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ORIGINAL ARTICLE

Determine the Mean Levels of Vitamin D in Children with First Episode of Urinary Tract Infection

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ABSTRACT

Urinary tract infections (UTI) have a prevalence of 1% in boys and about 1-3% in girls. It is more common in boys under 1 year of age after which the incidence is higher in girls. Vitamin D is a fat-soluble vitamin that is synthesized in the skin epithelial cells and also obtained from diet. It has an important role in bone formation and deficiency of vitamin D leads to rickets in children.

Objective: To determine the mean levels of vitamin D in children with first episode of urinary tract infection.

Study Design: Descriptive cross-sectional study.

Place and Duration of Study: Study was conducted at Department of pediatrics, Fauji Foundation Hospital Rawalpindi from 16th Nov, 2021 to 16th May, 2022.

Materials and Methods: 50 patients fulfilling the criteria for first episode of urinary tract infection included. All patients age, gender, height and weight were noted. Samples were inoculated on culture media and were examined at 24-48hrs for colony counts and bacterial identification. All patients who were tested positive for urinary tract infection had their serum Vitamin D 25(OH) D3 levels done, a deficiency was defined as values of less than 25ng/ml. Data was entered and analysed in SPSS version 22.0

Results: Mean age (6.70+3.9) with ranges from 02 to 12 years and Mean height (cm) and weight (kg) were (121.76+31.58), (25.64+12.36) respectively. There were 12 (24.0) male and 38 (76.0) female patients who were included in the study according to the inclusion criteria. Mean vitamin-D levels in children with first episode of urinary tract infection in the study was (23.46+1.68). Mean vitamin-D levels in children with first episode of urinary tract infection in children ages 02-06 years was (23.36+1.36), whereas mean vitamin-D levels in children ages 7 – 12 years was (23.54+1.91), Mean vitamin-D levels in among male and female children with first episode of urinary tract infection was (22.83+1.26) (23.66+1.76) which was statistically not significant (p-value 0.139). Mean vitamin-D levels in children with first episode of urinary tract infection in children have height between 101 – 175 cm, was (23.50+1.18). Mean vitamin-D levels in children with first episode of urinary tract infection in children having weight between 21 – 50 kg was (23.63+1.88).

Conclusion: The study concluded that average vitamin D deficiency was substantial among children with urinary tract infection.

Keywords: Urinary tract infections. Vitamin D levels, E coli

INTRODUCTION

The commonest organisms causing UTI in children are Escherichia coli and Klebsiella species along with Extended-spectrum beta-lactamase (ESBL) producing organisms (1). Vesicoureteral reflux is a risk factor for urinary tract infection in children. It leads to renal injury and scarring leading to end stage renal disease. Other causes of urinary tract infection are urinary stones, neurogenic bladder, chronic constipation, diabetes mellitus, prolonged urinary catheterization and immunodeficiency(2).

Vitamin D has an important role in immunity, different studies have shown that vitamin D has a role in modulating the innate immune response against different pathogens(3). The immune system is a target for the effects of vitamin D as vitamin D causes the expression of different genes and markers by macrophages and T lymphocytes Recently a lot of studies have showed that vitamin D had an important role in regulating the immune response against different inflammatory and autoimmune diseases. Based on this it was concluded that vitamin D supplementation can help reduce the adverse outcomes of different inflammatory and infectious diseases(4).

Endogenously synthesized vitamin D binds to different receptors and stimulates the defensin genes, it also increases the levels of cathelicidin that has an important antimicrobial role (5). Vitamin D deficiency leads to different infections in children such as tonsillitis, pneumonia, influenza, acute respiratory distress syndrome. Vitamin D also has an important role in urinary tract infection in children as recent studies showed that deficiency of vitamin led to decreased production of uromodulin proteins leading to increased susceptibility to urinary tract infections(6).

Urinary tract infection is common health problem in children in our population , we conducted the present study to see the vitamin D deficiency with urinary tract infection so that early supplementation could be done in children at risk to prevent urinary tract infection and to increase their immunity(7), also to identify if vitamin D deficiency is contributing for urinary tract infection in children as very less studies were available on the role of vitamin D in urinary tract infection in children(8).

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted at Department of pediatrics, Fauji Foundation Hospital Rawalpindi from 16th Nov, 2021 to 16th May, 2022.

Sample size: Total 50 individuals whereas 12 male and 38 were females.

Sampling technique: Urine samples were obtained by midstream clean catch method.

Inclusion criteria:

- Children between the ages of 2 months to 12 years
- Both males and females
- First episode of urinary tract infection

Exclusion criteria

- Presence of any known acute or chronic systemic disease
- Vitamin D or any other vitamin supplementation
- Obesity or malnourished children with height and weight below 3rd centile
- Any known renal disorders/anomalies
- Uncircumcised boys.
- Children taking immunosuppressive drugs

After approval of the ethical committee 50 patients fulfilling the criteria for first episode of urinary tract infection that is who presented with signs and symptoms of dysuria, urgency, burning micturition, increased frequency, abdominal/flank pain were enrolled informed consent were taken from the parents of the patients. All patients age, gender, height and weight were noted. Urine samples were obtained by midstream clean catch method in toilet trained children and by catheters for infants and small children in patients presenting with signs and symptoms of urine infection. Samples was inoculated on culture media and were examined at 24-48hrs for colony counts and bacterial identification. Positive cultures were defined as more than 10^5 CFU/ml of a single pathogen. Urine were also be sent for routine examination. Urinary tract infection is defined as presence of pyuria (5 or more than 5 WBC) on urine routine examination and positive urine culture..

All patients who were tested positive for urinary tract infection had their serum Vitamin D 25(OH)D3 levels done, a deficiency were defined as values of less than 25ng/ml. Other lab tests that were done included complete blood counts, serum CRP,renal function tests, serum calcium levels, serum phosphorous and serum alkaline phosphatase levels .All patients had their ultrasound abdomen/KUB within 48 hours of presentation to rule out any underlying renal disease. All tests were performed in the hospital labs and were verified by a pathologist. Data was analyzed using SPSS version 22. All quantitative variables such as age, height, weight and vitamin D levels were measured as mean and standard deviation. All qualitative data such as gender was measured as frequency and percentages. Post stratification was applied to rule out confounders such as weight, age, gender, education, SES, residence. Independent sample t-test were applied and P-value less than 0.05 were considered significant

RESULTS

Mean age (years) in the study was 6.70+3.9 with ranges from 02 to 12 years. Mean height (cm) and weight (kg) was 121.76+31.58 and 25.64+12.36 respectively. There were 12 (24.0) male and 38 (76.0) female patients who were included in the study according to the inclusion criteria. Mean vitamin-D levels in children with first episode of urinary tract infection in the study was 23.46+1.68.Mean vitamin-D levels in children with first episode of urinary tract infection in children ages 02-06 years was 23.36+1.36, whereas mean vitamin-D levels in children ages 7 – 12 years was 23.54+1.91, Mean vitamin-D levels in among male and female children with first episode of urinary tract infection was 22.83+1.26 23.66+1.76 which was statistically not significant (p-value 0.139).Mean vitamin-D levels in children with first episode of urinary tract infection in children have height between 101 – 175 cm, was 23.50+1.18.Mean vitamin-D levels in children with first episode of urinary tract infection in children having weight between 21 – 50 kg was 23.63+1.88.

Effect modifier like education was stratified and compared with mean vitamin-D levels in children with first episode of urinary tract infection. Mean vitamin-D levels in children with first episode of urinary tract infection was 23.59+1.82, these children have educated parents. Effect modifier like residence status was stratified and compared with mean vitamin-D levels in children with first episode of urinary tract infection. Mean vitamin-D levels in children with first episode of urinary tract infection was 22.68+0.78, these children have parents belong to rural areas. Similarly, effect modifier like social economic status was stratified and compared with mean vitamin-D levels in children with first episode of urinary tract infection. Mean vitamin-D levels in children with first episode of urinary tract infection was 12.66+1.23, these children have parents with low socio-economic status (< Rs. 20,000 / monthly income).

Table 1: Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age (years)	50	2	12	6.70	3.9
	50	66	172	121.76	31.58
Weight (kg)	50	08	47	25.64	12.36
Vitamin D levels	50	20	27	23.46	1.68

Table 2: Distribution of Gender

	Frequency	Percentage
Male	12	24.0
Female	38	76.0
Total	50	100.0

Table 3: Effect modifier stratification with mean levels of Vitamin-D with first episode of urinary tract infection

	Age group	n	Mean	Std. Deviation	P-value
Vitamin D levels	2 - 6 years	21	23.36	1.36	0.720
	7 - 12 years	29	23.54	1.91	
	Gender	N	Mean	Std. Deviation	p-value
Vitamin D levels	Male	12	22.83	1.26	
	Female	38	23.66	1.76	0.139
	Height (cm)	n	Mean	Std. Deviation	p-value
Vitamin D levels	65 – 100	15	23.37	1.41	0.807
	101 – 175	35	23.50	1.18	
	Weight (kg)	n	Mean	Std. Deviation	p-value
Vitamin D levels	8 – 20	19	23.19	1.31	0.374
	21 – 50	31	23.63	1.88	
	education of parents	n	Mean	Std. Deviation	p-value
Vitamin D levels	Educated	33	23.59	1.82	0.454
	Uneducated	17	23.21	1.39	
	Residence	n	Mean	Std. Deviation	P-value
Vitamin D levels	Rural	12	22.68	0.78	0.066
	Urban	38	23.71	1.82	
	Socio Economic Status	n	Mean	Std. Deviation	P-value
a	low (< 20,000 / monthly income)	13	12.66	1.23	0.007
	middle (> 20,000-50,000 / monthly income)	25	23.30	1.91	
	high (>50,000 / monthly income)	12	24.67	0.77	
	Total	50	23.46	1.68	

DISCUSSION

Urinary tract infection (UTI) is the most common bacterial disease in childhood. The incidence is especially high in febrile infants (5-25%), and the recurrence is common after first UTI (12-50%) (9). UTI is frequently associated (15-50%) with primary vesicoureteral reflux (VUR), and reflux nephropathy (renal scars) is a possible cause of childhood hypertension and chronic kidney disease(10). This concept has led to the aggressive treatment and extensive imaging studies to find primary VUR and renal scar in children with first UTI (11). Besides, there are some difficulties in diagnosing UTI in young children; delayed diagnosis from non-specific symptoms and frequent over diagnosis from contaminated urine specimens. The delay in diagnosis and treatment induced renal scar, and over diagnosis is responsible for unnecessary antibiotics, radiation exposure and high cost (12).

Urinary tract infections (UTIs) usually occur as a consequence of colonization of the peri urethral area by a virulent organism that subsequently gains access to the bladder. During the first few months of life, uncircumcised male infants are at increased risk for UTIs, but thereafter UTIs predominate in females(13). An important risk factor for UTIs in girls is antibiotic therapy, which disrupts the normal periurethral flora and fosters the growth of uropathogenic bacteria. Another risk factor is voiding dysfunction(14).

Evidence suggests that vitamin D might play a role in mitigating or eliminating the influence of bacteria in the urinary tract system. Knowledge of the anatomy of the urinary tract helps to understand how the tract can be compromised and result in an infection(15). The urinary meatus is not sterile, but the rest of the urinary tract, including the urethra, bladder, ureters, and kidneys, does maintain sterility. Anatomy in females can make them prone to infections as the urethra is located close to the rectum leaving the meatus potentially exposed to numerous pathogenic organisms. Individuals requiring urinary catheterization are also at increased risk because catheters can introduce bacteria into the urinary tract and bladder (16). Several protective factors can help stop the development of a UTI and include the innate immune system and antimicrobial peptides (AMPS). Evidence suggests that vitamin D might play a role in supporting and enhancing these systems(17).

A recent study done to see the levels of vitamin D in children with UTI showed that mean serum levels of 25(OH)D 3 were 11.7 ± 3.3 ng/ml in children with UTI and 27.6 ± 4.7 ng/ ml in the healthy control uromodulin proteins leading to increased susceptibility to urinary tract infections group ($p < 0.001$) (18). The serum levels of 25(OH)D 3 were significantly lower in children with urinary tract infection showing that vitamin D deficiency was a risk factor for urinary tract infection in children(19).Similarly, Our study also calculated the vitamin D levels in children with first episode of UTI. Mean vitamin-D levels in children with first episode of urinary tract infection in the study was 23.46+1.68.

In our study, effect modifier like age .gender, height (cm). weight(kg) , education , residence status, and socioeconomic status were stratified and compared with mean Vitamin-D levels in children with first episode of urinary tract infection. Our results show significant p value only for socio economic status that is patients belonging to low socioeconomic status have more decreased levels of vitamin D. Another study conducted by Hacıhamdioğlu DÖ, Altun D, Hacıhamdioğlu B et al. showed Vitamin D levels differed significantly between the study and control groups groups ($p<0.05$); however, no differences in urine cathelicidin levels were detected (18).

CONCLUSION

The study concluded that there was average vitamin D deficiency was substantial among children with urinary tract infection. Such studies must be conducted in the other multiple setups, so that to identify vitamin D deficiency contributing for urinary tract infection in children as very less studies were available on the role of vitamin D in urinary tract infection in children.

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