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Distribution and determinants associated with febrile urinary tract infection In infants.

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ABSTRACT:-

INTRODUCTION:-

Urinary tract infections (UTIs) are a common bacterial infection in children, affecting around 7.8% of those under 19 years with urinary symptoms or fever. The prevalence of UTIs varies by age, sex, and circumcision status. Boys are more frequently affected in the first year of life (3.7%) compared to girls (2%), often signaling congenital anomalies of the kidneys and urinary tract (CAKUT). After infancy, girls experience a higher incidence due to anatomical factors such as a shorter urethra. Escherichia coli accounts for 80% of pediatric UTIs, and other bacteria like Enterococcus, Proteus, and Klebsiella are also implicated. Diagnosis is challenging in younger children, where fever and nonspecific symptoms often prevail. This study aims to identify the distribution and determinants of febrile UTI in children aged 1–12 months.

Aim & Objectives:

This study aimed to analyze the distribution and risk factors associated with febrile urinary tract infections (UTIs) in children aged 1 to 12 months. The objective was to explore the prevalence of UTIs across this age group and examine key determinants influencing their occurrence.

Materials & Methods:

A total of 564 infants were included in the study, which was conducted in the Department of Pediatrics at Sree Balaji Medical College and Hospital. Informed consent was obtained from the parents or guardians. Data were collected through interviews using a structured questionnaire, covering demographic information, medical history, symptoms, and breastfeeding patterns. Anthropometric measurements were recorded, and urine samples were analyzed. Statistical analysis was conducted using SPSS version 27, employing the Chi-square test and odds ratio with a significance threshold of $p < 0.05$.

Results:

UTIs were more prevalent among infants younger than six months (OR = 2.33, 95% CI = 1.16-4.65, p = 0.016), while no significant association was found with gender or socioeconomic status. Escherichia coli was the predominant pathogen (59.5%). Poor weight gain (OR = 2.84, p = 0.0039) and the presence of anatomical abnormalities such as vesicoureteral reflux (VUR) (OR = 4.42, p = 0.0002) were significantly associated with UTIs. Breastfeeding had a protective effect (OR = 0.09, p = 0.0001), while tight clothing and uncircumcised status increased UTI risk. Other indicators, including poor feeding and foul-smelling urine, were also significant.

Conclusion:

Infants younger than six months had a higher risk of developing febrile UTIs. While gender and socioeconomic status were not significantly related to UTI occurrence, breastfeeding, circumcision, and anatomical abnormalities played crucial roles in determining the risk. Proper infant care, including breastfeeding and addressing anatomical issues, could reduce UTI incidence in this population

INTRODUCTION:-

Urinary tract infections (UTIs) are one of the most common bacterial infections in children[1], affecting approximately 7.8% of those under 19 years old who exhibit urinary symptoms or fever[2]. The prevalence of UTIs in children is influenced by factors such as age, sex, race/ethnicity, and circumcision status[3,4]. During the first year of life, UTIs are more frequently seen in boys (3.7%) than in girls (2%), and they may signal underlying congenital anomalies of the kidneys and urinary tract (CAKUT)[3]. After the first year, girls experience a higher incidence of UTIs, likely due to anatomical factors such as the shorter length of the female urethra[1,2,4-6], regular colonization of the perineum by enteric organisms, higher vaginal pH, and increased bacterial adherence to vaginal cells[4]

UTIs can be classified according to their site, recurrence, symptoms, and associated risk factors, with acute pyelonephritis (APN), cystitis (CYS), and asymptomatic bacteriuria (ABU) being the primary categories[1,2]. Escherichia coli accounts for approximately 80% of childhood UTIs and is more common in females[2,4,6]. The pathogenicity of E. coli is enhanced by adhesins, including type 1 pili, P-fimbriae, and X-adhesins, which aid in bacterial attachment to uroepithelial receptors, leading to invasion and infection. Additionally, uropathogenic strains of E. coli produce a glycosylated polysaccharide capsule that impairs phagocytosis and complement-mediated destruction, while forming an intracellular biofilm that protects the bacteria from the host's immune response[6,7].

Other bacterial species commonly responsible for UTIs in children include Enterococcus, Proteus, Klebsiella, and Pseudomonas aeruginosa[8,9]. Viral and fungal causes of UTIs in children are rare and typically limited to the lower urinary tract[4,6].

Risk factors for UTIs in children include female sex, CAKUT, bladder and bowel dysfunction (BBD), neurogenic bladder, urolithiasis, diabetes mellitus (DM), and immunodeficiency[1,10]. Diagnosing UTIs in children, particularly those under 2–3 years of age, can be difficult. Fever is a key indicator, especially in infants and non-toilet-trained children, where it may occur alone or alongside symptoms such as poor feeding, failure to thrive, lethargy, irritability, diarrhea, and vomiting. In toilet-trained children, typical symptoms include increased urinary frequency, painful urination, changes in continence, and pain in the lower abdomen or loin[2,11-15].

Our present study aims at identifying the distribution and the determinants associated with febrile urinary tract infection in children aged 1 month to 12 months.

AIMS AND OBJECTIVES:-

Aim:

The main aim is to investigate the distribution and determinants associated with febrile urinary tract infections (UTIs) in children between 1 and 12 months of age.

Primary Objective:

To assess the prevalence of febrile UTIs in children aged 1 to 12 months.

Secondary Objective:

To explore and evaluate the risk factors connected to febrile UTIs in the target population.

MATERIALS AND METHODS:-

The present study is a hospital based cross-sectional study conducted in the Department of Pediatrics, Sree Balaji Medical College and Hospital, Chrompet, Chennai for a duration of 12 months from July 22 to June 23. The study population included Children aged 1 month to 12 month having fever >38.3C attending OPD/ admitted in the Department of Pediatrics, Sree Balaji Medical College and Hospital, Chrompet, Chennai.

The sampling method that was done in our study is purposive sampling method and the sample size was calculated according to Maria Gonzalez et al , Considering the prevalence of UTI in infants as 15.7% with a precision of 3% and 95% CI the sample size is calculated as

sample size is calculated as,

N = Z2 x p x q /d2 Z1-α/2 - two tailed probability for 95% confidence interval = 1.96

p (%) - prevalence of UTI in infants =0.157

d (%) - precision or allowable error for UTI in infants = 3

Sample size calculation = N = (1.96 X 1.96) X 15.7 X 84.3 / $(3)^2$

Thus the total number of participants included in the study= 564

ELIGIBILITY CRITERIA:-

INCLUSION CRITERIA:

- Boys and girls aged 1month to 12 months
- Children with temperature > 38.3°C
- No source or minor potential source of fever as determined by examining physician such as Otitis media (Visualization of redness, loss of landmarks, or abnormal movement of tympanic membrane), URI (Rhinorrhea, cough, upper airway sounds), Gastroenteritis (Abnormal frequency of monofluid or watery stools), Viral exanthem (Rash not identified as having one definite virus as an etiology)

EXCLUSION CRITERIA:

- Children who took antibiotics in the 72h preceding the visit.
- Parental refusal to participate.
- Definite source of fever such as confirmed bacterial infection, meningitis by cerebrospinal fluid cell count, group A b-hemolytic streptococci + by rapid test or culture, pneumonia by chest radiograph, septic arthritis by joint aspirate, cellulitis, perforated otitis media with exudate, adenitis, Scarlet fever, osteomyelitis, specific viral infection such as Varicella Herpetic stomatitis, Coxsackie disease bronchiolitis, Measles, Kawasaki's disease Henoch–Schoenlein purpura as confirmed by the physical examination
- Immunodeficiency (ANC<300)

METHODOLOGY:-

This study includes 564 participants who satisfied inclusion and exclusion criteria. The study was conducted in Department of Paediatrics, Sree Balaji Medical College, and Hospital. Individual participants and the parents/guardians were explained about the study and were assured of confidentiality with regards to their identity. Written and informed consents, assents were acquired from the participants and from their parents/ guardians prior to the enrolment of participants in the study. Both, English and Tamil format of consents and assents are enclosed within the annexure. After obtaining the consent, the respondent was interviewed using the pre-tested structured questionnaire in their preferred language. Demographic, socio-economic and particulars of the child were recorded. Anthropometric measurements such as height and weight were taken. Detailed history of symptoms, past history, treatment taken elsewhere were noted. History about the breast feeding pattern. Urine sample was obtained from the infants for further analysis

ETHICAL COMMITTEE APPROVAL:

Ethical committee approval for this study was sought from the Institutional Human Ethics Committee of Sree Balaji Medical College and Hospital, Chennai.

STATISTICAL ANALYSIS:

The statistical analysis has been carried out using SPSS (Statistical Package of Social Sciences) software version 27. The variables are expressed as percentages and frequencies for the various demographic parameters such as age, gender, socio-economic parameters, educational qualification of the mother and also based on the microorganism causing the UTI infections. The association between the variables is calculated using Odds ratio in order to find the test of significance and a p-value of <0.005 is considered significant.

RESULTS:-

Table 1 : Socio-demographic details of the study participants

S. NO	Socio-demographic details	Frequency N=564	Percentage (%)
	Age		
	<6 months	300	53.2
	>6 months	264	46.8
	Gender		
	Males	287	50.90
	Females	277	49.10
3.	Socioeconomic status		
	Class- I	97	17.1
	Class-II	102	18.2
	Class-III	104	18.4
	Class- IV	121	21.5
	Class- V	140	24.8
4.	Mothers Education		
	Illiterate	77	13.3
	School	263	46.6
	Graduate	226	40.1

Table 1 represents the socio-demographic details of the study participants where in 300 participants (i.e) 53.2% were less than 6 months and 264 participants (i.e) 46.8% were more than 6 months. 50.90% were males and 49.10% were females i.e 287 and 277 participants respectively. Based on B.G Prasad classification, the participants were divided into Class I, II, III, IV, V and 97 participants belonged to Class I, 102 participants belonged to Class II, 104 of them belonged to Class III , 121 participants belonged to Class IV and 140 of them belonged to Class V which is 17.1%, 18.2%, 18.4%, 21.5% and 24.8% respectively.77 of the mothers were illiterate which is 13.3%, 263 mothers attended school which accounts to 46.6% and 226 mothers were graduates which is 40.1%

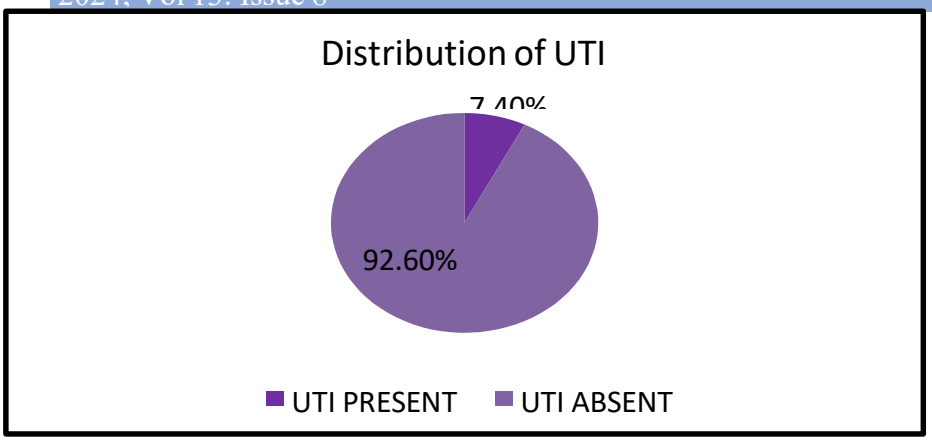

Fig 1: Distribution of UTI Among Study Participants

Figure 1 represents the distribution of UTI among the study participants. UTI was absent in 92.60% of the study participants and UTI was present in 7.40% of the study participants.

Table 2 : Distribution of Organisms in the Urine culture

Pathogen	Frequency N=42	Percentage (%)
E coli	25	59.5
Klebsiella pneumoniae	10	23.9
Pseudomonas	3	7.1
Proteus	3	7.1
Citrobacter	1	2.4
Total	42	100

Table 2 represents the distribution of organism in the Urine culture. Out of the 42 participants with growth in the urine culture, 25 were E.Coli which is 59.5%, 10 were Klebsiella pneumoniae which is 23.9%, 3 were Pseudomonas and Proteus which is 7.1%, 1 was Citrobacter(2.4%)

Table 3 : Association of socio demographic variables with UTI

Socio demographic variables		UTI		ODDS RATIO	95 % CI	P VALUE
		YES N=42 (%)	NO N =522 (%)			
Age	< 6 months	30 (10.0)	270 (90)	2.33	1.16-4.65	**0.016***
	>6 months	12 (4.5)	252(95.5)			
Gender	Male	22 (7.7)	265(92.3)	1.06	0.57- 2.00	0.840
	Female	20 (7.2)	257(92.8)			
Socio economic status	Class I-III	21 (50)	264 (50.5)	-	-	0.991
	Class IV & V	21 (50)	259 (49.5)			
Mothers Education	Illiterate	20 (47.6)	206 (39.4)	-	-	0.500
	Literate	22 (52.4)	316 (60.6)			

*P value <0.05-statistically significant

Table 3 shows the association of socio- demographic variables with UTI. Among the urine culture positive participants 30(10.0%) were less than 6 months, and 12 were more than 6 months which is 4.5% , hence the incidence of UTI is 2.33 times more among participants less than 6 months. 22 (7.7%) of the infected participants were males and 20 i.e 7.2% of them were females denoting that incidence among males were 1.06% more than in females.

21(50%) of the study participants belonged to Class I-III , like wise 21 of them belonged to Class IV and V. 20(47.6%) of the mothers were illiterate , 22(52.4%) of the mother were literate.

Table 4 : Association of symptoms with UTI

Symptoms		UTI		ODDS RATIO	95 % CI	P VALUE
		YES N=42 (%)	NO N=522 (%)			
Temperature	>39°C	20(5)	384 (95)	3.06	1.62-5.78	**0.0006***
	<39°C	22 (13.8)	138 (86.3)			
Vomiting	Yes	7 (9.0)	71 (91)	1.270	.543-2.97	0.580
	No	35 (7.2)	451(92.8)			
Poor feeding	Yes	33(10.2)	290(89.8)	2.93	1.38-6.25	**0.005***
	No	9(3.7)	232(96.3)			
Poor weight gain	Yes	31(10.7)	260(89.3)	2.84	1.39-5.77	**0.0039***
	No	11(4)	262(96)			
Foul smelling urine	Yes	35(10.9)	286(89.1)	4.13	1.79-9.45	**0.0008***
	No	7(2.9)	236(97.1)			
Breast feeding	Yes	11(2.6)	410 (97.4)	0.09	0.04-0.19	**0.0001***
	No	31(21.7)	112 (78.3)			
Obstructive uropathy	Yes	32(10.6)	270(89.4)	2.99	1.43-6.20	**0.003***
	No	10(3.8)	252(96.2)			
VUR	Yes	34(11.7)	256(88.3)	4.42	2.01-9.72	**0.0002***
	No	8(3)	266(97)			
Circumcision	Yes	5 (2.1)	236 (97.9)	0.036	0.01-0.10	**0.0001***
	No	17 (37.0)	29 (63.0)			
Labial adhesions	Yes	15 (11)	121(89)	3.37	1.19-9.55	**0.022***
	No	5(3.5)	136(96.5)			
Tight clothing	Yes	29(10.6)	244(89.4)	2.54	1.29-4.99	**0.0069***
	No	13(4.5)	278(95.5)			
Wiping from back	Yes	34(10.1)	302(89.9)	3.09	1.40-6.81	**0.005***
	No	8(3.5)	220(96.5)			

*P value <0.05-statistically significant

Table 4 represents the association of symptoms with UTI.

Among the participants, 20 individuals (5%) had a fever above 39°C, while 22 (13.8%) had a temperature below 39°C. A fever exceeding 39°C was less common, and a lower temperature was more frequent (3.06%). A significant association was observed between fever and UTI (OR=3.06, 95% CI=1.62-5.78, p=0.0006). Regarding vomiting, 7 individuals (9%)

with UTI had vomiting, compared to 35 (7.2%) who did not. However, there was no statistically significant link between vomiting and UTI (OR=1.270, 95% CI=0.543-2.97, p=0.580).

In terms of feeding patterns, 30 children (10%) with poor feeding had UTI, while only 9 (3.7%) of those feeding well had UTI. Children with poor feeding were 2.93 times more likely to develop UTI, with a statistically significant association (OR=2.93, 95% CI=1.38-6.25, p=0.005).

Weight gain was also analyzed, showing that 31 children (10.7%) unable to gain weight had UTI, compared to 11 children (4%) who gained weight. This association was statistically significant as well (OR=2.84, 95% CI=1.39-5.77, p=0.0039).

For foul-smelling urine, the risk of UTI was four times greater in children with this symptom compared to those without, with the association being statistically significant (OR=4.13, 95% CI=1.79-9.45, p=0.0008).

The study also found that the incidence of UTI was lower among breastfed children, indicating that breastfeeding provides protection. This association was statistically significant (OR=0.09, 95% CI=0.04-0.19, p=0.0001).

Children with obstructive uropathy had a 2.99 times higher risk of UTI compared to those without the condition, with a statistically significant relationship (OR=2.99, 95% CI=1.43-6.20, p=0.003).

Among children with vesicoureteral reflux (VUR), 34 (11.7%) had UTI, while only 12 (4.5%) without VUR had UTI. The risk of UTI was 4.42 times higher in children with VUR, and this association was statistically significant (OR=4.42, 95% CI=2.01-9.72, p=0.0002).

Additionally, 17 children (35%) who were uncircumcised had UTI, compared to 5 (2.1%) who were circumcised. Circumcision was strongly associated with a lower risk of UTI (OR=0.036, 95% CI=0.01-0.10, p=0.0001).

Regarding labial adhesions, 15 children (11%) with this condition had UTI, while only 5 (3.5%) without labial adhesions had UTI. The risk was 3.37 times higher in children with labial adhesions, and the association was statistically significant (OR=3.37, 95% CI=1.19-9.55, p=0.022).

Tight clothing was another factor; 29 children (10.6%) wearing tight clothing had UTI, compared to 13 (4.5%) without tight clothing. The likelihood of UTI was 2.54 times higher in those wearing tight clothing, and this association was statistically significant (OR=2.54, 95% CI=1.29-4.99, p=0.0069).

Finally, 34 children (10.1%) who wiped from back to front had UTI, compared to 8 (3.5%) who wiped from front to back. The risk of UTI was 3.09 times higher in children who wiped from back to front, with the association being statistically significant (OR=3.09, 95% CI=1.40-6.8, p=0.005).

DISCUSSION:-

In this study, the prevalence of febrile UTI was 7.4% (42 cases). This aligns with findings from Alejandro Hoberman et al., who reported a prevalence range of 4.1%-7.5%, but contrasts with Kathy N. Shaw et al.'s[16] report of a lower prevalence of 3.3%. Regarding age, 53.2% of the infants were under 6 months old, while 46.8% were over 6 months. A significantly higher risk of UTI was found among febrile infants younger than 6 months (OR=2.33, 95% CI=1.16-4.65, p=0.016). This differs from Dharni et al.'s[17] study, which found that 63.8% of febrile UTI cases occurred in infants younger than 6 months.

In terms of gender, 50.9% of the infants were male and 49.1% were female, with no significant association between gender and UTI (OR=1.06, 95% CI=0.57-2.00, p=0.840). This finding contrasts with Almofarreh M et al.'s [18]research, which highlighted gender as an important factor in UTI occurrence, particularly noting a higher prevalence among female children. When looking at socioeconomic status (SES), 24.8% of the infants belonged to the lowest class (class 5), followed by 21.5% in class 4. While UTI was more common among infants from lower and middle SES backgrounds, likely due to hygiene and nutrition issues, there was no significant association between SES and UTI in this study (x^2=0.26, p=0.99). This finding differs from Moftah M. Rabeea et al[19]., who observed a higher prevalence of febrile UTI in children from lower socioeconomic backgrounds.

Escherichia coli was identified as the leading cause of UTI, being isolated in 59.5% of cases, followed by Klebsiella (23.9%), Pseudomonas, Proteus (7.1% each), and Citrobacter (2.4%). This finding aligns with other studies, including those by Lee et al[20]. and Arvind Bagga et al[21]., which identified E. coli as the most common pathogen in first-time and recurrent UTIs. The study also analysed maternal education, showing that 40.1% of the mothers were graduates and 46.6% had basic school education. There was no significant relationship between maternal education and UTI occurrence (x^2=1.38, p=0.50). This contrasts with the findings of Kendal et al[22]., which linked maternal illiteracy to higher UTI rates, attributing this to insufficient hygiene knowledge.

Infants experiencing poor weight gain were significantly more likely to develop UTI (OR=2.84, 95% CI=1.39-5.77, p=0.0039), a finding consistent with P.L. Prasad et al.'s study[23], which also found a strong link between poor weight gain and UTI. Furthermore, breastfeeding appeared to offer protection against UTI, as breastfed infants had a lower prevalence of the infection (OR=0.09, 95% CI=0.04-0.19, p=0.0001), a result that echoes Itzhak Levy et al.'s research. Other significant associations were found between UTI and symptoms such as poor feeding (OR=2.93, 95% CI=1.38-6.25, p=0.005) and foul-smelling urine (OR=4.13, 95% CI=1.79-9.45, p=0.0008). These results are in line with findings by P.L. Prasad et al. Additionally, UTI risk was significantly higher in children with vesico ureteric reflux (VUR) or obstructive uropathy (OR=4.42, 95% CI=2.01-9.72, p=0.0002), consistent with studies by Zhang et al[24]. and Prasad et al., which also demonstrated an increased UTI risk in children with anatomical abnormalities. Circumcision was found to be protective, with uncircumcised children having a higher prevalence of UTI (OR=0.036, 95% CI=0.01-0.10, p=0.0001), a result that concurs with Kathy N. Shaw et al.'s findings.

Tight clothing was another significant risk factor, with children wearing tight clothing more likely to develop UTI (OR=2.54, 95% CI=1.29-4.99, p=0.0069), a result that aligns with Prasad et al.'s research. On the other hand, factors such as gender, SES, maternal education, duration of fever, and vomiting showed no significant association with UTI in this study, indicating they may not play a significant role in the development or severity of febrile UTI. Further research is needed to clarify the relevance of these factors.

The findings underscore the importance of thoroughly evaluating febrile infants for UTI, even in cases without obvious symptoms, and support the practice of obtaining urine cultures from such infants. However, UTI incidence appears to vary based on factors such as gender, race, and fever characteristics. Study limitations include a small sample size, lack of differentiation between inpatient and outpatient care, and no testing for antibiotic susceptibility.

STRENGTH:-

Our study stands out as one of the first to comprehensively examine and integrate multiple factors contributing to the development of febrile UTI in infants under one year of age, a crucial developmental stage. While numerous studies have focused on individual factors, our research provides a more holistic view, establishing positive correlations between these factors and UTI occurrence in this vulnerable population.

LIMITATIONS:-

However, the study does have limitations. Conducted in a hospital setting, the sample size was relatively small, potentially limiting the generalizability of the results to the broader community. Additionally, the strict criteria used to define UTI in the study reduced the number of cases included. Many cases with negative or low colony counts in urine cultures were excluded, possibly due to the prior use of over-the-counter antibiotics before sample collection. By adhering to these cutoffs, we may have overlooked a number of UTI cases with colony counts below the threshold. Therefore, larger and more comprehensive studies are necessary to confirm our findings.

CONCLUSIONS:-

The study revealed a UTI prevalence of 7.4% in the population studied. Infants under six months were found to have a significantly higher risk of UTI, with a strong association between age and UTI occurrence. No gender predisposition was identified. The mother's educational level and socioeconomic status did not show a significant relationship with

UTI. However, a strong correlation was found between the severity of fever and UTI, though the duration of fever and the presence of vomiting were not significantly associated. Other factors such as poor feeding, failure to gain weight, and foul-smelling urine were strongly linked to UTI.

Additionally, circumcision and labial adhesions were significantly associated with UTI, while breastfeeding was found to be protective. Vesicoureteral reflux (VUR) and obstructive uropathy were also strongly associated with UTI, and the use of tight clothing and improper wiping from front to back increased the risk.

In clinical practice, UTI should be considered as a potential diagnosis for infants and children presenting with fever without localized signs. Delayed treatment can result in serious complications like hypertension and renal scarring, highlighting the importance of not only treating the UTI but also investigating any underlying conditions.

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