MEDICAL UNIVERSITY- VARNA
FACULTY OF MEDICINE
DEPARTMENT OF GENERAL MEDICINE

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CONGENITAL ANOMALIES OF THE KIDNEY AND URINARY TRACT IN CHILDREN UNDER 3 YEARS OF AGE

EXTENDED ABSTRACT of PhD THESIS

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The dissertation contains 221 typewritten pages and is illustrated with 71 tables and 60 figures. The bibliography includes 407 titles, of which 6 are in Cyrillic and 401 are in Latin.
Note: The numbers of the tables and figures in the abstract do not correspond to those in the dissertation.

The dissertation has been discussed and approved for defense by the Department Council of the Department of General Medicine at the Medical University - Varna
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The public defense of the dissertation will take place on March 25, 2026, at 1:00 p.m. at the Medical University – Varna during a meeting of the scientific jury.

The materials related to the defense are published on the website of the University and are available at the Department of General Medicine, Faculty of Medicine..

CONTENTS

I. INTRODUCTION

Congenital anomalies of the kidney and urinary tract (CAKUT) are a major cause of chronic kidney disease (CKD) in childhood, leading to serious complications, deterioration in the quality of life of affected patients, disability, and early mortality.

The aim of this study were to examine the knowledge and practices of general practitioners (GPs) when congenital anomalies of the urinary system are suspected, the awareness of parents about the first signs of urinary tract infection, as well as other symptoms of diseases of the excretory system and their attitude towards screening tests and consultations with specialists under the Child Health Care program.

Identification and elimination of risk factors, whenever possible, as well as prevention, treatment, and monitoring, are joint tasks of the GP, pediatric nephrologist, urologist, obstetrician-gynecologist, and the parents. Essential for early prevention are the knowledge and attitudes of the parents in relation to the care for their children. Adequate parental awareness of the initial symptoms of excretory system diseases, the correct procedure for urine collection, and trust in the GP facilitate early diagnosis, accurate treatment, and prevention of complications.

Application of a proven algorithm in monitoring patients aged 0 to 36 months for congenital anomalies of the excretory system would lead to early diagnosis, treatment, and prevention of chronic kidney disease in early childhood. Preventing the progression to chronic kidney disease will reduce the risk of early disability in patients, onset of irreversible changes in kidney structure, and development of complications such as hypertension, cardiovascular diseases, anemia, osteoporosis, and others. Targeted search for extrarenal anomalies in patients with congenital anomalies of the excretory system would aid

in preventing accompanying problems and timely therapy. A multidisciplinary approach to these anomalies is crucial for achieving accurate results, correct diagnosis, and prevention of complications. Expanding the panel of tests and consultations in the Child Health Care package carried out by the GP would help enhance and improve early childhood prevention.

The need for reform, systematic data collection, and establishment of a register for children with congenital anomalies of the excretory system and chronic kidney disease is a future change necessary for achieving better practice in patient monitoring, complication prevention, and comprehensive care for this group of patients. This could reduce the progression to end-stage kidney disease, early disability, and improve the quality of life for children with excretory system diseases and their families.

The GP plays a vital role and is a key figure in performing preventative activities. Building a doctor-patient relationship based on trust, empathy, and respect is an important part of effective communication, prevention, and therapeutic activities. The GP is the main source of information for parents, and a fundamental part in monitoring children's development from birth and preventing the onset of chronic diseases or complications of already existing ones.

II. OBJECTIVE, TASKS, AND WORKING HYPOTHESES

1. OBJECTIVE

The aim of this study was to investigate GP knowledge and practices concerning suspected CAKUT, as well as parents' awareness of early symptoms of urinary tract infections (UTI), and their attitudes towards screening tests planned under the Children's Healthcare program.

2. TASKS

1. To investigate GP knowledge and practices in cases of suspected CAKUT.
2. To evaluate the significance of prevention and GP pediatric consultations for the diagnosis and timely treatment of CAKUT.
3. To develop a diagnostic algorithm for GPs to improve early CAKUT detection, reduce the occurrence of complications, and decrease chronic kidney diseases.
4. To investigate parents' attitudes towards conducting screening tests and consultations with specialists under the Child Health Care program.
5. To investigate parents' understanding of the initial UTI signs, risk factors, and potential complications.
6. To increase parents' awareness of the initial UTI signs and symptoms, to conduct regular pediatric consultations, and to follow GP recommendations for preventive examinations and consultative examinations.

3. WORKING HYPOTHESES

1. Parents' awareness and knowledge of the main symptoms, risk factors, and possible complications of diseases of the excretory system are limited and insufficient.
2. The screening program needs to be improved and its implementation by GPs needs to be enhanced for the early detection of CAUT and prevention of complications.
3. There is a need to develop a registry for children with CAUT and CKD and to expand the panel of screening tests at an earlier stage.
4. There is a need to reduction of risk factors and ensure optimal control of chronic diseases in mothers, as well as the introduce mandatory genetic screening during pregnancy.

III. MATERIAL, DESIGN, AND METHODS

1. MATERIAL

The subject of this study were 292 parents of children up to 3 years of age and 96 GPs treating patients aged 0 to 3 years in the Varna region. After signing an informed consent form for the provision of personal data, all participants in the study were given an explanation of the parameters of the scientific research. The criteria for inclusion and exclusion in the study were assessed, and the survey forms were completed.

2. STUDY DESIGN

The dissertation was initiated after approval from the Scientific Research Ethics Committee of the Medical University – Varna.

2.1. Inclusion criteria:

- Parents of children aged 0 to 3
- Parents over the age of 18 (of legal age)
- GPs treating children aged 0 to 3 years in their practice

2.2. Exclusion criteria

- Parents of children who do not fall within the studied age group of 0 to 3 years old
- Parents under the age of 18 (minors)
- GPs who do not have children aged 0 to 3 years in their patient list

To achieve the objective and tasks of the dissertation, we conducted two parallel independent studies.

STUDY I. CAKUT IN CHILDREN UP TO 3 YEARS OF AGE: KNOWLEDGE, AWARENESS, AND ATTITUDES TOWARDS SCREENING AND CONSULTATIONS AMONG PARENTS

The study aimed to assess knowledge and awareness of the first signs, risk factors, and possible complications of recurrent UTI, as well as attitudes toward preventive examinations and consultations with specialists for the purpose of prevention and early diagnosis.

Study design and duration: cross-sectional epidemiological study conducted over a period of one year from February 2023 to February 2024.

General population: parents of children aged 0 to 3 years. The age range was selected based on the age at which CAKUT are most commonly diagnosed.

The study sample was formed on a random quota basis from the lists of some GPs participating in the study in the city of Varna. Their participation was voluntary and confidential.

Observed study indicators among parents:

- Demographic and socio-economic indicators of parents – gender, age, ethnicity, education, employment, and others;
- Parents' knowledge of the first symptoms of urinary tract infection
- Their opinion regarding the time spent and recommendations given by the GP
- Parents' awareness of the need for prevention
- Parents' attitudes towards preventive examinations and consultations with specialists
- Parents' awareness of possible complications from recurrent urinary tract infections

Fieldwork: parents filled out the survey themselves during a scheduled pediatric consultation with their GP and at home, after being sent a link to the survey online. The survey was prepared in two versions: on paper and in electronic format, developed in Google Forms. The electronic survey format was necessary in order to facilitate the conduct of the study among more parents. The tool for collecting information was a direct individual survey consisting of 31 questions.

STUDY II. CAKUT IN CHILDREN UP TO 3 YEARS OF AGE: GP ROUTINES FOR CONDUCTING SCREENING TESTS, CONSULTATIONS, AND CLINICAL PRACTICE IN THE PRESENCE OF UTI

The aim of the study was GPs' knowledge of CAKUT, clinical practice in cases of UTI in early childhood, and attitudes towards performing screening tests.

Study design and duration: cross-sectional epidemiological study conducted over a period of one year from January 2022 to January 2023.

General population: The participants were GPs from the Varna region. They were selected at random from individual and group practices for primary medical care (PMC). The condition for the selection of GPs was the presence of children in the age group 0 to 3 years in their practice. Their participation was confidential.

Observed study indicators among GPs:

- Demographic (age, gender) and professional factors (experience)

- Self-assessment of the time spent on pediatric consultations and promotion of preventive and screening tests and consultations
- Knowledge and practices in the presence of UTI in early childhood and suspicion of CAKUT
- Main sources for updating GPs' knowledge of current trends and recommendations for the treatment of UTI and suspected CAKUT
- Opinion on the trend among parents to refuse screening tests and consultations with specialists
- Clinical characteristics of children in practice with diagnosed CAKUT

Fieldwork: to conduct the study, the Regional Health Insurance Fund provided lists of email addresses of GPs in the Varna region. A survey was sent to randomly selected medical specialists. The survey was prepared in two versions: on paper and in electronic format, developed in Google Forms. The survey was prepared in two versions: on paper and in electronic format, developed in Google Forms. The electronic survey format was necessary in order to facilitate the conduct of the study among more GPs. The tool for collecting information was a direct individual survey consisting of 22 questions.

3. METHODS

1. Documentary method

For this work, a selection and analysis of literary sources was made - textbooks, articles, publications, and regulatory documents relating to the causes and prevalence of CAKUT, as well as the complications arising from them, CKD development, its prevalence, and the role of screening for early diagnosis and treatment.

2. Sociological method

We conducted two surveys on knowledge, attitudes, and practices for preventive examinations and consultations in order to address issues related to early diagnosis, treatment, and prevention of complications from CAKUT, urinary tract infections, and CKD from the perspective of GPs and parents.

3. Statistical methods (analysis)

The collected empirical data were processed and analyzed using SPSS statistical software (version 27). Various statistical methods were applied in the analysis, taking into account the nature of the data and the research tasks set:

3.1 Descriptive statistics, which calculate absolute and relative frequencies, as well as measures of central tendency and dispersion (mean and standard deviation) to describe the sample in terms of socio-demographic and professional characteristics.

3.2. Contingency tables were used to present the relationships between the variables studied.

3.3. Pearson's χ^2 test was used to assess the statistical significance of the dependencies between the categorical indicators. The tables present both absolute values (n) and relative shares (%).

3.4 The results obtained were interpreted at a significance level of $p < 0.05$.

3.5. Correlation analysis (Spearman's rho) was used to assess the relationships between rank and categorical variables

3.6. The results obtained were presented in tables and graphs, which facilitate the visual perception and comparison of data, as well as highlight the main dependencies and trends.

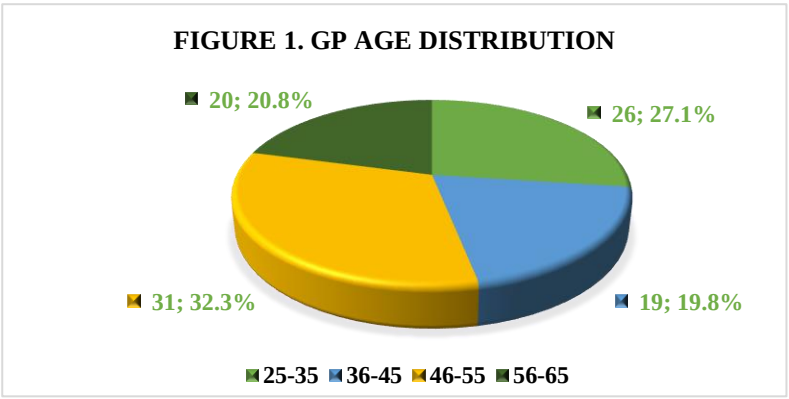
IV. OWN RESULTS

1. Demographic profile of study participants

The respondents were 96 GPs who treat children aged 0 to 3 years in their practice.

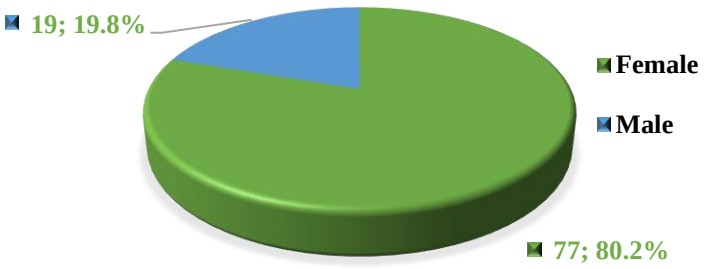
- **GP age distribution (Figure 1.)**

FIGURE 1. GP AGE DISTRIBUTION



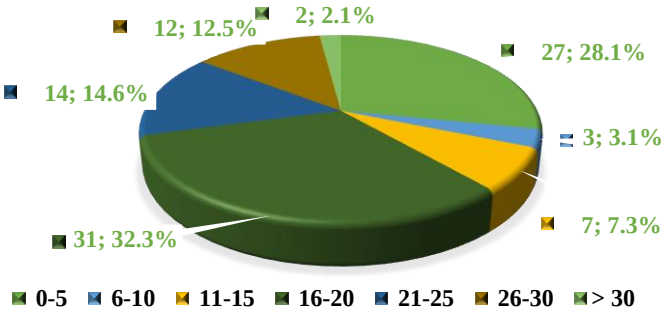
- **GP distribution by gender (Figure 2).**

FIGURE 2. GP SEX DISTRIBUTION



- **GP work experience in years (Figure 3.)**

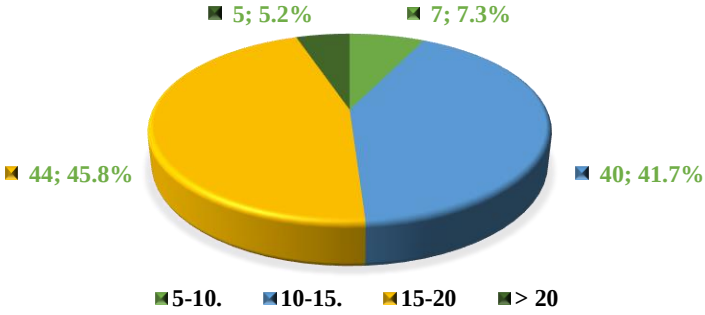
FIGURE 3. GP WORK EXPERIENCE IN YEARS



- **Average GP pediatric consultation duration in minutes:**

5-10 minutes in 7.3% (n=7); 10-15 minutes on average in 41.7% (n=40); 15-20 minutes in 45.8% (n=44) and more than 20 minutes in 5.2% (n=5) of GPs for a pediatric consultation (Figure 4.)

FIGURE 4. AVERAGE GP PEDIATRIC CONSULTATION DURATION IN MINUTES



- **Presence of CAKUT patients:**

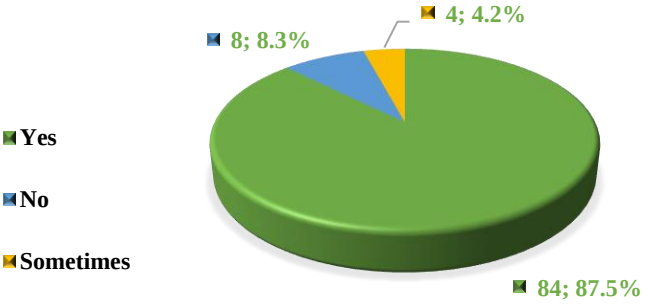
The majority of surveyed GPs indicated that they have CAKUT patients in their practice: 76% (n=73), while the remaining 24% (n=23) indicated that they do not have such pathology among their patients. (Figure 5.)

FIGURE 5. PRESENCE OF CAKUT PATIENTS

- **Implementation of CAKUT prevention program by GPs**

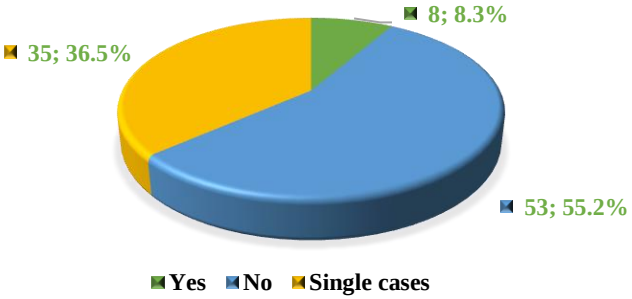
Among those surveyed, 87.5% (n=84) always perform screening tests and consult with a pediatric nephrologist for eligible patients; 8.3% (n=8) indicate that they do not implement this prevention program, and 4.2% (n=4) respond that they sometimes perform the necessary tests and consultations for the CAKUT prevention. (Figure 6.)

FIGURE 6. IMPLEMENTATION OF CAKUT PREVENTION PROGRAM BY GPS



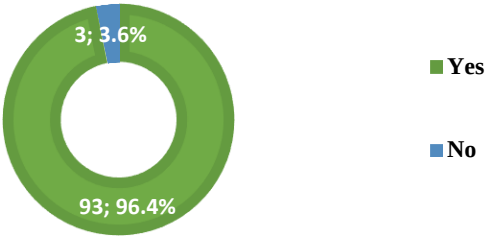
- **Cases of parents refusing preventive examinations and consultation with a pediatric nephrologist (Figure 7).**

FIGURE 7. CASES OF PARENTS REFUSING PREVENTIVE EXAMINATIONS AND CONSULTATION WITH A PEDIATRIC NEPHROLOGIST



- **Proportion of children undergoing preventive examinations at six months and one year of age (Figure 8).**

FIGURE 8. PROPORTION OF CHILDREN UNDERGOING PREVENTIVE EXAMINATIONS AT SIX MONTHS AND ONE YEAR OF AGE

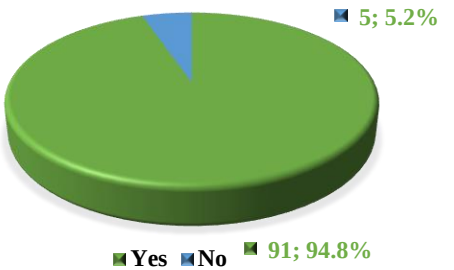


- **Proportion of GPs associating early "failure to thrive" with CAKUT**

94.8% (n=91) of GPs in the sample indicated that in infants with unsatisfactory weight gain and overall growth, they focused their clinical thinking on the presence of CAKUT and conducted the

appropriate examinations and consultations. Only 5.2% (n=5) indicated that they saw no connection between "failure to thrive" in early childhood and CAKUT. (Figure 9.).

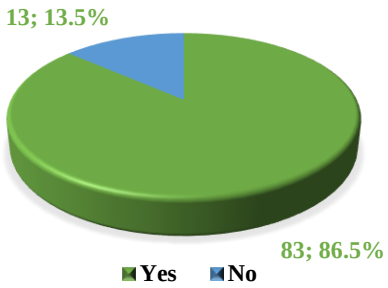
FIGURE 9. PROPORTION OF GPS ASSOCIATING EARLY "FAILURE TO THRIVE" WITH CAKUT



- **Proportion of GPs detecting asymptomatic UTI**

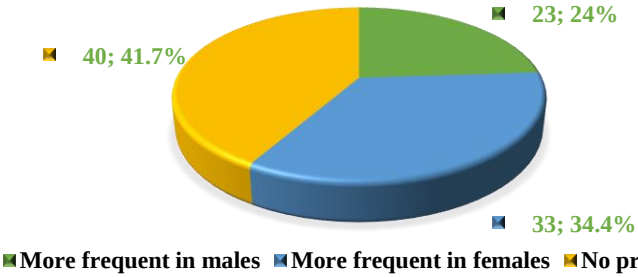
In the sample of GPs surveyed, 86.5% (n=83) noted that during preventive blood and urine tests, they had diagnosed cases of asymptomatic urinary tract infection, and 13.5% (n=13) reported that they had not diagnosed such cases during routine examinations at six months and one year of age. (Figure 10.).

FIGURE 10. PROPORTION OF GPS DETECTING ASYMPTOMATIC UTI



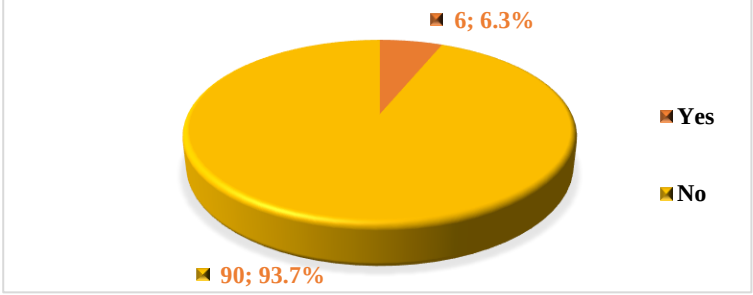
- **Data on the relationship between CAKUT and gender of children in general practice (Figure 11).**

FIGURE 11. PREVALENCE OF CAKUT IN GP PRACTICES AND RELATIONSHIP WITH PATIENT GENDER



- **GP opinions on the link between the method of conception and CAKUT frequency (Figure 12).**

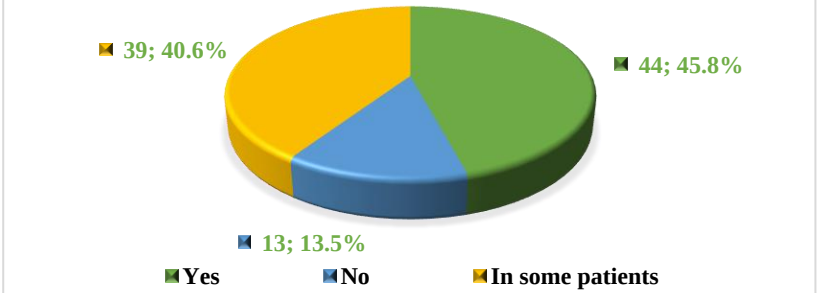
FIGURE 12. GPS' VIEWS ON THE LINK BETWEEN CAKUT AND METHOD OF CONCEPTION



- **Opinion of the surveyed GPs on the relationship between CAKUT frequency and family predisposition in children**

Of the GPs surveyed, 45.8% (n=44) confirmed that there was a link between CAKUT and family history of such anomalies among children in their practice. 40.6% (n=39) also believed that there is such a link, but only in some of the patients with CAKUT. (Figure 13.)

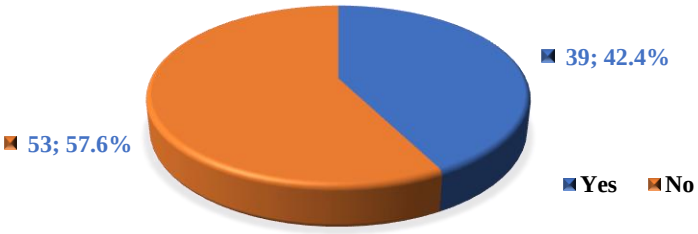
FIGURE 13. GPS' VIEWS ON THE LINK BETWEEN PEDIATRIC CAKUT AND FAMILY HISTORY



- **Distribution of GPs by the presence of other congenital anomalies among their patients with CAOD**

Among the GPs surveyed, 42.4% (n=39) indicated that their patients with CAKUT also had other congenital anomalies, and 57.6% (n=53) responded that CAKUT patients had no other known anomalies. (Figure 14.).

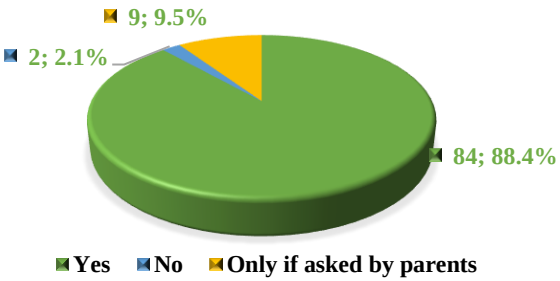
FIGURE 14. PRESENCE OF OTHER CONGENITAL ANOMALIES IN PATIENTS WITH CAKUT IN GENERAL PRACTICE



- **Time spent by GPs explaining to parents how to correctly collect a urine sample for laboratory testing of their children**

Among the general practitioners surveyed, 88.4% (n=84) said they took the time to explain to parents how to properly collect a urine sample from their children for laboratory testing, 9.5% (n=9) noted that they explained to parents only if they requested information from them. (Figure 15.).

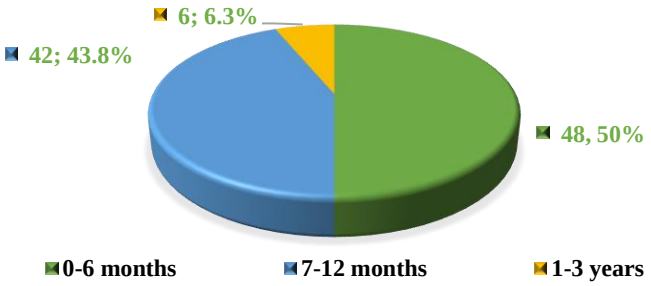
FIGURE 15. GPS EXPLAINING PROPER URINE SAMPLE COLLECTION



- **Age group of newly diagnosed CAKUT in children**

Half of the surveyed GPs 50% (n=48) note that newly diagnosed children with CAKUT were in the 0-6 month age group; 43.8% (n=42) responded that newly diagnosed CAKUT in their practice occurred in the 7-12 month age range, and 6.3% (n=6) noted that in their practice, CAKUT were most often detected in the 1-3 year age range. (Figure 16).

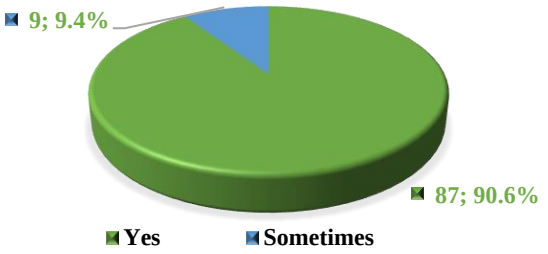
FIGURE 16. DISTRIBUTION OF GPS BY MOST COMMON CAKUT DETECTION AGE GROUP



- **Clinical practice of GPs when receiving a suspicious urine test result**

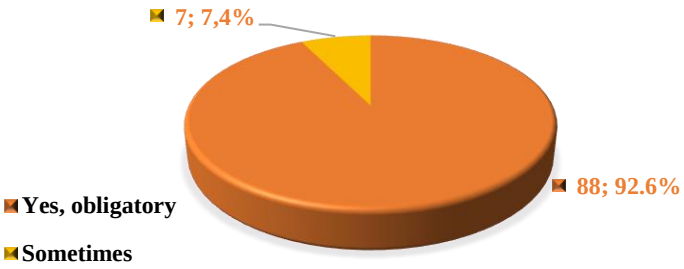
Almost all of the general practitioners surveyed (90.6% (n=87)) had the clinical practice of repeating urine tests when receiving a suspicious result, and 9.4% (n=9) only sometimes repeated the tests. (Figure 17.)

FIGURE 17. GPS' PRACTICE OF REPEATING URINALYSIS AFTER RECEIVING A DOUBTFUL RESULT



- **Diagnostic practices for performing urine culture with antibiogram in the presence of bacteriuria in normal urine tests among GPs (Figure 18).**

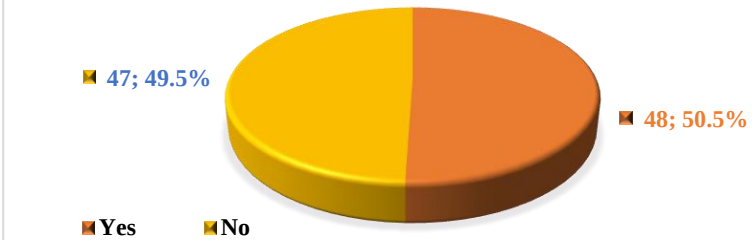
FIGURE 18. GPS' USE OF URINE CULTURE AND ANTIBIOGRAM IN PATIENTS WITH BACTERIURIA



- **GP's practice of prescribing antibiotic treatment before antibiogram results**

Among the GPs surveyed, 50.5% (n=48) prescribed antibiotic treatment without antibiogram results in cases of urinary tract infection, and 49.5% (n=47) prefer to prescribe antibiotic therapy only after the results of an antibiogram are available. (Figure 19.).

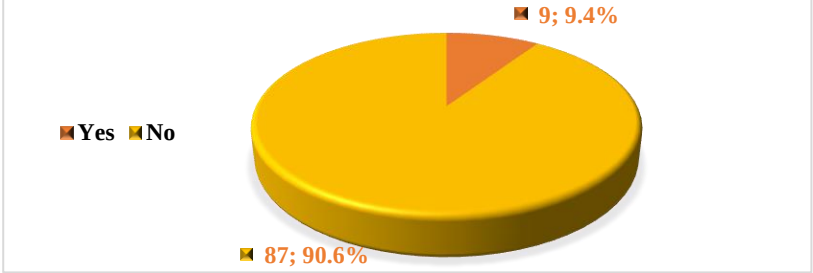
FIGURE 19. GPS PRESCRIBING ANTIBIOTICS FOR UTI WITHOUT ANTIBIOGRAM RESULTS



- **Distribution of GPs by presence of children with CKD due to CAKUT in their practice**

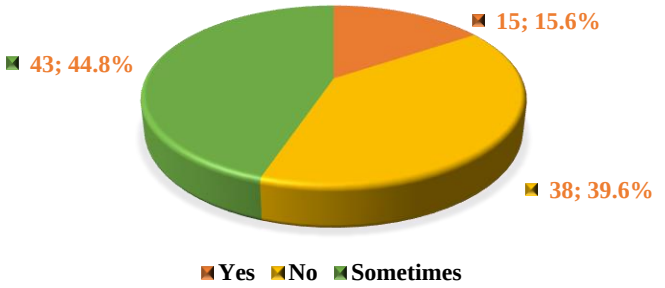
9.4% (n=9) of the GPs surveyed report that they have children in their practice who have developed HUS as a result of HAUT, and 90.6% (n=87) note that they have not yet encountered such a complication in children with HAUT in their practice. (Figure 20.)

FIGURE 20. CKD DEVELOPMENT IN CHILDREN WITH CAKUT IN GP PRACTICES



- **Distribution of surveyed GPs by parents' information-seeking on early UTI symptoms (Figure 21).**

FIGURE 21. PARENTS' INFORMATION-SEEKING ON RISK FACTORS FOR UTI FROM GENERAL PRACTITIONERS



- **Distribution of surveyed general practitioners by sources of information they use to update their knowledge (Table 1).**

Table 1. Distribution of surveyed GPs according to information sources

Source of information	N	%
Internet	3	3.1
Training courses	1	1
Training courses, Online training	8	8.3
Training courses, Online training, Internet, Scientific articles and publications	1	1
Online training, Information from the Internet, Research publications	4	4.2

Online training, Research publications	**3**	**3**
Textbooks	**14**	**14.6**
Textbooks, Research publications	**15**	**15**
Textbooks, Training courses	**20**	**20**
Textbooks, Training courses, Research publications	**3**	**3**
Textbooks, Training courses, Online training	**4**	**4.2**
Textbooks, Training courses, Online training, Internet	**1**	**1**
Textbooks, Training courses, Online training, Internet, Research publications	**1**	**13.5**
Textbooks, Training courses, Online training, Research publications	**6**	**6**

- **Relationship between experience and UTI treatment practices**

The youngest doctors (0–5 years) prescribed antibiotics without antibiotic susceptibility testing significantly less often (18.5%), while this proportion increases in the groups with 16–20 years of experience (54.8%), 21–25 years (71.4%), and 26–30 years (75.0%). (Table 2)

Table 2. Experience and prescribing antibiotics without an antibiogram

Experience (years)	Yes	No	Total
0	**5 (18.5%)**	**22 (81.5%)**	**27 (100%)**
6	**2**	**1 (33.3%)**	**3 (100%)**

11	**4**	**3 (42.9%)**	**7**
16	**17**	**14**	**31**
21	**10**	**4 (28.6%)**	**14**
26	**9**	**3 (25.0%)**	**12 (100%)**
>30	**1 (50.0%)**	**1 (50.0%)**	**2 (100%)**
Total	**48 (50.0%)**	**48 (50.0%)**	**96 (100%)**

- **Proportion of GPs reporting children with non-CAKUT congenital anomalies and cases of renal failure**

The results showed a statistically significant association between the two variables ($\chi^2 = 13.6$, df = 1, $p < .001$). As shown in Table 3, among children who have other congenital anomalies in addition to CKD, 23.1% have developed renal failure. In contrast, in the group without additional anomalies, not a single case of renal failure was reported.

Table 3. Relationship between additional congenital anomalies and development of renal failure

Additional anomalies	Renal failure: Yes	Renal failure: No
Yes (n = 39)	**9 (23.1%)**	**30 (76.9%)**
No (n = 53)	**0**	**53**

The results showed a statistically significant association between the two variables ($\chi^2 = 47.0$, df = 18, $p < .001$), indicating that the length of practice as a general practitioner was related to the structure of time allocated to pediatric consultations. As can be seen in Table 4, the youngest doctors (0–5 years of experience) more often allocated 10–

15 minutes (17.7% of all participants), while more experienced doctors (16–20, 21–25, and 26–30 years of experience) mostly indicated 15–20 minutes (20.8%, 8.3%, and 8.3% of the total sample). On the other hand, the group with 6–10 years of experience was more varied, with the three categories of 5–10, 15–20, and >20 minutes evenly represented. The most experienced doctors (over 30 years of experience) indicated only 15–20 minutes (2.1% of the total sample).

Table 4. Pediatric consultation time by professional experience.

Experience (years)	5–10 minutes	10–15 minutes	15–20 minutes	>20 minutes	Total
0	3.1	17.7	4.2	3.1	28.1
6–10	1.0	0.0	1.0	1.0	3.1
11–15	3.1	3.1	1.0	0.0	7.3
16–20	0.0	11.5	20.8	0	32.3
21–25	0	5.2	8.3	1.0	14.6
26–30	0.0	4.2	8.3	0.	12.5
>30	0.0	0.0	2.1	0.0	2.1
Total	7.3	41.7	45.8	5.2	100

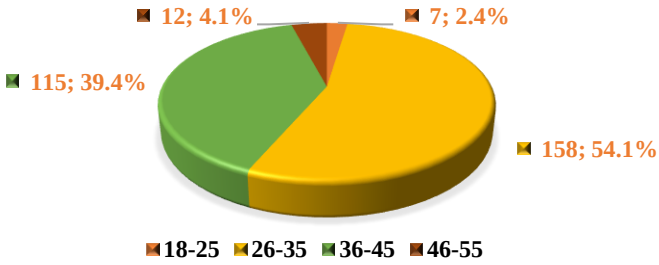
Parents survey

- **Demographic profile of study participants**

A total of 292 parents of children aged 0 to 3 years residing in the city of Varna were surveyed.

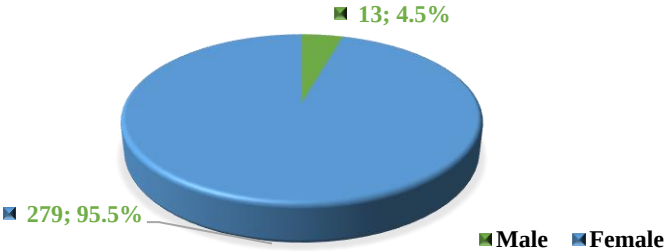
- **The age distribution of the study participants is as follows: (Figure 22).**

FIGURE 22. AGE DISTRIBUTION OF PARENTS



- **Distribution of respondents by gender (Figure 23).**

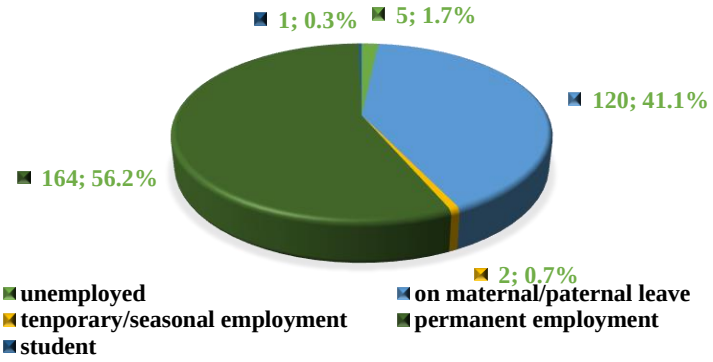
FIGURE 23. GENDER DISTRIBUTION OF SURVEYED PARENTS



- **Distribution of surveyed parents according to their employment status**

Half of the respondents indicated that they had permanent employment – 56.2% (n=164); the remaining larger sample of respondents were on maternity/paternity leave – 41.1% (n=120); in 1.7% (n=5) of cases, respondents indicated that they were currently unemployed, 0.3% (n=2) responded that their employment was related to temporary or seasonal work, and 0.3% (n=1) of respondents were students (Figure 24).

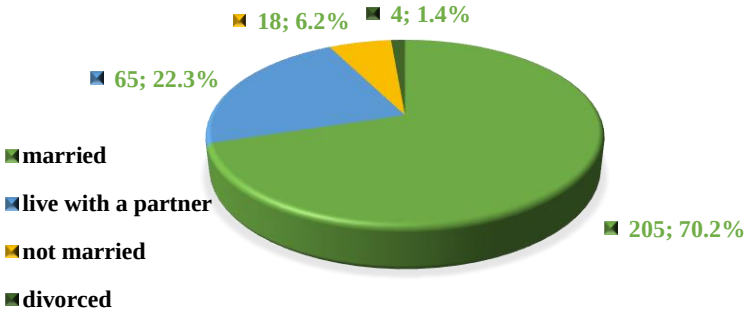
FIGURE 24. DISTRIBUTION OF PARENTS BY EMPLOYMENT STATUS



➢ Distribution of surveyed parents by marital status

There were four groups of marital status among the respondents. 70.2% (n=205) were married; 22.3% (n=65) indicated that they live with a partner; 6.2% (n=18) of respondents indicated that they were single, and 1.4% (n=4) of respondents indicated that they were divorced (Figure 25).

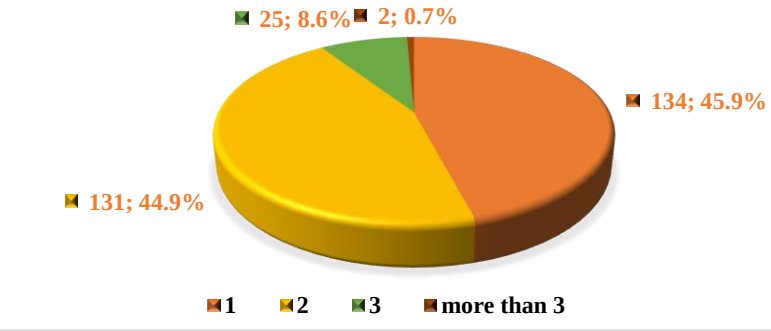
FIGURE 25. DISTRIBUTION OF PARENTS BY MARITAL STATUS



- **Distribution of surveyed parents by number of children in the family**

Of the parents who completed the survey, there were two main groups with one and two children in the family, respectively 45.9% (n=134) with two children and 45.9% (n=131). From the remaining respondents, 8.6% (n=25), had three, and 0.7% (n=2) had more than three children in the family (Figure 26).

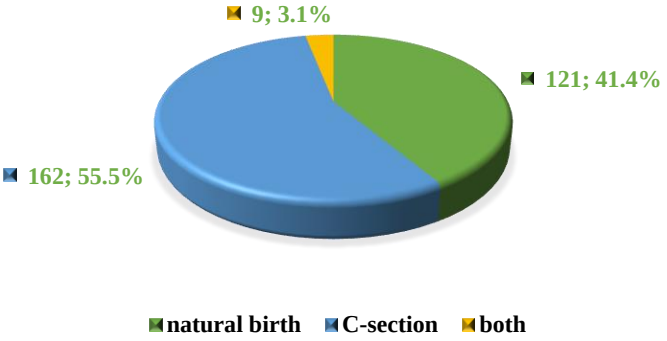
FIGURE 26. DISTRIBUTION OF PARENTS BY NUMBER OF CHILDREN IN THE FAMILY



- **Distribution of surveyed parents by method of birth of their children**

According to the method of delivery of their children, parents were distributed in the following groups: natural delivery in 41.4% (n=121), 55.5% (n=162) by Caesarean section, and 3.1% (n=9) by both (when there was more than one child in the family born by different means) (Figure 27).

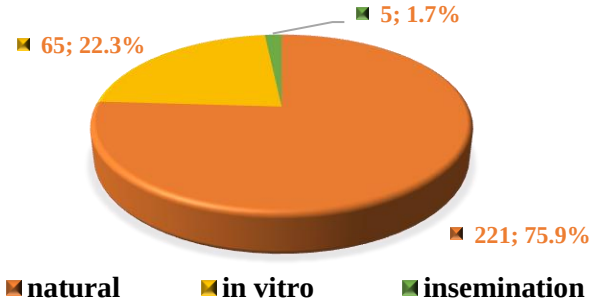
FIGURE 27. DISTRIBUTION OF PARENTS BY MODE OF DELIVERY OF THEIR CHILDREN



- **Distribution of parents by method of conception of their children**

According to the method of conception of the child/children in the family, the surveyed parents were divided into three groups, as described in Figure 32. 75.9% (n=221) reported that their children were conceived naturally; 22.3% (n=65) responded that their children were conceived through in vitro fertilization, and in 1.7% (n=5) the conception occurred after insemination (Figure 28).

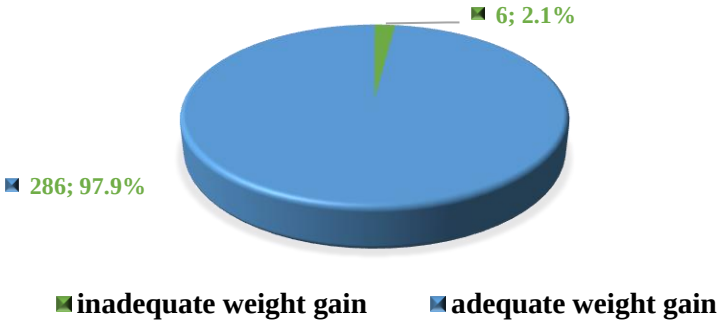
FIGURE 28. DISTRIBUTION OF PARENTS BY MODE OF CONCEPTION OF THEIR CHILDREN



- **Distribution of parents by their children's postnatal clinical course**

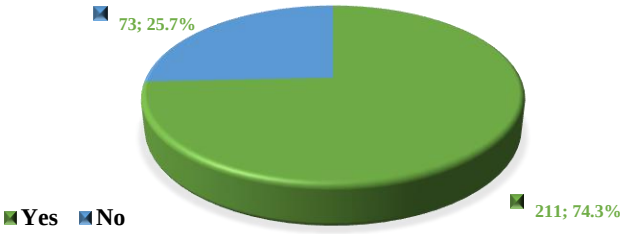
In 97.9% (n=286) of the parents in the postpartum period, the child was feeding, gaining weight, and not sick, and 2.1% (n=6) reported that the child was not gaining weight well and was restless (Figure 29).

FIGURE 29. DISTRIBUTION OF PARENTS BY THEIR CHILDREN'S POSTNATAL CLINICAL COURSE



- **Distribution of parents based on laboratory diagnostics performed for unexplained childhood fever (Figure 30).**

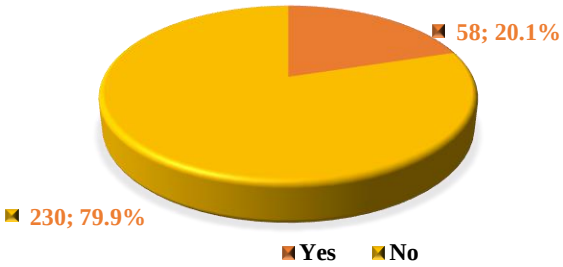
FIGURE 30. DISTRIBUTION OF PARENTS BY GP-INITIATED LABORATORY INVESTIGATIONS FOR UNEXPLAINED FEVER



- **Distribution of parents by UTI diagnosis after laboratory tests for fever**

In 20.1% (n=58) of the parents surveyed, there were cases of urinary tract infection diagnosed in the presence of fever without other symptoms, while in the remaining 79.9% (n=230) there were no such episodes (Figure 31).

ФИГУРА 31. PREVALENCE OF DIAGNOSED UTIS IN THE STUDY COHORT

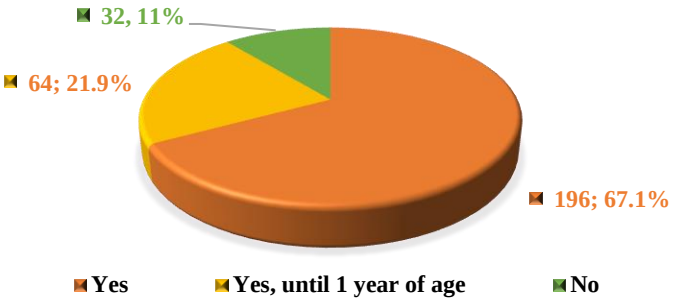


- **Distribution of parents by frequency of routine pediatric visits**

Of the parents surveyed, 67.1% (n=196) responded that they regularly attend pediatric consultations, 21.9% (n=64) noted that they had

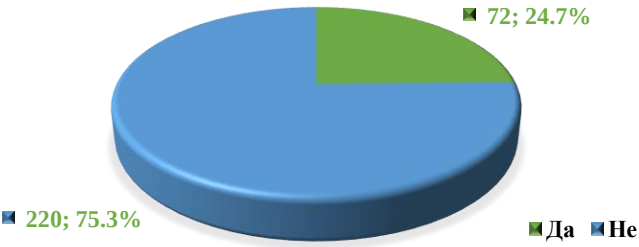
attended them regularly until their child reached 1 year of age, and 11% (n=32) noted that they did not attend these consultations regularly (Figure 32).

FIGURE 32. DISTRIBUTION OF PARENTS BY FREQUENCY OF ROUTINE PEDIATRIC VISITS



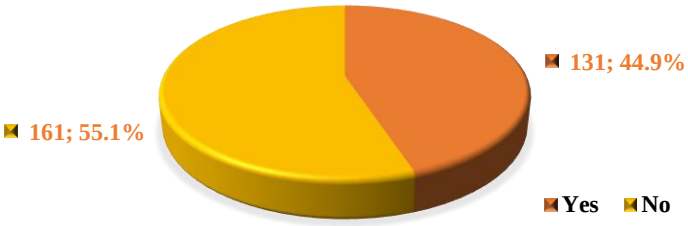
- **Distribution of parents by UTI cases among their children (Figure 33).**

ФИГУРА. 33 DISTRIBUTION OF PARENTS BY OCCURRENCE OF PEDIATRIC UTIS



- **Distribution of parents based on knowledge of primary UTI symptoms (Figure 34).**

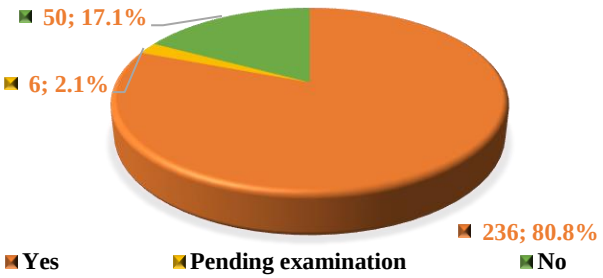
ФИГУРА 34. PARENTAL AWARENESS OF INITIAL UTI SYMPTOMATOLOGY



- **Preventive examination by a pediatric nephrologist**

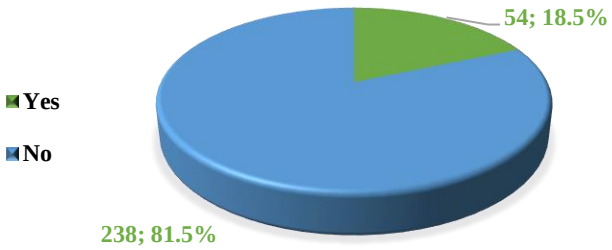
Among the parents surveyed, 80.8% (n=236) responded that their children had undergone such an examination; 2.1% (n=6) noted that such an examination was forthcoming, and 17.1% (n=50) responded that their child/children had not undergone such an examination (Figure 35).

FIGURE 35. PREVENTIVE EXAMINATION BY A PEDIATRIC NEPHROLOGIST



- **Need for a follow-up visit to a pediatric nephrologist after the initial examination (Figure 36).**

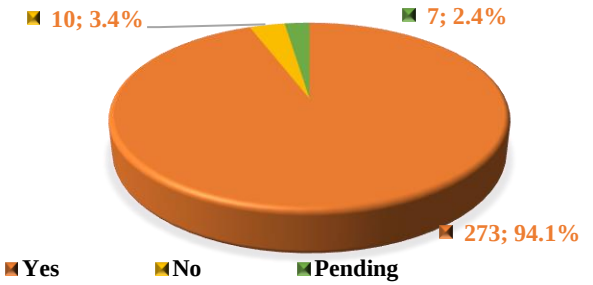
FIGURE 36. FOLLOW-UP REQUIREMENTS POST-INITIAL NEPHROLOGICAL EXAMINATION



- **Parental adherence to preventive laboratory screening at 6 months of age**

94.1% (n=273) responded that they had conducted laboratory tests, 2.4% (n=7) noted that such tests were pending and they had been informed about this, and 3.4% (n=10) of respondents had not conducted such preventive tests. (Figure 37).

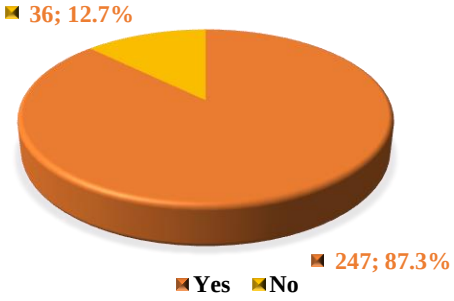
FIGURE 37. UPTAKE OF PREVENTIVE BLOOD AND URINE SCREENING AT 6 MONTHS



- **Parental distribution by receipt of urine collection guidance**

87.3% (n=247) of respondents reported that they had received information on how to collect a urine sample for laboratory testing for their child, and 12.7% (n=36) responded that they had not received any explanation or advice from their general practitioner on how to collect a urine sample from their child. (Figure 38.)

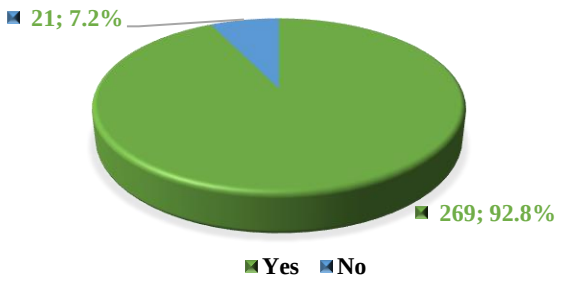
FIGURE 38. PARENTAL DISTRIBUTION BY RECEIPT OF URINE COLLECTION GUIDANCE



- **Information received from the family doctor that their child is subject to preventive examinations and consultations**

92.8% (n=269) of the parents responded that they had been informed by their general practitioner about the need for preventive blood and urine tests, as well as a consultation with a pediatric nephrologist after their child reached 6 months of age. (Figure 39).

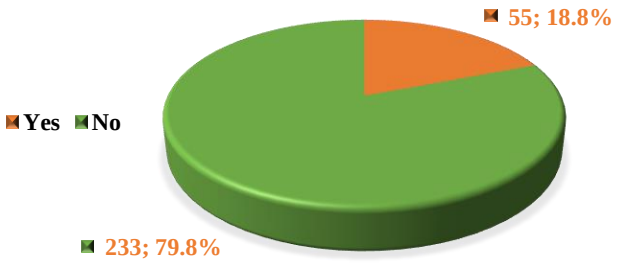
FIGURE 39. GP-LED NOTIFICATION OF SCHEDULED PREVENTIVE PEDIATRIC CARE



- **The necessity of antimicrobial treatment for confirmed UTI**

18.8% (n=55) of the parents surveyed responded that there had been cases where antibiotic treatment was necessary for their children's urinary tract infections. In some cases, combination therapy with more than one antibiotic was necessary – 1.4% (n=4), and the majority of respondents reported no cases of urinary tract infection for which their child had taken antibiotics – 79.8% (n=233). (Figure 40.).

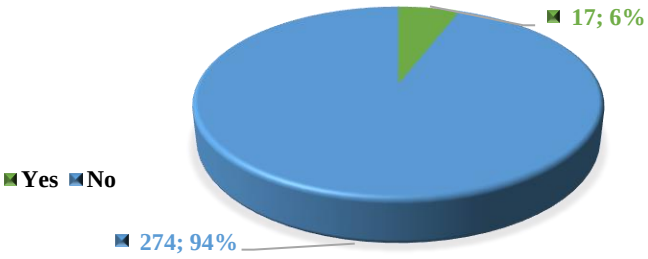
FIGURE 40. ANTIBIOTIC TREATMENT REQUIREMENTS FOR PEDIATRIC UTIS



- **Distribution of respondents by recurrent UTI cases over a six-month period**

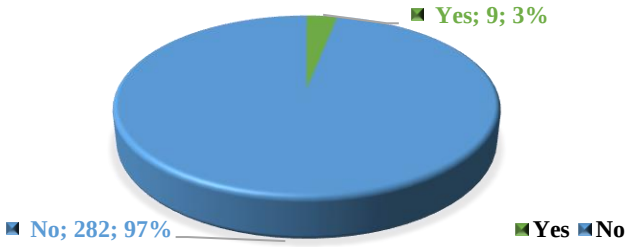
Figure 41 shows that UTI recurrence in the children of respondents over a six-month period was observed in only 5.8% (n=17) of the 24.7% (n=72) who reported that their children had had a UTI.

FIGURE 41. DISTRIBUTION OF RESPONDENTS BY RECURRENT UTI CASES OVER A SIX-MONTH PERIOD



- **Prevalence of Combination Antibiotic Therapy for UTIs (Figure 42).**

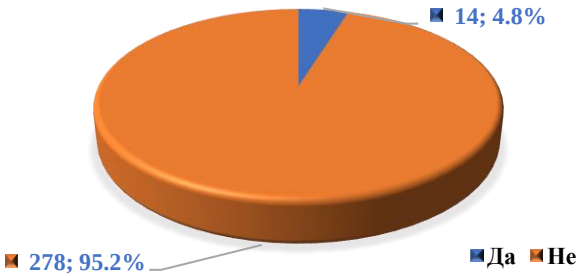
FIGURE 42. PREVALENCE OF MULTI-DRUG ANTIBIOTIC REGIMENS FOR UTIS



- **Distribution of respondents by deferral of statutory vaccinations due to pediatric UTI**

Of the parents surveyed, 4.8% (n= 14) reported that it was necessary to postpone mandatory immunization due to a urinary tract infection. (Figure 43).

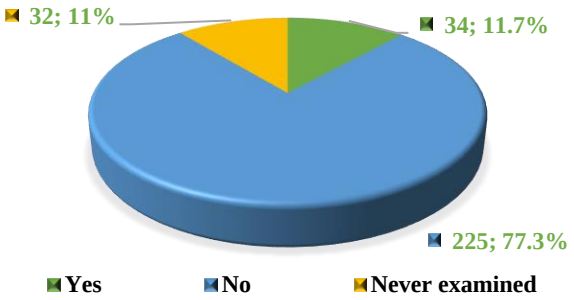
ФИГУРА 43. VACCINATION DEFERRAL DUE TO PEDIATRIC UTI



- **Distribution of parents by reported CAKUT**

A relatively high percentage of congenital anomalies of the excretory system was observed among the respondents, which may be due to the need for a follow-up examination by a pediatric nephrologist. 11.7% (n=34) answered "Yes"; 11% (n=32) noted that no examination for such anomalies had been performed, and 77.3% (n=225) reported that no such pathology had been detected in their children. (Figure 44).

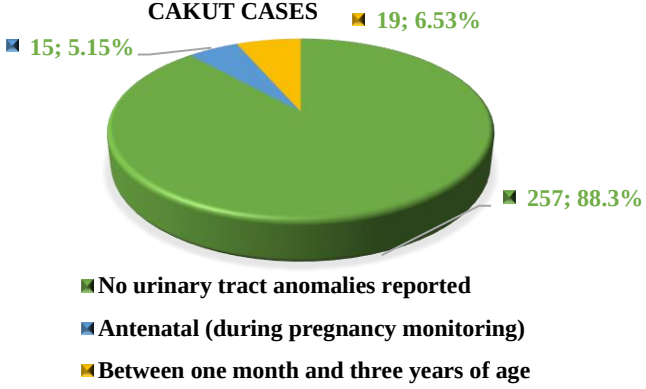
ФИГУРА 44. PREVALENCE OF PEDIATRIC CAKUT



- **Distribution of respondents according to the timing of CAKUT diagnosis in offspring**

Antenatal diagnosis during routine pregnancy monitoring was reported by 5.15% (n=15) of respondents, while 6.53% (n=19) were diagnosed postnatally between the ages of one month and three years. The majority of the sample, 88.3% (n=257), reported no presence of CAKUT in their children. (Figure 45.).

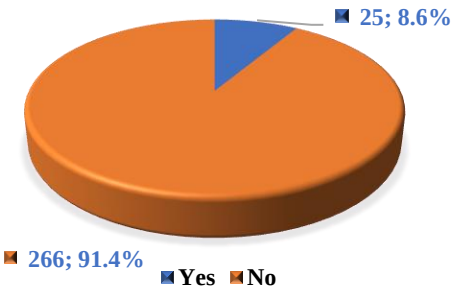
FIGURE 45. TIMING OF DIAGNOSIS FOR PEDIATRIC CAKUT CASES



- **Distribution of respondents by familial history of CAKUT**

Of the parents who completed the questionnaire, 8.6% (n=25) reported that there were members of their family with congenital anomalies of the urinary system, and 91.4% (n=266) reported no such pathology in their family. (Figure 46.).

FIGURE 46. FAMILIAL HISTORY OF CAKUT



- **Distribution of respondents according to their awareness concerning UTI risk factors and etiology**

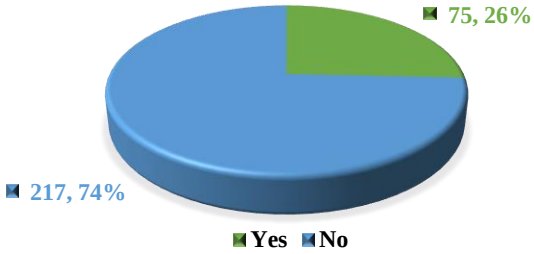
Only 13.7% (n=40) responded that they were aware of the risk factors for developing urinary tract infections in childhood; 44.2% (n=129) hesitantly responded that they were not sure, and 42.1% (n=123) responded that they were not aware of these risk factors. (Figure 47.).

FIGURE 47. PARENTAL AWARENESS OF UTI RISK FACTORS

- **Distribution of surveyed parents by awareness of possible complications from UTI**

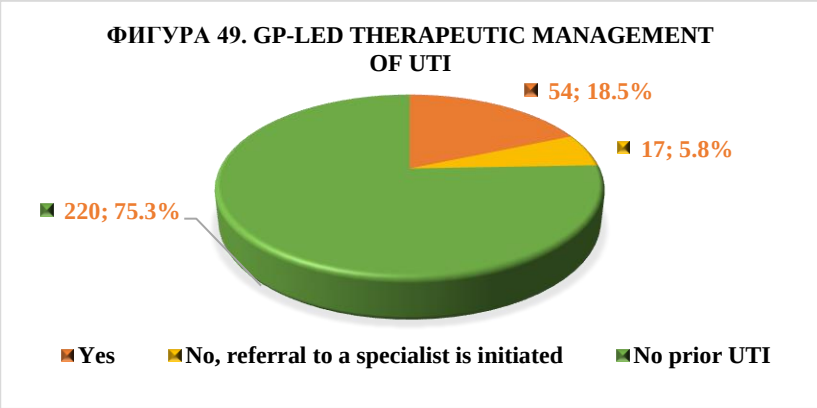
The majority of respondents said they were not familiar with the possible complications that can occur after a UTI – 74.3% (n=217). (Figure 48.)

FIGURE 48. PARENTAL AWARENESS OF POTENTIAL UTI COMPLICATIONS



- **Distribution of respondents by GP-led management for UTI**

Among parents whose children had cases of urinary tract infection, in most cases the general practitioner administered therapy – 18.5% (n=54); and in 5.8% (n=17) of cases, the child's GP decided to refer them to a specialist pediatric nephrologist for treatment. (Figure 49.).



- **Distribution of respondents by maternal gestational health status (Table 4).**

Table 4. Distribution of respondents by maternal gestational health status

Disease	N	%
Vaginal Infection	48	17.2
Gestational Diabetes Mellitus	27	9.7
Gestational Diabetes Mellitus, Vaginal Infection	1	0.
UTI	16	5.7

UTI, Vaginal Infection	**5**	**1.8%**
No complications	**163**	**58.4**
Preeclampsia/Eclampsia	**5**	**1.8**
Pre-gestational Infectious Diseases	**9**	**3.2**
Pre-gestational Infectious Diseases, Vaginal Infection	**5**	**1.8**

- **Analysis of Antibiotic Requirements for Urinary Tract Infections in Children with Confirmed CAKUT**

Of the parents who reported the presence of CAKUT, **8 (23.5%)** indicated that treatment with more than one antibiotic was necessary, while **26 (76.5%)** reported that this was not necessary (Table 5).

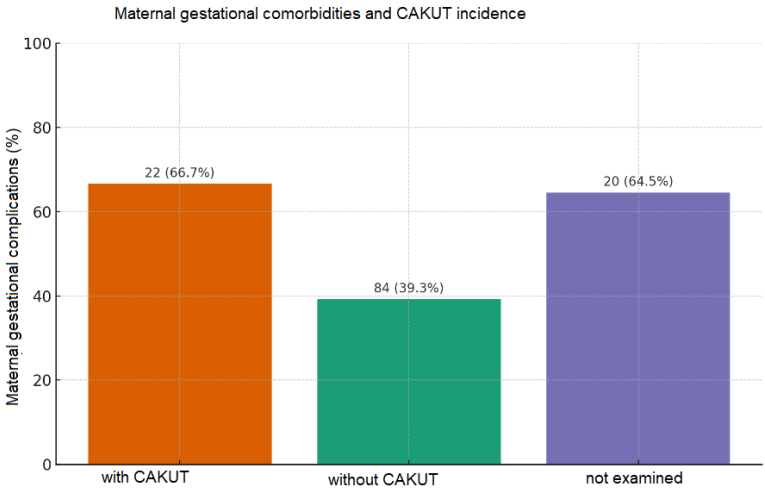
Table 5. Antibiotic Treatment Rates in Children with CAKUT

	Antibiotic therapy		
CAKUT	**Yes n (%)**	**No n (%)**	**Total n (%)**
Yes	**8**	**26 (76.5%)**	**34 (11.7%)**
No	**1 (0.4%)**	**223 (99.6%)**	**224 (77.2%)**
Never examined	**0**	**32 (100.0%)**	**32 (11.0%)**
Total	**9 (3.1%)**	**281 (96.9%)**	**290 (100.0%)**

- **Correlation between maternal gestational comorbidities and the incidence of CAKUT in offspring**

Of the total of 33 parents who reported having a child with CAKUT, 22 (66.7%) reported a gestational problem, while 11 (33.3%) report no such problems. (Figure 50.)

Figure 50. Correlation between maternal gestational comorbidities and the incidence of CAKUT in Offspring.



- **Analysis of the association between familial history and the incidence of CAKUT in offspring**

Of all parents who reported a child with CAKUT, 17 (50.0%) indicated the presence of another family member with a similar anomaly. The remaining 17 (50.0%) did not report a family history. (Table 6.)

Table 6. What proportion of parents who reported having children with CAKUT indicated a family history

Family history of CAKUT	Presence of a congenital anomaly in the child				
		Yes	No	Never examined	Total
Yes	N	17	4	4	25
	%	5.9	1.4	1.4	8.6
No	N	17	220	28	265
	%	5.9	75.9	9.7	91.4
Total	N	34	224	32	290
	%	11.7	77.2	11.0	100

VII. DISCUSSION

CAKUT are structural and functional abnormalities of the kidneys, collecting system, bladder, and urethra. The development of the urinary tract can be disrupted at any stage of embryogenesis, causing developmental anomalies with various manifestations. CAKUT can occur in isolation or in combination with other phenotypes affecting other organs in a syndromic form. CAKUT can be observed as unilateral or bilateral malformation; anatomical classification is complex due to the high variability in phenotypic expression, incomplete penetrance, and variable expression. (Murugapoopathy V, et al. (2020), van der Ven AT et al. (2018)).

According to Kagan M, et al. (2022), congenital anomalies of the excretory system occur in more than 1% of live births, representing 23% of all congenital defects and accounting for 34–59% of cases of chronic kidney disease. In addition, chronic kidney disease is a significant cause of end-stage renal failure, as it occurs in 40–50% of pediatric patients and 7% of adults with chronic renal failure (Talati AN, et al. (2019) and Capone VP, et al. (2017)).

In a review article by Celina de Faria Rezende et al. (2023), pediatric chronic kidney disease has different characteristics from the disease in adults and can lead to severe and specific complications. It can be caused by urological problems such as CAKUT or problems unrelated to CAKUT, followed by hereditary diseases such as glomerulopathies, which can vary with age and be more common in older age groups. Several risk factors for CKD and end-stage renal failure can be identified. Modifiable factors include metabolic acidosis, proteinuria, arterial hypertension, and underlying urological abnormalities; non-modifiable factors include age, gender, racial and genetic factors, low birth weight, premature birth, and socioeconomic status.

Due to the lack of information in Bulgaria on the implementation of preventive screening for congenital anomalies of the urinary system, the percentage of patients diagnosed with CAKUT, and what proportion of these patients have developed renal failure among the pediatric population, we made an official request to the Regional Health Insurance Fund (RHIF) in Varna for data on these issues.

In response to our inquiry, we were provided with the following public data for the Varna region for the period from 01.01.2020 to 31.12.2024.

1. Number of referrals issued by GPs to pediatric nephrologists for CAKUT prevention with ICD Z00.1 – 15,619

2. Number of referrals reported by pediatric nephrology specialists with ICD Z00.1 – 6,640
3. Number of children diagnosed with CAKUT with ICD codes from Q60 to Q64 – 1,905
4. Number of registered children with renal failure with ICD codes N17 to N18 – 5
5. What proportion of patients with ICD codes N17 to N18 had a previous diagnosis with ICD codes Q60 to Q64 – 3 cases

The information received shows that the number of referrals issued with ICD Z00.1 – 15,619 by general practitioners for the purpose of screening for CAKUT is more than twice the number reported by pediatric nephrology specialists with ICD Z00.1 – 6,640. This may be due to the fact that some of the patients did not use the referral issued by the GP because they underwent a paid examination by a specialist or because they did not undergo such a preventive examination despite the recommendation of the general practitioner.

Of the examinations carried out by a pediatric nephrologist for the purpose of screening for early CAKUT detection, 1,905 were diagnosed with CAKUT with ICD codes from Q60 to Q64, representing 12.2% of the total 15,619 children referred for preventive examination.

According to the requested information, there were 5 children registered with renal failure for the period from 01.01.2020 to 31.12.2024 with ICD codes N17 to N18. Among them, three children had a previous disease registered with an ICD code from Q60 to Q64. Comparing the results obtained, we can conclude that in 60% of cases, the cause of the disease in children diagnosed with chronic renal failure was CAKUT.

Due to the lack of other national studies related to CAKUT prevalence and complications in the pediatric population, there were no other data with which to compare our results.

Our study found the following data. Among the general practitioners surveyed, 76% reported that they had children in their practices who had been diagnosed with congenital anomalies of the excretory system. Of these, 42.4% confirmed the presence of concomitant anomalies in organs other than CAKUT in this group of patients.
The results show that in 50% of cases, CAKUT was diagnosed between 0 and 6 months of age, 43.7% in the 7-12 month age group, and only 6.3% between 1 and 3 years of age. This confirms the importance of regular preventive check-ups with a general practitioner and screening tests.

According to Safdar A, et al. (2021) and Lange-Sperandio B, et al. (2023), they emphasize the positive impact of healthcare interventions, such as early fetal interventions, on improving outcomes for patients with fetal hydronephrosis. More recently, advances in robotic surgery have further contributed to shorter recovery times and better postoperative outcomes in CAKUT patients (Zhang X, et al. (2025); Mittal S, et al. (2022)).

According to McCulloch M et al. (2021) and Sanderson KR (2020), despite these advances in treatment, CAKUT remain a major cause of pediatric renal failure, which in severe cases requires renal replacement therapy to increase the survival of these patients. However, the high cost and limited availability of renal replacement therapy pose significant challenges, especially in resource-limited settings such as developing countries and remote areas. Therefore, the development of cost-effective alternatives to renal replacement therapy is essential to improve its accessibility, especially in underserved regions.

According to Buffin-Meyer B, et al. (2025) and Liu W, et al. (2022), the use of multiple ultrasound features improves prenatal CAKUT assessment, and the combination of whole exome sequencing with karyotype analysis and copy number variation plays an important role in the prenatal diagnosis of this pathology, especially for high-risk fetuses with inconclusive ultrasound results.

Harada R et al. (2022) report that advances in diagnosis and treatment have increased survival rates in children and adolescents with chronic kidney disease and end-stage renal failure. Ideally, it would be useful to understand the epidemiology of CKD before hemodialysis is required in order to take effective action to prevent or slow the progression of the disease.

In this context, it is essential to evaluate the results of kidney disease progression. The challenge is to verify the relevant results through long-term observations and to find evidence that will provide epidemiological data on chronic kidney disease and end-stage renal disease (frequency, prevalence, risk factors for progression and mortality, underlying causes, age, sex, race, socioeconomic factors, and medical resources) and thus propose appropriate follow-up and treatment for the pediatric population. (Atkinson MA, et al. (2021), Harambat J, Madden I. (2023))

These data confirm the need to develop a national pediatric registry of children with CAKUT and chronic kidney disease, which could lead to improved early diagnosis, care, treatment, prevention of complications, and reduction of mortality in childhood.

Studies by Chavers BM et al. (2015) and Chesnaye N et al. (2014) report that children and adolescents with end-stage renal failure are exposed to a 30 to 60 times higher risk of mortality compared to their

healthy peers. Cardiovascular disease is the leading cause of death in the United States, Canada, Australia, and New Zealand, where rates are reported to be between 25 and 40% according to Sanderson KR et al. (2019) and Okuda Y et al. (2020). On the other hand, infection is the most common cause in other countries or regions, including those in Europe and Asia, where reported rates range from 20 to 40% according to data from Hattori M, et al. (2015), Tjaden LA et al. (2016).

Different registries have data on heterogeneous study populations, but nevertheless, several factors may be associated with a higher risk of mortality in the pediatric population on renal replacement therapy, such as: younger age, especially under 5 years; female sex; non-Caucasian patients, dialysis patients compared to those with transplants, and the presence of comorbidities (Mitsnefes MM et al. (2013); Sanderson KR et al. (2020); Okuda Y et al. (2020)). Other factors that may be independently associated with high mortality include: short stature, low and high body mass index, anemia (Wong CS et al. (2000); Ku E, et al. (2016); Borzych-Duzalka D, et al. (2013)); hypoalbuminemia and high eGFR at the start of dialysis (Vidal E et al. (2017); Winnicki E, et al. (2019); Amaral S, et al. (2008)). These factors can be modified in clinical practice. It is therefore important to identify the main signs that lead to poorer outcomes, given the etiology of end-stage renal failure in children.

According to Jager KJ et al. (2019), the survival of these patients is determined by multiple factors, such as access to treatment, the amount of investment each country makes in the healthcare sector, the etiology of the disease, age, transplant eligibility, weight development issues, gender, body mass index, race, and the presence of comorbidities.

Celina de Faria Rezende et al. (2023) summarize based on multiple hospital studies investigating the prevalence of pediatric CKD (0.3 to 1 per 10,000 children) and limited population studies suggesting a much higher prevalence (1 to 10 per 1,000 children), that the current total number of children and adolescents affected by stages 2-5 CKD cases worldwide can be isolated to over two million cases of chronic kidney disease in a population of two billion children. Public awareness, political attention, and the necessary investment in pediatric CKD and end-stage renal disease are still very limited. This is partly due to the complexity of these conditions, which encompass many etiologies (often rare diseases) and involve a wide spectrum of manifestations, often starting as a silent disease. However, it can progress with devastating effects on quality and length of life.

General practitioners play a key role in the early diagnosis of congenital anomalies of the excretory system, monitoring and preventing the development of complications from this pathology. Therefore, we examined the implementation of a screening program for the detection of CAKUT, practices related to the diagnosis and treatment of diseases of the excretory system, as well as various demographic and other factors influencing the work of GPs.

From the data obtained, we found that 87.5% of respondents comply with the national program for the prevention of CAKUT. The data show that laboratory blood and urine tests at six months and one year of age are performed in 96.4% of the GPs surveyed. There are gaps in the performance of preventive ultrasound examinations by pediatric nephrologists. About half of the general practitioners surveyed responded that they do not have parents in their practice who refuse such examinations – 55.2%, while the rest of the respondents reported such cases – 44.8%. This may be due to parents' lack of awareness of the importance of such preventive measures, limited knowledge of

diseases of the urinary system, and the serious complications they can lead to.

In their practice, the general practitioners surveyed found that 94.8% of children with "failure to thrive" – poor nutrition, failure to gain weight, delayed growth and development, frequent illness, or recurrent urinary tract infections – were clinically referred for CAKUT, which indicates a good level of knowledge and diagnostic thinking among GPs regarding this type of pathology.

The results show that 86.5% of the general practitioners surveyed reported cases of asymptomatic urinary tract infections among pediatric patients, which were diagnosed during preventive examinations included in the screening program for early CAKUT detection.

Among the surveyed general practitioners, 76% reported having cases of children with CAKUT in their practice, with 42.4% of them also having concomitant anomalies in other organs.

We looked for a correlation between the proportion of patients with CAKUT among the surveyed general practitioners and cases of chronic renal failure and found that such a correlation occurred in 9.4% of respondents.

Looking at GP practices in cases of urinary tract infection among pediatric patients, which may be the first sign of CAKUT, we found the following data. In 90.6% of cases of questionable urine test results, general practitioners repeated the tests, and in 92.6% of cases they prescribed a urine culture with an antibiogram. The prescription of antibiotic treatment without a ready antibiogram result was found in half of the respondents (50.5%), this practice being characteristic of more experienced general practitioners.

The results show a statistically significant relationship between job experience and the practice of empirical treatment ($\chi^2 = 17.28$, df = 6, p = .008). The youngest doctors (0–5 years) prescribed antibiotics without antibiotic susceptibility testing significantly less often (18.5%), while this proportion increases in the groups with 16–20 years of experience (54.8%), 21–25 years (71.4%), and 26–30 years (75.0%). This shows a tendency for more experienced physicians to rely more often on their clinical experience and start treatment before laboratory confirmation.

We analyzed the relationship between GPs' experience and the time they spend on pediatric consultations, providing parents with information on how to properly collect urine samples from their children, and educating parents about the main symptoms of urinary tract diseases.

To analyze the impact of professional experience on the time spent on pediatric consultations, a χ^2 test of independence was performed. The results showed a statistically significant association between the two variables ($\chi^2 = 47.0$, df = 18, $p < .001$), indicating that the length of practice as a general practitioner is related to the structure of time spent on pediatric consultations. We found that the youngest doctors (0–5 years of experience) more often allocated 10–15 minutes (17.7% of all participants), while more experienced doctors (16–20, 21–25, and 26–30 years of experience) mostly indicated 15–20 minutes (20.8%, 8.3%, and 8.3% of the total sample). On the other hand, the group with 6–10 years of experience was more varied, with the three categories of 5–10, 15–20, and >20 minutes evenly represented. The most experienced doctors (over 30 years of experience) indicated only 15–20 minutes (2.1% of the total sample).

Getting information from parents on how exactly to collect a urine sample for testing was important to minimize sample contamination and get accurate results. When analyzing the surveyed general practitioners and their years of experience, a statistically significant relationship was found ($\chi^2 = 21.7$, df = 12, p = .041). Doctors with the shortest experience (0–5 years) and those with over 30 years of experience almost always explained the procedure (92.6% and 100%). In the groups with 11–15 and 16–20 years of experience, there was a higher relative proportion of the answer "only if the parents ask" (50.0% and 12.9%). The answer "no" was found only among doctors with up to 5 years of experience (7.4%).

The practices of general practitioners in response to a suspicious urine test result are extremely important for the early diagnosis and timely treatment of diseases of the excretory system. The results of the study showed that 90.6% repeated the test and 92.6% additionally prescribed a urine culture with an antibiogram.

Doctor-patient communication is extremely important for prevention, early diagnosis, and treatment. Therefore, we sought to determine what proportion of the GPs surveyed reported that parents had sought information from them about the main risk factors that could lead to urinary tract infections. The results obtained are extremely unsatisfactory, with only 15.6% of respondents indicating that parents in their practice had sought information on this issue. Parents' response to their child's illness could change the course of the disease if it is timely and correct, which is why it is important that they be educated and informed about the main risk factors, symptoms, and complications.

Abolhassan Seyezadeh (2021) conducted a study to assess the awareness of parents of infants and children with urinary tract infections and related demographic factors. The results show that

awareness is average among 37% of parents and desirable among 63%. Based on the answers to the awareness questions, most parents were sufficiently informed about the main causes of urinary tract infections, symptoms, complications, treatment, prevention, and diagnosis.

The general practitioner is one of the most accessible reliable sources of information on various health topics of interest to parents. Each regular pediatric consultation can be linked to enriching parents' knowledge and awareness in various aspects. Regular visits to the GP for preventive check-ups are important for monitoring children's growth and development, early diagnosis and prevention of complications from acute and chronic diseases, as well as enriching parents' knowledge and awareness in various aspects related to their children's health.

We looked for a correlation among the surveyed parents regarding regular visits to pediatric consultations at the GP and obtained the following data: 67.1% visit regularly and 21.9% visited pediatric consultations regularly only until the age of 1. The highest regularity is among parents on maternity/paternity leave (85.8% attend in total), while among those in permanent employment, 53.0% attend regularly and 18.3% do not attend at all. A strong statistically significant relationship was found between employment and regular attendance at consultations ($\chi^2(8, N=292)=39.7, p<0.001$).

In the Child Health Care program implemented by GPs, the prevention measures provided for screening for congenital anomalies of the excretory system include laboratory tests of blood and urine at 6 months and 1 year of age, as well as an examination by a pediatric nephrologist. Its implementation depends not only on the general practitioner, but also on the parents. Among the groups of parents

surveyed, these screening tests and consultations are not carried out among all respondents.

A preventive examination by a pediatric nephrologist was performed in 80.8% of the children of the surveyed parents, with 18.8% of them requiring a follow-up visit. Preventive blood and urine tests, as part of the screening included in the Child Health Care package at 6 months of age, were performed in 94.1% of the children of the respondents. The results show that laboratory tests are widely performed by parents, while almost 20% of respondents did not have their children examined by a pediatric nephrologist at this stage.

We looked for a correlation in the practice of GPs in informing parents about upcoming preventive examinations and the correct way to collect urine samples from their children. The analysis showed that 237 parents (84.3%) answered "Yes" to both questions: whether their GP had informed them about the need for preventive tests and a check-up with a pediatric nephrologist, and whether they had explained how to collect a urine sample correctly. Only 44 parents (15.7%) gave different answers or "No" to both questions. The results indicate a strong and statistically significant relationship between the two variables ($\chi^2(1, N=281)=49.0$, $p<0.001$), which shows consistency in the practices of general practitioners in informing parents.

Among parents of children with CAKUT, only 16 (64.0%) reported that their general practitioner had explained how to take a urine sample correctly, while 9 (36.0%) stated that they had not received such an explanation. In comparison, in the group without CAKUT, the proportion of informed parents is significantly higher – 205 (91.1%), compared to only 20 (8.9%) who did not receive an explanation. In the group that did not undergo screening for CAKUT (n = 32), 81.3% (n = 26) were informed. The χ^2 test showed a statistically significant

relationship between the presence of CAKUT and receiving information about urine sampling ($\chi^2(2, N = 282) = 16.5, p < .001$).

In our study of parents of children aged 0-3 years, 11.7% of respondents reported that their children had been diagnosed with a congenital anomaly of the urinary system. Due to the high percentage of genetic defects associated with the occurrence of congenital anomalies of the urinary system, we sought to determine the proportion of parents of children with CAKUT who reported such a correlation. Data analysis showed that family history is common among families of children with CAKUT. Of all parents who reported a child with a congenital anomaly of the excretory system, 17 (50.0%) indicated the presence of another family member with a similar anomaly. The remaining 17 (50.0%) did not report a family history.
In comparison, in the group of parents without a child with CAKUT, only 17 (6.4%) reported a similar burden, and in the group without examination (n = 32), the frequency was 12.5%. The χ^2 test confirmed the existence of a statistically significant relationship between the presence of a child with CAKUT and a family history of similar anomalies ($\chi^2(2, N = 290) = 87.8, p < .001$).

According to Stefan Kohl et al. (2021), careful assessment of family members and thorough screening for other affected organs may reveal a monogenic CAKUT form, which could be confirmed by genetic testing based on generation sequencing. Healthcare professionals caring for families with CAKUT should be aware that different individuals from the same family may have different CAKUT phenotypes ("variable expressivity") and that variant carriers may not be affected ("reduced or incomplete penetrance"), which further complicates the identification of familial cases and family counseling.

The influence of various external and internal factors during pregnancy can increase the risk of congenital anomalies of the

excretory system. Therefore, we sought to determine the proportion of mothers of children with CAKUT who had health problems during pregnancy. The analysis of the data showed that mothers of children with CAKUT reported health problems during pregnancy significantly more often than mothers of children without such anomalies. Of the 33 parents who reported having a child with CAKUT, 22 (66.7%) indicated that the mother had a health problem during pregnancy, while 11 (33.3%) reported no such problems. The most commonly reported conditions among mothers of children with CAKUT were diabetes during pregnancy (33.3%), infectious diseases (12.1%), vaginal infections (6.1%), urinary tract infections (3.0%), and rarer cases of preeclampsia/eclampsia (3.0%). Some women also reported combined conditions, such as infection and vaginal infection (9.1%). The χ^2 test showed a statistically significant association between the presence of BAOS in the child and the mother's health problems during pregnancy ($\chi^2(16, N = 278) = 66.0, p < .001$). In infancy and early childhood, the symptoms of diseases of the urinary system may be nonspecific, so parents may not pay attention or delay consulting a medical specialist.

Results from a survey of parents on diagnosing urinary tract infections in cases of unexplained fever in their children show that 20.1% of respondents had experienced such an episode. We asked parents about their awareness and found that 55.1% of parents are not familiar with the first symptoms of urinary tract infection in children. Only 13.7% of parents responded that they were aware of the main risk factors for developing a urinary tract infection in childhood, and 25.7% reported that they were aware of the possible complications of a urinary tract infection.

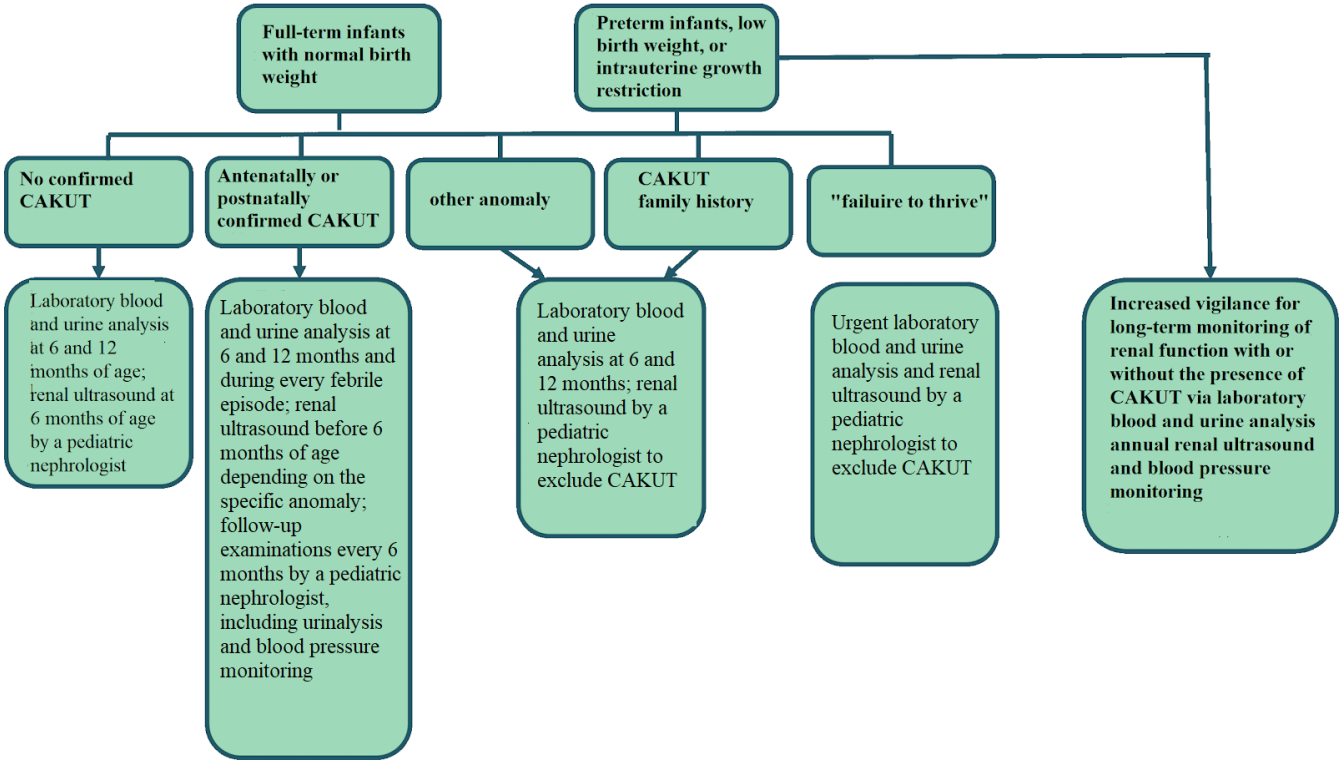
Alyson Campbell et al. (2021) report that parents play a vital role in the detection and treatment of pediatric UTIs. Since they can be the first sign of a more serious disease of the excretory system, which can

have a significant impact on children and their families, it is important to develop tools to raise parents' awareness of this pathology, which will reduce confusion and uncertainty among parents.

In a study, Celina de Faria Rezende et al. (2023) examined the long-term concern of the association of clinically apparent but mild chronic kidney disease in pediatric patients at increased risk of developing kidney failure in young people. There is a need to raise awareness of chronic kidney failure in childhood in order to improve health outcomes. To achieve this, more data needs to be collected and population-based registries maintained that include not only end-stage renal failure but also the early stages, when it can be delayed or prevented. It is imperative to assess the impact of population screening in children with risk factors for CKD. The authors believe that identifying individuals with risk factors for CKD and implementing and enforcing CKD prevention programs are extremely important for primary care. Given the increasing incidence and prevalence of CKD and ESRD among pediatric patients, combined with the possibilities for preventing and delaying the progression of these diseases, it is extremely important to examine the detailed profile of the pediatric population undergoing treatment for end-stage renal disease in order to build important and necessary data for adjusting healthcare policies.

Improving early CAKUT diagnosis, as well as monitoring to prevent the development of associated complications, is key to the successful management of this type of pathology. The practical algorithm we have developed (Figure 60) can be successfully applied in general medical practice to achieve this goal.

Figure 60. Practical algorithm for early CAKUT diagnosis and management by GPs


Full-term infants with normal birth weight
Preterm infants, low birth weight, or intrauterine growth restriction
No confirmed CAKUT
Antenatally or postnatally confirmed CAKUT
other anomaly
CAKUT family history
"failuire to thrive"
Laboratory blood and urine analysis at 6 and 12 months of age; renal ultrasound at 6 months of age by a pediatric nephrologist
Laboratory blood and urine analysis at 6 and 12 months and during every febrile episode; renal ultrasound before 6 months of age depending on the specific anomaly; follow-up examinations every 6 months by a pediatric nephrologist, including urinalysis and blood pressure monitoring
Laboratory blood and urine analysis at 6 and 12 months; renal ultrasound by a pediatric nephrologist to exclude CAKUT
Urgent laboratory blood and urine analysis and renal ultrasound by a pediatric nephrologist to exclude CAKUT
Increased vigilance for long-term monitoring of renal function with or without the presence of CAKUT via laboratory blood and urine analysis annual renal ultrasound and blood pressure monitoring

VIII. CONCLUSION

Improving the early CAKUT diagnosis will lead to effective care for children's kidney health and slow down the development of chronic kidney disease, its accompanying complications, and early mortality caused by it. The current alarming situation is due to insufficient public awareness and lack of information among policymakers about CKD in the pediatric population, main causes leading to it, and consequences of delayed diagnosis and appropriate treatment.

The lack of information at the national level on urinary tract pathology and, in particular, congenital anomalies among children is one of the main reasons for the development of this dissertation, as CAKUT remains one of the leading causes of chronic renal failure. The creation of a pediatric CAKUT registry, chronic kidney disease, chronic renal failure, renal replacement therapy, and kidney transplantation will have an extremely positive impact on healthcare in terms of providing adequate and effective care for this vulnerable group of patients, as well as a targeted approach to timely diagnosis and prevention.

The algorithm we developed for general practitioners can be applied in their practice to improve timely diagnosis and long-term follow-up, which will prevent the early development of chronic kidney disease and its associated complications, and preserve the quality of life of these patients and their loved ones.

IX. INFERENCES

1. In the Varna region, 1,905 children were diagnosed with CAKUT over a period of 5 years (2020-2024); 5 children developed CKD, and in 3 of them, CKD was a complication of CAKUT.

2. The lack of a national pediatric registry for CAKUT and CKD masks the seriousness of their prevalence, complications, and early mortality, which is why it is necessary to develop a behavior algorithm for GPs to improve CAKUT screening among children aged 0-3 years

3. Over ¾ of the GPs surveyed have children with CAKUT in their practice

4. In 20% of cases of prolonged unclear temperature, a urinary tract infection was found

5. 11.7% of the parents surveyed had children with VAS

6. In 23.1% of CHD cases, they also had other anomalies, which requires a multidisciplinary approach for their detection

7. 66.7% of mothers of children with CAKUT had health problems during pregnancy, which requires improved control of chronic diseases and elimination of risk factors during pregnancy.

8. There is a need to increase regular attendance at pediatric preventive consultations with general practitioners, which was currently observed in only 67.1% of parents.

9. 55.1% of parents had no information about the first UTI symptoms in childhood, and 74% of them were not informed about possible complications from diseases of the urinary system.

10. Our data showed that only 15.6% of parents seek information from GPs about risk factors for developing urinary tract infections, which leads to delays in diagnosis, the development of complications, or improper care.

X. CONTRIBUTIONS

Original scientific and applied contributions

 For the first time in Bulgaria, a survey assessing parents' awareness and attitudes toward CAKUT screening was conducted.
 This study represents the first Bulgarian survey of general practitioners examining screening activities and clinical practices related to the early diagnosis of CAKUT.
 For the first time in Bulgaria, a practical algorithm for early diagnosis and general practitioner management of CAKUT in childhood has been developed and proposed.

1. This is the first study in Bulgaria to investigate CAKUT in the pediatric population, with a focus on the role of general practitioners and parents in its early detection and management.
2. For the first time in Bulgaria, a survey assessing parents' awareness and attitudes toward CAKUT screening was conducted.

3. This study represents the first Bulgarian survey of general practitioners examining screening activities and clinical practices related to the early diagnosis of CAKUT.

4. For the first time in Bulgaria, a practical algorithm for early diagnosis and general practitioner management of CAKUT in childhood has been developed and proposed

Confirmatory contributions

1. The decisive role of CAKUT in the development of chronic kidney disease in early childhood is confirmed.

2. The importance of screening tests and general practitioners' clinical practices for the early diagnosis of CAKUT is confirmed.

3. The need for earlier implementation of screening tests, expansion of the screening panel, and the introduction of mandatory genetic counseling during pregnancy is confirmed.

4. The need for targeted training initiatives to increase parents' awareness of the early symptoms of excretory system disorders in childhood is confirmed.

5. The necessity of establishing a national pediatric registry for CAKUT and CKD.

XI. PUBLICATIONS RELATED TO THE STUDY

1. Ив. Христова, В. Александрова, Р. Алексовска, Косев, Ж. Русева, В. Маджова. "Вродени аномалии на отделителната система в детска възраст и подход на общопрактикуващия лекар при диагностицирането им". Сп. „Обща медицина", 2021, 23 (4): 57- 61

2. Р. Алексовска, Ив. Христова, В. Александрова, Е. Христова, В.Маджова. "Инфекциите на пикочните пътища в детска възраст и ролята на общопрактикуващия лекар в профилактиката и лечението им". Сп. „Детски и инфекциозни болести", 2021, 13 (1): 3-8

3. Р. Алексовска, Ив. Христова, В. Александрова, Е. Христова, В. Маджова. „Оценка на рисковите фактори за инфекции на пикочните пътища в детска възраст". Сп. „Детски и инфекциозни болести", 2021, 13 (1): 9-12

4. Р.Алексовска, Ив. Христова, В. Александрова, М.Близнакова, В.Маджова. „Ролята на родителите в диагностиката и лечението на деца с инфекции на пикочните пътища - оценка на знанията, нагласите и практиките им". Сп. „Обща медицина", 2021, 23 (5): 20-25

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6. Iv. Hristova-Nikolova, Valentina Madjova, Jenia Ruseva. "Parental awareness and screening of congenital urinary tract anomalies in general practice”, Poster session, 101st European General Practice Research Network Meeting Plovdiv, Bulgaria, 16-19 October 2025