individu dan lingkungan yang buruk terbukti merupakan faktor risiko terjadinya ISK.

Keywords: urinary tract infection - risk factors - protective factor - elementary school students - pathogenic microorganism

INTRODUCTION

Urinary tract infection (UTI) remains a health problem in developing countries including Indonesia. Urinary tract infection is one of the commonest bacterial infection in children, placing as the second most prevalent among infectious diseases after respiratory tract infection.¹⁻³ Urinary tract infection is commoner in male neonates and younger babies compared to the female ones in the first 6-12 months of life. The male to female ratio in UTI varies with age, as it is found as 5:1 in babies and shifts to 1:10 after the second year of life or preschool and school children.⁴⁻⁶

The diagnosis of UTI remains a difficult task probably because its symptoms is non-specific particularly in younger patients. Moreover, the symptoms may be similar to other common diseases. This makes it easy to miss children with UTI.^{2,7} In babies, the common symptoms are fever, agitation, dehydration, diarrhea, constipation, vomiting, or lethargy. In preschool children who are just learning to walk, common symptoms are fever, abdominal discomfort, anorexia, a change in urination pattern, and enuresis after toilet training. In school children and adolescents, the symptoms are similar with those in adults, namely

polakisuria, urgency, dysuria, pelvic discomfort, fever, hematuria, and suprapubic pain.⁸ Despite the signs and symptoms and physical examination findings, urinary examination is needed to confirm the diagnosis of UTI.

Urinary tract infection results from invasion of pathogenic microorganisms such as bacteria, viruses, or fungi to the urinary tract system through the urethra.^{9,10} Gram negative enteric bacteria are the most common etiologic microorganisms in UTI. *Echerichia coli* is the commonest microorganism isolated from 80% cases of uncomplicated UTI in children. Other microorganisms commonly found are *Proteus mirabilis*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa*, Enterobacteriaceae, *Streptococcus viridans*, and *Candida albicans*.^{6,9,10}

Treatment of UTI is generally aimed to eradicate the infection, prevent and treat recurrent infection, as well as find and correct the anatomical abnormality. Children with symptomatic UTI have to be given antibiotics immediately. The choice of antibiotics is based on resistance pattern of pathogenic bacteria in the area.¹⁰ Besides pharmacological interventions, educational intervention to children or parents/baby sitters is very important. The need of drinking a lot of water to assure diuresis and

emptying urinary bladder thoroughly in each urination should be informed to the patients. Girls need to be taught how to clean perineum from the front to back direction.^{10,11}

Risk factors for UTI in children include age, gender, abnormality in urinary tract structure, circumcision, personal hygiene, environmental sanitation related to socioeconomic status, parents' education, and concomitant diseases.¹²⁻¹⁵ Babies and younger children have higher risk for UTI compared to older children due to higher risk to have renal damage. Prevalence of UTI in girls compared to boys varies with age. In neonates and babies up to 12 months, boys have higher risk from UTI compared to girls. However, in preschool and school children, a shift is observed where UTI is more commonly found in girls compared to boys.¹² Abnormality in urinary tract structure including vesicoureteral, urinary stasis, urinary tract stones, and trauma are other important risk factors for UTI.¹³ Circumcision is a protective factor of UTI. Odds ratio of UTI in circumcized children compared to the uncircumcized children is 0.13. Uncircumcized children are susceptible to UTI due to bacterial colonization and attachment. Urethral meatus and periurethral area in uncircumcized children are more possible to contain uropathogenic organisms as indicated with higher bacterial count in this organ. Moreover, reputium also facilitates the bacterial attachment.¹⁴ Personal hygiene, environmental sanitation related to socioeconomic status and parents' education level may influence the incidence of UTI in children. However, the role of these risk factors is still controversial.^{12,13,15} Some diseases such as diabetes mellitus, malnutrition and immune system dysfunction decrease individual immunity leading to increased risk of UTI, whereas constipation in children is often related to UTI. The distended rectum would push the wall of urinary bladder and cause obstruction of the urinary orifice causing instability of detrusor muscle.¹⁶

This study was conducted to evaluate the risk factors of UTI among elementary school students in Sleman District, Yogyakarta Special Region. The findings of this study are important to help healthcare practitioners in this area in managing UTI in children.

MATERIALS AND METHODS

This was an observational study using a case-control study design conducted in several elementary schools in rural areas of Sleman District, Yogyakarta Special Region, in November-December 2008, simultaneous with school children immunization month (*Bulan Imunisasi Anak Sekolah* = BIAS). Target population was school children in rural areas of Sleman District, who were registered in the National Education Board (*Dinas Pendidikan Nasional*) Yogyakarta Special Region in the school year 2007-2008.

Subjects were school children in Depok and Ngaglik Sub Districts, Sleman District who fulfilled the inclusion and exclusion criteria. The inclusion criteria were students of *Sekolah Dasar Negeri* (Public Elementary School=PES) who were willing to participate in this study by signing the informed consent. The exclusion criteria were subjects who were not present at the time of the study and took antibiotics in the month before the study started.

Stratified random sampling based on clusters was conducted in this study.¹⁷ To represent school children in each Sub District, PES in *Puskesmas* (Primary Health Centres/PHCs) Depok-1 area and PHCs Ngaglik-1 area were randomized. Elementary schools were chosen based on BIAS program in PHCs Depok-1 and PHCs Ngaglik-1. Urine samples were taken with the cooperation of PHCs Depok-1 and PHCs Ngaglik-1. Stratification was conducted based on class.

Subjects were divided into case and control group. The sample size was determined based on the size of the samples according to paired

case-control. Control was matched based on school grade and gender. Ninety one cases, and a minimum of 90 controls were enrolled in this study. The case group consisted of children who were diagnosed to have UTI based on urine culture, with bacterial count $\geq 10^5$, while the control group consisted of children who were not proven to have UTI (dipstick result was negative or bacterial count $\leq 10^5$).

The study subjects were urinary samples of elementary school students obtained as clean-catch midstream urine. Early screening was conducted through urinary examination using dipstick. Dipstick with positive urinary samples were then further examined using bacterial count and urine culture to confirm the incidence of UTI. The study was continued by evaluating the relation between variables of risk factors including uncircumcized boys, personal hygiene, environmental sanitation, nutritional status, educational level of the parents, socio-economic status, constipation, class attendance and the incidence of UTI by using a questionnaire for the students or their parents. The questionnaire had been tested previously for its reliability with test-retest method using r-product moment formula.¹⁸

Children diagnosed with UTI were then given antibiotic of choices for UTI (sulfa-methoxazole trimethoprim). After 7 days of treatment, urinary examination with dipstick was performed again. If the clinical features and urinary examination result were in the normal range, the children were considered as cured.

If clinical features and urinary examination result showed signs of UTI, urine culture was reperformed and treatment was adjusted according to antibiotic sensitivity. Besides pharmacological intervention, education was also given to the children and their parents or baby sitters.

Data obtained from case and control groups were compared and analyzed by Chi square and nonparametric test (Mann-Whitney test) using SPSS software, with p value < 0.05 considered as significant. The study has been approved by the Health Research Ethics Committee of the Faculty of Medicine, Universitas Gadjah Mada, Yogyakarta. All parents were given clear explanations regarding the methodology of the research. The children were included in the study if their parents agreed and signed the inform consent.

RESULTS

Characteristics of subjects based on PES in Depok and Ngaglik Sub Districts, Sleman District are presented in TABLE 1. Ninety three of the 934 students in Sleman District during the period of study have proven to have UTI in the early screening using dipstick. The prevalence of UTI was different in each PES with the average prevalence of 9.96%. The highest prevalence of UTI (20.59%) was observed in students of Nanggulan PES, Depok Sub District, whereas the lowest prevalence of UTI (5.6%) was observed in students of Depok 2 PES, Depok Sub District.

TABLE 1. Characteristics of subjects based on PES in Depok and Ngaglik Sub Districts

Public Elementary School	UTI positive N (%)	UTI negative N (%)	Total N (%)
Depok Sub District			
1. Depok 1	11 (10.38)	95 (89.62)	106 (100)
2. Depok 2	5 (5.68)	83 (94.32)	88 (100)
3. Catur Tunggal 4	7 (9.33)	68 (90.67)	75 (100)
4. Ringin Sari	14 (7.11)	183 (92.89)	197 (100)
5. Nanggulan	7 (20.59)	27 (79.41)	34 (100)
Ngaglik Sub District			
1. Karang Jati	12 (9.6)	113 (93.4)	125 (100)
2. Minomartani 1	7 (8.86)	72 (91.14)	79 (100)
3. Ngebel Gede 1	13 (12.04)	95 (87.96)	108 (100)
4. Sardonoarjo	17 (15.18)	95 (84.82)	112 (100)
Total	93 (9.96)	841 (90.04)	934 (100)

Characteristics of subjects based on school grade and gender of students of PES in Depok and Ngaglik Sub Districts, Sleman District are presented in TABLE 2. The prevalence of UTI based on the school grade and gender varied, but not significantly different. The highest prevalence of UTI was observed in students in

the 1st grade (11.4%), followed by students in 2nd grade (10.4%), 3rd grade (10.37%), 6th grade (8.82%), 4th grade (8.63%), and the lowest prevalence of UTI was observed in students in 5th grade (5.98%). The prevalence of UTI in male students (8.55%) was lower than in female students (11.54%).

TABLE 2. Characteristics of samples based on school grade and gender of students of PES in Depok and Ngaglik Sub Districts, Sleman District

Variables	UTI positive N (%)	UTI negative N (%)	Total N (%)	p value
School grade				
• 1 st	35 (11.4)	272 (88.6)	307 (100)	0.736
• 2 nd	20 (10.4)	172 (99.6)	192 (100)	
• 3 rd	14 (10.37)	121 (99.63)	135 (100)	
• 4 th	12 (8.63)	127 (91.37)	139 (100)	
• 5 th	3 (5.08)	56 (94.92)	59 (100)	
• 6 th	9 (8.82)	93 (91.18)	102 (100)	
Total	93 (9.96)	841 (91.40)	934 (100)	
Gender				
• Male	42 (8.55)	449 (91.45)	491 (100)	0.129
• Female	52 (11.54)	391 (88.46)	442 (100)	
Total	93 (9.96)	841 (91.04)	934 (100)	

Signs and symptoms of UTI observed on students of PES in Depok and Ngaglik Sub Districts, Sleman District are presented in TABLE 3. Most of students (80.6%) with UTI in PES in Sleman District were asymptomatic. Among 93 students with UTI, there were only 18 students (19.4%) who had symptoms of UTI consisting enuresis 12.9% (12 students) and cloudy urine 6.5% (6 students).

TABLE 3. The common presenting signs and symptoms of UTI on students of PES in Depok and Ngaglik Sub Districts, Sleman District

Symptoms of UTI	Frequency	Percent (%)
Polakisuria	-	-
Dysuria	-	-
Enuresis	12	12.9
Incontinence	-	-
Pain/tender on abdomen/hip	-	-
Fever	-	-
Malaise	-	-
Vomiting	-	-
Hematuria	-	-
Foul smelling urine	-	-
Cloudy urine	6	6.45

The microorganisms cultured from the urine of the students of PES in Depok and Ngaglik Sub Districts, Sleman District are presented in TABLE 4. The commonest microorganisms cultured in this study was *Klebsiella* (44.1%) followed by *E. coli* (31.2%) and *Pseudomonas* (24.7%).

TABLE 4. The microorganisms cultured from the urine of the students of PES in Depok and Ngaglik Sub Districts, Sleman District

Bacteria	Frequency	Percent (%)
1. <i>Echerichia coli</i>	29	31.2
2. <i>Klebsiela</i>	41	44.1
3. <i>Pseudomonas</i>	23	24.7

Risk factors of UTI in the students of PES in Depok and Ngaglik Sub Districts, Sleman District are presented in TABLE 5. All risk factors observed in this study were found to be associated with UTI in the students enrolled in this study. Circumcision (OR=8; p=0.39) was statistically significant as protective factor of UTI in the students, whereas socioeconomic status (OR=3.3; p=0.001), educational level of parents (OR=2.83; p=0.035), personal hygiene (OR=3.43; p=0.000) and environmental sanitation (OR:3.163; p=0.000) were found to be associated with UTI in the students.

Further analysis using logistic regression and multivariate analysis was performed to evaluate risk factors of UTI among the students of PES in Depok and Ngaglik Sub Districts, Sleman District. The results of analysis are presented in TABLE 6. The results showed that poor personal hygiene was the highest risk factor of UTI in students of PES in Depok and Ngaglik Sub Districts, Sleman District (aOR = 4.314; 95% CI = 2.202-8.451; p = 0.000) followed by poor environmental sanitation (aOR = 2.481; 95% CI = 1.264-4.872; p = 0.008). Meanwhile, lower socioeconomic status (aOR = 1.901; 95% CI = 0.933-3.873; p = 0.077) and lower educational level of the parents (aOR = 1.276; 95% CI = 0.542-3.002; p = 0.577) were not significant as risk factors of UTI of the students.

TABLE 5. Risk factors of UTI in the students of PES in Depok and Ngaglik Sub Districts, Sleman District

Risk factors	Case	Control		OR	p
		Risk +	Risk -		
Circumcision	Risk +	27	8	8.00	0.039
	Risk -	1	6		
Socioeconomic status	Risk +	14	33	3.30	0.001
	Risk -	1	6		
Parents' educational level	Risk +	7	17	2.83	0.035
	Risk -	6	63		
Personal hygiene	Risk +	6	48	3.43	0.000
	Risk -	14	25		
Environmental sanitation	Risk +	31	37	3.16	0.000
	Risk -	12	13		

TABLE 6. Multivariate analysis of risk factors of UTI among the students of PES in Depok and Ngaglik Sub Districts, Sleman District

Risk factors	aOR	95% CI	p
1. Lower socioeconomic status	1.901	0.933-3.873	0.077
2. Lower educational level of the parents	1.276	0.542-3.002	0.577
3. Poor personal hygiene	4.314	2.202-8.451	0.000
4. Poor environmental sanitation	2.481	1.264-4.872	0.008

DISCUSSION

The prevalence of UTI obtained in this study was 9.96% varying from 5.08% to 11.4% depending on the school grade of the students. The highest prevalence of UTI was observed in students in the 1st grade (11.4%), whereas the lowest prevalence of UTI was observed in students in 5th grade (5.98%). The result of this study is almost similar with the result obtained from other study conducted by Rochmanadji and Kosnadi¹⁹ in students of an elementary school in Semarang, Central Java. It was reported that the prevalence of UTI was 10.1% with the highest prevalence was 16.0% and the lowest prevalence was 7.0%.¹⁹ A study conducted in Tuntungan District, North Sumatra reported that

the prevalence of UTI in student of elementary school was lower i.e. 8.0%.²⁰

The prevalence of UTI in girls of the elementary school (11.54%) was higher than in boys (8.55%) in this study, although it was not significantly different. This result is similar with the result reported by Lumbanbatu *et al.*²⁰ in which the prevalence of UTI in girls (7.0%) was higher than in boys (1.0%) in school children in Tuntungan District, North Sumatra. It has been reported in many studies that the prevalence of UTI in girls compared to boys varies depending on age. In neonates and babies up to 12 months, prevalence of UTI in boys was higher compared to girls. However, in preschool and school children, the prevalence of UTI shifts, where UTI is more commonly found in girls

compared to boys.¹² The higher prevalence of UTI in girls compared to boys is related to the anatomy of female urinary tract system. The girls have shorter urethras than boys which makes it easy to get bacterial invasion from perineum to urinary bladder. In addition, microorganism may also be introduced into a girl's bladder by wiping from back to front after a bowel movement, which can contaminate the urethral opening. It may also increase the risk of getting a UTI.⁶

Most of students (80.6%) with UTI in this study were asymptomatic. Among 93 students with UTI, there were only 18 students (19.4%) who had symptoms of UTI. Asymptomatic UTI is the presence of bacteria in urine in the absence of clinical signs or symptoms of UTI in the host. The microbiologic definition is usually e^{10^5} colony-forming units per mL of the same microorganism or microorganisms in two consecutive urine specimens.²¹ The frequency of asymptomatic UTI in children varies for different populations. However, asymptomatic UTI is commoner than symptomatic UTI in children.^{22,23}

The predominant presenting signs and symptoms of UTI on students reported in this study were enuresis 12.9% (12 students) and cloudy urine 6.5% (6 students). Different from other studies, fever was the predominant presenting symptom of UTI in children.^{7,20} Other common symptoms include vomiting, diarrhea, abdominal pains, dysuria, urgency, urinary frequency and costovertebral angle tenderness.^{7,20,22}

There were no other signs or symptoms observed in this study as reported in previous study because the students were selected from the community or their schools. Students who have more severe signs or symptoms would be brought by their parents to the doctor or other health service providers.

The commonest microorganism cultured in this study was *Klebsiella* (44.1%) followed

by *E. coli* (31.2%) and *Pseudomonas* (24.7%). It was similar to other study conducted by Muoneke et al.⁷ in Abakaliki, Nigeria who reported that *Klebsiella* (24.5%) was the commonest microorganism followed by *S. aureus* (21.8%). However, many other studies reported that *E. coli* was the most frequent microorganism isolated from children with UTI.¹⁹⁻²³ The difference of pathogenesis of microorganism of UTI in this study compared to other previous study may be influenced by the bacterial pattern in the areas. It was reported that epidemiology and bacterial pathogens in children with UTI showed large inter-regional and rates of bacterial resistance variability.²⁴

Some factors have been reported to be associated with UTI in children namely age, gender, abnormality in urinary tract structure, circumcision, personal hygiene and environmental sanitation related to socioeconomic status, parents's education, and concomitant diseases.¹²⁻¹⁵ It was reported in this study that circumcision (OR=8.00; 95% CI=2.115-193.91; $p=0.039$) was statistically significant as protective factor of UTI. Furthermore, children with poor personal hygiene had four times higher risk to have UTI compared with children with better personal hygiene (aOR = 4.314; 95% CI = 2.202-8.451; $p = 0.000$), whereas children with poor environmental sanitation had 2.5 times higher risk to have UTI compared with children with better environmental status (aOR = 2.481; 95% CI = 1.264-4.872; $p = 0.008$). Children with lower socioeconomic level had two times higher risk to have UTI compared with children with better socioeconomic level. However, the difference was not statistically significant (aOR = 1.901; 95% CI = 0.933-3.873; $p = 0.077$). Children who had parents with lower educational level had similar risk to have UTI compared with children who had parents with higher educational level (aOR = 1.276; 95% CI = 0.542-3.002; $p = 0.577$).

Other factors i.e. poor/fair nutritional status, constipation, and class attendance were reported not to be risk factors of UTI in this study. Nutritional status could not be assessed, because all children in case and control groups had good nutritional status. Constipation could not be evaluated because children with constipation in case and control groups were not observed. Class attendance also could not be analyzed because there were no children who had high class absence.

A study of risk factors of a disease using a case control design has a limitation concerning the occurrence of recall bias. Data of risk factor exposure in the subjects were obtained by relying on the memory of the children and their parents. The occurrence of recall bias may be caused by subjects' failure of remembering, as subjects who had UTI tended to remember the exposure of risk factor compared with subjects who did not have UTI.¹⁷ To minimize the occurrence of recall bias in this study, the answers to the questionnaire items had been cross-checked between the children and their parents.

CONCLUSION

It can be concluded that the prevalence of UTI in elementary school students in Ngaglik Sub District and Depok Sub District, Sleman District is 9.96%. Furthermore, circumcision is a protective factor of UTI, whereas poor personal hygiene and poor environmental sanitation are proven as risk factors of UTI.

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