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ORIGINAL RESEARCH

Prevalence of urinary tract infection and associated factors in hospitalized patients aged 0 to 5 years.

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Abstract

Introduction: Urinary tract infection is a frequent affliction in children, and its recurrence predisposes the patient to chronic pathologies that decrease the survival of hospitalized patients. The objective of the present study was to determine the prevalence of urinary tract infection and associated factors in hospitalized children aged 0 to 5 years.

Methods: The present study is cross-sectional analytical. The universe was made up of children hospitalized in pediatrics, aged 0-5 years, at "José Carrasco Arteaga" Hospital in Cuenca-Ecuador. The sample was probabilistic, with 147 cases, while the sampling was simple random. The variables were the presence of UTI, age, sex, socioeconomic status, balanitis, constipation, and history of UTI. In the bivariate analysis, the association was determined using chi-square, and the intensity of the association was measured by prevalence ratio (PR) with a 95% confidence interval and a significant value of P <0.05.

Results: There were 147 cases. The prevalence of UTI was 10.6%. The following were presented as protective factors: age <1 year PR 0.21 (95% CI 0.16-0.42, *P* <0.001) and male sex PR 0.28 (CI 0.18-0.471, *P* <0.001). The risk factors were: low-middle socioeconomic level PR 1.70 (CI 1.01-2.86, P = 0.04), balanitis PR 3.23 (CI 2.48-4.21, P = 0.012), phimosis PR 29.37 (CI 6.34-136.3., *P* <0.001), synechiae PR 1.43 (CI 1.14-1.79, *P*= 0.02), history of urinary tract infection PR 78.91 (CI 10.72-580.7, *P* <0.001), and constipation PR 4.51 (CI 2.16-9.50, *P* <0.001). Hydronephrosis was the most frequent ultrasound finding PR 78.9 (CI 10.7-580.7, *P* <0.001).

Conclusions: Male sex was a protective factor, and anatomical alterations of the urinary tract were the major risk factors.

Keywords: Urinary tract infection, Pediatrics, Associated factors.

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Introduction

Urinary tract infection (UTI) is defined as the presence of microorganisms in urine that can manifest asymptomatically or symptomatically, affecting any part of the urinary system: the kidneys, ureters, bladder, and urethra. The most common have been described as occurring in the lower tract; however, if the urinary tract infection spreads to the kidneys, it can have serious consequences [1].

UTI is a common pathology in children, especially those under 5 years of age. It is said that, for this age, about 8% of girls and 1 to 2% of boys have had at least their first UTI; however, children who have one episode will not have another because it is a condition with a very good prognosis, though it can also be the early clinical manifestation of congenital anomalies or related to functional alterations [2].

There are risk factors that increase the prevalence and recurrence of urinary tract infections, which include sociodemographic factors. Women are significantly more likely to experience UTI than men. Other factors included ages between 1-2 years due to physiological phimosis, patients lived in rural areas, had a corresponding medium-low socioeconomic level, and were in the care of third parties who are not related to the family. Clinical circumstances are also known, including anatomical alterations (vulvar synechia and phimosis), constipation, balanitis, a history of UTI, and malformations detected by ultrasound, which can contribute to a high risk of reinfection, kidney dysfunction, and chronic pathologies that compromise the child's life [3, 4].

Knowledge about the prevalence and risk factors, together with certain clinical and epidemiological evaluation considerations, are essential to guide preventive strategies for urinary tract infection. As it is a disease with high morbidity, it is essential to recognize patients vulnerable to long-term renal involvement secondary to the recurrence of this disease. Currently, limited investigations in our environment demonstrate the existence of associated factors. Many of these studies were carried out in healthcare contexts different from ours.

Urinary tract infection is the most common bacterial disease in childhood. It is a frequent reason for consultation in children, with a variable incidence according to age and sex. In children under 5 years, it reaches 5-10% with a greater preponderance in women. It is a clinical entity that, if not diagnosed early, and without timely treatment, can lead to short-term complications such as hospital admissions for urinary reinfections, which cause financial expenses for parents or legal representatives, as well as for the health system. In the long term, it can cause health problems of a chronic nature, such as secondary arterial hypertension and severe pyelonephritis, which are conditioning factors for kidney scars and limitation of kidney function [5].

According to the bibliography, the Mexican Pediatric Society in 2018, the Colombian consensus in the same year, and the Spanish Pediatric Society in 2019 identified associated factors that may predispose one to UTI, among them urinary tract abnormalities, the presence of phimosis in infants, a short urethra, constipation, pinworm infection, bladder dysfunction, and neurogenic bladder [6-8].

The combination of the child's biological factors, added to those derived from the social and family environment, enhances the effect of each of them and increases the probability of urinary tract infection and its possible complications.

At present, few studies in our environment represent the link between associated variables and the presence of urinary tract infection in the age group under 5 years. Our study is directed toward primary prevention. Therefore, the following research question arose: What is the prevalence of urinary tract infection and the relationship with associated factors in children under 5 years of age in the pediatric service of the Hospital "José Carrasco Arteaga" from May 2018 to November 2019? We propose an observational study to answer this question.

Population and methods

Type of study

A cross-sectional analytical study was carried out.

Stage

The study was carried out at the "José Carrasco Arteaga" hospital belonging to the Ecuadorian Institute of Social Security, in Cuenca-Ecuador. The study period was from May 1, 2018 to November 30, 2019.

Universe and sample

The universe was hospitalized patients in the pediatric service, 0-5 years of age. The sample was probabilistic. It was calculated in the Epi InfoTM program (CDC, Georgia, USA) by calculating the sample size and precision to estimate a population proportion of 1,221 hospitalized patients between the ages comprising the study, with an expected frequency of UTI of 11%, a confidence level of 95%, and an error of 5%, obtaining a necessary sample of 134 patients. With the addition of 10% losses, the total sample is made up of 147 patients. The sampling was simple random.

Participants

Patients between 0 and 5 years of age, hospitalized in the presence of a legal companion who signed the informed consent for participation in the study, were included. Patients with insufficient medical records, insufficient urine samples, and the application of creams and antibiotic intake were excluded.

Variables

The dependent variable was the presence of urinary tract infection. The independent variables were age, sex, origin, socio-economic condition, family income, care by third parties, nutritional status, visible anatomical alterations (synechiae, phimosis), balanitis, constipation, previous urinary infection, and anatomical alterations found in ultrasound in patients with a diagnosis of UTI.

Methods, techniques, and instruments

The data were obtained through an interview and observation of the medical record in the AS400 system. After authorization by the directors of the "José Carrasco Arteaga" Hospital and the acceptance of the parents or legal representatives through informed consent, a form designed by the first author was applied. Through an interview, the following information was recorded:

Assessments of nutritional status were carried out through stratification by gender and age, as well as the use of standardized WHO curves. The level of socioeconomic status was defined through the stratification survey of the socioeconomic level of the INEC (National Institute of Statistics and Censuses), while family income was stratified according to the unified basic salary of the country. Through the physical examination, the presence of visible anatomical alterations (synechiae, phimosis) was determined. The presence of balanitis was defined by history and physical examination. According to the Roma criteria, the diagnosis of constipation was determined. The ultrasound alterations found in patients diagnosed with UTI were described, the history of UTI was questioned, and the diagnosis of UTI was determined using EMO (elemental urine test) and positive urine culture. For the collection of the urine sample, the technique was used according to age and sex, following the protocol established in the institution.

Children under 2 years (lurking method)

Hand washing was carried out before and after the collection of the sample. The genital area was cleaned with saline solution and sterile gauze. Boys: The entire penis was placed inside the bag and the adhesive was attached to the skin. Girls: The bag was placed over the two skin folds on each side of the vagina (labia majora).

In the cases in which the EMO result gave us a positive value for infection, we proceeded with the prior consent and company of the parents to perform bladder catheterization, as it is the method of choice in incontinent children [9].

Bladder catheterization

Hand washing was performed before and after collection of the sample, followed by washing of the genital area with saline solution and sterile gauze. Gloves were changed, using a sterile technique, and the distal end of the catheter was placed inside the sterile collection bottle. Lubricating gel was placed at the proximal end to be introduced into the urethra. Behind the child, the mother immobilized him and the catheter was inserted into the meatus. It was gently inserted until urine reflux was obtained. The first milliliters of urine were discarded to avoid contamination.

The samples were transferred to the laboratory of the "José Carrasco Arteaga" Hospital and were taken maintaining the 4 °C of the cold chain by means of a cooler and were analyzed. The EMO was carried out, including the physical, chemical, and microscopic analysis of the urine. The instrument used was the microscope. All fields were observed with a 40x lens.

Depending on the elements found, they were reported by crosses or the number per field. Urinary infection was considered with the presence of more than 5 leukocytes per field and the presence of bacteria in the urinary examination. If there were nitrites in the chemical analysis, a urine culture was requested from all patients to analyze the type of isolated germ and antibiogram [10].

Positive urine culture criteria: collection bag: > 100,000 CFU / ml, confirm with bladder catheterization, clean mid-urination urine: > 100,000 CFU / ml, bladder catheterization > 50,000 CFU / ml [9, 10].

Children over 2 years

In children with sphincter control, the collection of urine in the middle of urination (medium stream), with prior hygiene of the genitals, retraction of the foreskin in boys, and separation of the labia majora in girls, is the recommended method [11]. It was sent to the laboratory within 30 minutes of collection and the steps described above were followed.

Statistical analysis

Once the data were collected, they were codified and recorded in a database in the SPSS v.15 system (IBM, Chicago, USA).

Frequency and percentages were obtained from the quantitative and qualitative variables, such as age, sex, origin, nutritional status, socioeconomic status, family income, anatomical alterations, balanitis, constipation, history of UTI, and presence of malformations detected by ultrasound.

To determine the prevalence of urinary tract infection, the total number of patients with UTI was divided by the total number of hospitalized patients 0-5 years old until the completion date of data collection.

To determine association, the variables were dichotomized using the SPSS v.15 system. The prevalence relationship was obtained with the following formulas: (a / a + b) / (c / c + d). The association was considered positive if the PR was greater than 1. There was no association if the PR was equal to 1, and a negative association if the PR was less than 1.

The 95% CIs were obtained for these PRs. Values that were less than 1 were considered reliable. P values were also obtained using chi2 and statistical significance was achieved when the P value was less than 0.05. The confidence interval for proportions was obtained.

Control of sources of bias

Patients with an incomplete medical history or data were excluded.

Results

Participants

The target population consisted of a total of 1,385 patients, of whom 147 presented a UTI, marking a prevalence of 10.6% (95% CI 10.57% -10.66%).

Characteristics of the studied population

The female sex was the predominant (71.4%) one, while the most frequent age group was 1-12 months (29.3%). Urban origin was the most frequent origin (83%), with medium-low socioeconomic status (64.4%), in which 1-2 basic salaries were counted as family income (76.7%), and the patients were in the care of third parties (45.9%). These data are presented in Table 1.

Table 1 Sex, age, place of residence and socioeconomic status

Variable(s)	Frequency n=147	Percentage (%)
Sex		
Female	105	71.4%
Male	42	28.6%
Age		
1-12 months	43	29.3%
13-24 months	28	19%
25- 36 months	25	17%
37-49 months	11	7.5%
50-60 months	40	27.2%
Place of residence		
Urban	122	83%
Rural	25	17%
Socioeconomic status		
Middle class upper stratum	28	19.2%
Middle class typical stratum	20	13.7%
Middle class lower stratum	95	64.4%
Lower class	4	2.7%
Family economic income		
< 400 USD	3	2.1%
>400-800 USD	113	76.7%
>800 USD	31	21.2%
Third party care		
Parents	30	20.5%
Relatives	49	33.6%
Not relatives	68	45.9%

Clinical features

Of the patients with a diagnosis of UTI, the highest percentage was within the normal nutritional state. Anatomical alterations were observed in 23.2%, constipation appeared in 24.7%, 34.9% had a history of infection (Table 2). In patients with a diagnosis of UTI, an ultrasound with renal screening was performed in which there were 4 cases (2.7%) of neurogenic bladder, 26 cases of hydronephrosis (17.6%), 6 cases of cystic disease (4%), and 111 cases without alterations (75.5%).

Associated factors

The following were presented as risk factors: lower middle socioeconomic level, phimosis, balanitis, synechiae, constipation, and a history of UTI. The associated factors are presented in Table 3.

Discussion

In this investigation, a prevalence of urinary tract infection was found, similar to that reported in the literature. The following were presented as protective factors: age < 1 year and male sex. Risk factors were low-medium socioeconomic level, balanitis, structural alterations (phimosis- synechiae), and constipation. Hydronephrosis was the most observed alteration in ultrasound.

Urinary tract infection (UTI) continues to be one of the most frequent bacterial infections in pediatrics, as shown in this study, which obtained a prevalence of 10.6%. This marks a decrease in this hospital compared to 2013, when 11.62% (N = 96) presented with a positive urine culture [11]. It is believed that this is related to the improvement in hygienic-dietary measures and antibiotic prophylaxis during the detection of uro-renal malformations; however, it differs from Spain, where the prevalence was 5%. It should be noted that this country has a different social and clinical context from Ecuador [12].

Table 2 Group clinical features

Frequency n=147		Percentage
Nutritional condition		
Under weight	40	27.2%
Normal	101	68.7 %
Overweight	6	4.1%
Anatomical alterations		
Phimosis	17	11.6%
Synechiae	17	11.6%
None	3	77.4%
Balanitis		
Yes	3	2.1%
No	144	97.9%
Constipation		
Yes	36	24.7%
No	111	75.3%
Previous UTI		
Yes	51	34.9%
No	96	65.1%
Frequency of infection in children with previous UTI		
In the last year	44	83%
1 to 2 years ago	6	11.3%
No data	3	5.7%

UTI: urinary tract infection

Table 3 Bivariate analysis of factors associated with urinary tract infections

Variable(s)	Urinary tract infections				PR	CI 95%	*P*
	Present		Absent				
	F=146	%	F=148	%			
Age (< 1 year)	43	29.5%	12	8.1%	0.210	0.16-0.42	<0.001
Male sex	41	28.1%	85	57.4%	0.289	0.18-0.471	<0.001
Low medium and low socio-economic status	98	67.1%	115	77.7%	1.707	1.01-2.86	0.04
Care of third parties: Relatives	116	79.5%	130	87.8%	1.868	0.99-3.53	0.52
Nutritional status: low weight	39	26.7%	22	14.9%	0.479	0.26-0.85	0.12
Phimosis	17	11.6%	2	1.4%	29.37	6.34-136.29	<0.001
Synechiae	17	11.6%	3	2.0%	1.43	1.14-1.79	0.02
Balanitis	3	2.1%	0	0%	3.23	2.48-4.21	0.01
Constipation	36	24.7%	10	6.8%	4.51	2.16-9.50	<0.001
ITU Previous UTI	51	34.9%	1	0.7%	78.92	10.72-580.68	<0.001

P: Prevalence ratio. CI: confidence interval. UTI: urinary tract infection

Regarding the sociodemographic profile, the female sex was the dominant one. This agrees with Europe and Latin America, where it is reported that from 3 years of age, UTI is much more frequent in girls, with a girl/boy ratio greater than 10/1 [6, 13]. Regarding age, it was more common between 1-12 months, which coincides with Ibeneme et al., who indicate that children under 12 months had a greater number of UTI episodes [14]. Urban origin was the most predominant, coinciding with what was reported in the country in 2017; then, 68% (75) children came from urban areas and 32% (35) came from rural areas [15]. This would be explained by the fact that the urban population is more concurrent to the "José Carrasco Arteaga" hospital.

According to the clinical profile, the normal nutritional status predominates. This is in line with that reported in the study of zone 7, in which most of the children, 26% of preschool children, had adequate nutrition and a history of urinary infection [16].

On the other hand, hydronephrosis was the most detected ultrasound alteration, which agrees with what was reported in Mexico in 2017. There, 38.7% presented genitourinary anomalies. Likewise, the most frequent were vesico-ureteral reflux (VUR), ureteropelvic stenosis, and incomplete bladder emptying [15].

It is known that the absence of adequate drainage of urination from the kidney will produce an inflammatory response and, finally, infection that, if not treated promptly, can lead to chronic diseases [17].

Certain factors present a statistically positive relationship with UTI. Among them, the low-middle socioeconomic level stands out, which fits with what was reported in Ecuador in 2017. There, children living in low socioeconomic conditions have twice the risk of presenting infection (OR 2 CI 95% 0.67–5.9) [16]. This may be because, at this social level, there is a limitation in education, economy, and hygiene and a lack of community support, which would act as conditions for infection.

In this study, phimosis was also presented as a risk factor. This relates to what was reported in Spain, where, during the first year of life, uncircumcised men are 9 times more likely to contract a UTI than are circumcised men (OR 9.1; 95% CI: 5.2-15.7) [18]. The literature indicates that anatomical alterations made genital hygiene difficult and may be an optimal medium for bacterial growth and urinary infection through the ascending route.

Constipation is considered a positive factor for UTI, as corroborated by Hossain M, and Col, in 2015. They presented a study of 50 cases and 50 controls and determined that constipation (P <0.001) had a statistically significant relationship with UTI [19]. Also, in Brazil in 2017, it was found that children with constipation were 6.8 times more likely to have a urinary tract infection than those who were not constipated (P <0.001) [20].

Children with a history of UTI are more likely to present it again, relating to what was stated in the "José Carrasco Arteaga" Hospital, where 67.4% had a diagnosis of recurrent UTI in 2013 [11]. This agrees with what was reported in Peru in 2017. There, recurrent urinary tract infection increases with a history of UTI (OR: 3.755 CI: 1.476-9.556) [21]. Recurrent UTI is generally thought to mask voiding disturbances, malformations, or intestinal disturbances.

It should be noted that in this research, malnutrition was not reported as a risk factor. This would be explained by the fact that the universe under study belongs to a population with a medium-high socioeconomic status. However, this result should be viewed with caution and corroborated by future studies including a larger number of patients.

However, the female sex, although it is more frequent in presentation, was not a risk factor in this research. This differs from Peru in 2017. There, the female sex had a 7 times greater risk of presenting UTI in relation to males (OR: 7.429 CI: 2.625-21.018) [21]. It is presumed that this difference is because, in our study, the most prevalent age was between 1–12 months and in this age group, physiological phimosis conditions an increase in prevalence in men.

One of the limitations of this study, as it is cross-sectional, is that the arguments issued have the characteristic of non-causal approximations that can be explained as epiphenomena.

Conclusions

Urinary tract infection is a highly prevalent disease in the pediatric population. UTI occurs more frequently in women, aged 1-12 months, of urban origin, with normal nutritional status. The following were

presented as protective factors: age < 1 year, male sex, and malnutrition. The risk factors were low-middle socioeconomic level, balanitis, phimosis, synechiae, constipation, and history of UTI. Hydronephrosis was the most frequent ultrasound finding.

Abbreviations
UTI: urinary tract infection. PR: Prevalence ratio.

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Authors' contributions
Johanna Estefanía Arias Regalado: conceptualization, formal analysis, acquisition of funds, research, resources, software, writing - original draft.
Marcela Ochoa Brito: validation, visualization, project management, writing: review and editing.
Luis Enrique Marcano Sanz, methodology, supervision, data curation.
All authors read and approved the final version of the manuscript.

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Availability of data and materials
The data sets generated and / or analyzed during the current study are not publicly available due to the confidentiality of the participants, but are available through the corresponding author upon reasonable academic request.

Ethical statements
The Bioethics Committee of the Universidad de Cuenca and the Teaching and Research Commission of the José Carrasco Arteaga Hospital approved the research protocol.

Protection of people
The authors declare that the procedures followed were in accordance with the ethical standards of the responsible human experimentation committee and in accordance with the World Medical Association and the Singapore Declaration.

Data confidentiality
The authors declare that they have followed the protocols of their work center on the publication of patient data without identification.

Publication consent
The authors have obtained the informed consent of the guardians of the patients and the respective assent. This document is in the possession of the corresponding author. The authorization for the publication of this article has been signed by the guardians or parents.

Conflicts of interest
The authors declare not to have any interest conflicts.

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