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EPIDEMIOLOGY OF UROLITHIASIS IN THE TURKESTAN REGION

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Abstract

Background: Urolithiasis is one of the most common urological diseases worldwide and in Kazakhstan after renal inflammatory diseases.

Aim: to study the epidemiology of diseases of the urinary system with a particular interest in urolithiasis.

Methods: The prevalence of diseases of the organs of the urinary system was observed in 81327 examined individuals, who were hospitalized in the clinics of the Turkestan region. Among urological diseases were chronic tubulointerstitial nephritis, chronic obstructive and non-obstructive pyelonephritis, terminal stages of kidney damage, tubulointerstitial kidney damage, renal cysts, acute tubulointerstitial nephritis, urinary tract infections, chronic nephritic disorders cystitis, hydronephrosis and others. Statistical analyses were carried out using MATLAB application package version R2017b (MathWorks, USA) and plots were drawn using Microsoft Excel.

Results: The incidence of pathologies of organs of the urinary system has increased by 1.17 times both from 2017 to 2018 and from 2018 to 2019 with linear growth ($R^2 = 9964$). Kidney stones with a prevalence of 1.4% among the pathology of the system are in 7th place. Results of the study indicate that more than 500 people will require hospitalizations in the coming years due to the stagnation of clinical administration due to the onset of COVID-19 pandemics in the end of the observation period.

Conclusion: There has been noted that the prevalence of kidney stone disease is among the leading cause of hospitalisation in the Turkestan region and the incidence rate is steadily increasing.

Key words: urolithiasis, epidemiology, Turkestan region.

Резюме

ЭПИДЕМИОЛОГИЯ МОЧЕКАМЕННОЙ БОЛЕЗНИ В ТУРКЕСТАНСКОЙ ОБЛАСТИ

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Актуальность: Мочекаменная болезнь - одна из самых распространенных урологических заболеваний в мире и в Казахстане после воспалительных заболеваний почек.

Цель: изучать эпидемиологию заболеваний мочевыделительной системы с особым интересом к мочекаменной болезни.

Материалы и методы исследования: Распространенность заболеваний органов мочевыделительной системы отмечена у 81 327 обследованных лиц, госпитализированных в поликлиники Туркестанской области. Среди урологических заболеваний были хронический тубулоинтерстициальный нефрит, хронический обструктивный и необструктивный пиелонефрит, терминальные стадии поражения почек, тубулоинтерстициальное поражение почек, кисты почек, острый тубулоинтерстициальный нефрит, инфекции мочевыводящих путей, хронический нефритический цистит, гидронефроз и другие. Статистический анализ проводился с использованием пакета приложений MATLAB версии R2017b (MathWorks, США), а графики строились с использованием Microsoft Excel.

Результаты: Заболеваемость патологиями органов мочевыделительной системы увеличилась в 1,17 раза как с 2017 по 2018 год, так и с 2018 по 2019 год с линейным ростом ($R^2 = 9964$). Камни в почках с распространенностью 1,4% среди патологий системы находятся на 7 месте. Результаты исследования показывают, что более 500 человек потребуют госпитализации в ближайшие годы из-за стагнации клинического администрирования из-за начала пандемии COVID-19 в конце периода наблюдения.

Заключение: Отмечено, что распространенность мочекаменной болезни является одной из основных причин госпитализации в Туркестанской области, и уровень заболеваемости неуклонно растет.

Ключевые слова: мочекаменная болезнь, эпидемиология, Туркестанская область.

Түйіндеме

**ТҮРКІСТАН ОБЛЫСЫ БОЙЫНША
НЕСЕП-ТАС АУРУЫНЫҢ ЭПИДЕМИОЛОГИЯСЫ****Реза А. Фатхи¹**, <https://orcid.org/0000-0001-5372-3155>**Шора М. Сейдинов¹**, <https://orcid.org/0000-0002-4236-3526>¹Қожа Ахмет Ясауи атындағы Халықаралық қазақ-түрік университеті,
Түркістан қ., Қазақстан Республикасы.

Өзектілігі: Несеп-тас ауруы – әлемде және Қазақстанда бүйрек қабынуынан кейінгі жиі кездесетін урологиялық ауруларының қатарына кіреді.

Мақсаты: несеп шығару жүйесінің, әсіресе несеп-тас ауруының эпидемиологиясын зерттеу.

Зерттеу әдістері: Түркістан облысы ауруханаларына жатқызылған науқастардың ішінде 81 327 респондентте адамда несеп шығару жүйесінің ауруы байқалған. Урологиялық аурулардың ішінде созылмалы тубулоинтерстициалды нефрит, созылмалы обструктивті және и обструктивсіз пиелонефрит, терминалды сатыдағы бүйрек аурулары, тубулоинтерстициалды бүйрек асқынуы, бүйрек кистасы, жіті тубулоинтерстициалды нефрит, несеп шығару жолдарының инфекциялары, созылмалы нефритикалық цистит, гидронефроз және басқалары кіреді. Статистикалық талдау MATLAB бағдарламасының R2017b версиясы (MathWorks, США) арқылы жасалды, графтер Microsoft Excel-ды пайдалана отырып сызылды.

Нәтижелер: Несеп шығару жүйесінің ауруы жиілігі 2017 жылдан 2018 жылға дейін және 2018 жылдан 2019 жылға дейін 1,17 есеге сызықты өсуімен жоғарлаған ($R^2 = 9964$). Несеп-тас ауруы аталған аурулар ішінде 1,4% кездесіп 7 орынды алды. Зерттеу нәтижелері келер жылдарда 500-ден аса адам несеп-тас ауруы себебінен госпитализацияға мұқтаж болады, негізгі себебінің бірі COVID-19 пандемиясына байланысты болуы мүмкін.

Қорытынды: Түркістан облысында несеп-тас ауруының таралуы госпитализациянудың негізгі себептерінің бірі болғаны байқалған және бұл тенденция әрі қарай өсуі мүмкін.

Негізгі сөздер: несеп-тас ауруы, эпидемиология, Түркістан облысы.

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Introduction

Urolithiasis is one of the most common urological diseases in the world and ranks second after inflammatory nonspecific diseases of the kidneys and urinary tract [4, 17, 27, 28]. The proportion of urolithiasis among all urological diseases is about 40% [1, 17, 28].

The prevalence of urolithiasis also varies depending on the geographic location [12]. Despite various local differences, there are regularities in lithogenesis depending on countries and continents. For example, the risk of developing urolithiasis in adults is higher in the Western Hemisphere (5-9% in Europe, 12% in Canada, 13-15% in the USA) than in the Eastern Hemisphere (1-5%) [18], although the highest risks have been reported in some Asian countries such as Saudi Arabia (20.1%) [20]. The annual incidence of urolithiasis in the world is from 0.5 to 5.3% of the total population, in the Russian Federation - up to 38% of all urological diseases, over the past 5 years, the incidence of nephrolithiasis in adults in Russia is 460 cases per 100 thousand population, and patients with urolithiasis make up 30-40% of all patients in urological hospitals [29].

Generally, the incidence of urolithiasis depends not only on the geographical area but also on the racial distribution

and socioeconomic status of the community. Changes in socio-economic conditions over time affect changes in dietary habits, which in turn has a high direct correlation not only with morbidity but also with the chemical composition of stones. Currently, calculi with a predominance of calcium oxalate and calcium phosphate are more common in economically developed countries, while stones consisting of ammonium urate and calcium oxalate are quite widespread in Asian countries [27]. An interesting observation was made that the prevalence of urolithiasis in Europe in the 19th century was very similar to the prevalence of urolithiasis in Asia in the 20th century [3].

In 70% of patients, urolithiasis is diagnosed at the age of 30–60 years, with the predominance of males [10, 24]. At the same time, recently, some researchers have noted a progressive increase in the development of urolithiasis among the female population [2, 11, 24] and children [8, 16, 21].

Urolithiasis is a multifactorial disease in which calculi are formed in any part of the urinary tract [5, 7, 13]. An imbalance between promoters and inhibitors of crystallization in the urinary system is one of the most common factors of the disease. Namely, low urine volume,

urine pH, the presence of minerals (calcium, sodium, oxalate and urate) contribute to the formation of crystals [4, 5, 22]. In contrast, citrate, pyrophosphate, magnesium, glycosaminoglycans, urinary prothrombin fragment 1, osteopontin and acidic polypeptides inhibit crystallization [15, 22, 26].

The chemical content of calculi has significantly changed towards an increase in the frequency of formation of oxalate and calcium phosphate stones, even in the Eastern Hemisphere, where these stones are traditionally less common than uric acid and infectious stones. Recent epidemiological studies conducted on different continents and in different countries show that calcium oxalate accounts for 60% to 90% of stones in children, followed by calcium phosphate (10-20%), struvite calculi (1-14%), uric acid (5-10%), cystine (1-5%) and mixed or different stones (4%) [14, 19, 30].

Despite the widespread occurrence of hypercalciuria (the basis of oxalate stones) throughout the world, in some countries of the Eastern Hemisphere, hypocitraturia is considered the leading cause of urolithiasis [25]. Other less common metabolic risk factors are hyperuricosuria and hyperoxaluria. However, increased urinary oxalate excretion may be underestimated and may even be a more common risk factor than hypercalciuria for urolithiasis in some populations [23].

Struvite (or infectious) stones, which were very common in children until the last century, are rarely found in industrialized countries today. This is due to improved treatment of both pediatric obstructive uropathy and urinary tract infections [6]. Nevertheless, one cannot exclude the fact that stones of this type are still found with a probability of 25-38% [9].

Materials and methods. This population-based study involved the investigation of resources of the state registration of patients with urological pathologies during 2017-2019 and conducted on the basis of the Regional Clinical Hospital of Shymkent city.

The source of information during the research work was the materials of the state registration of patients with urolithiasis of the International Classification of Diseases (ICD) - N20-N21 consolidated reporting form No. 12, medical outpatient cards, registration form No. 025 / u of the Ministry of Health of the Republic of Kazakhstan. The work used statistical data on the population in the Turkestan region, data of patients who applied to the departments of urology, nephrology, and functional diagnostics of medical institutions for the period 2017 - 2019. Consent forms were not required from patients, however, the study was approved by the Local Ethical Committee to use the data for the study, which was the part of the doctoral degree program 8D10110-«Medicine», funded by the state educational program for the support of postgraduate education.

We observed the prevalence of diseases of the organs of the urinary system (OUS) in all examined individuals. The list of OUS nosology covered all pathologies, including chronic tubulointerstitial nephritis, chronic obstructive and non-obstructive pyelonephritis, terminal stages of kidney damage, tubulointerstitial kidney damage, renal cysts, acute tubulointerstitial nephritis, urinary tract infections, chronic nephritic disorders, cystitis, hydronephrosis and other pathologies of OUS.

Linear regression and other statistical analyses were carried out using MATLAB application package version R2017b (MathWorks, USA) and plots were drawn using Microsoft Excel.

Results

In aggregate, for the period from 2017 to 2019, 81327 people were hospitalized in the clinics of the Turkestan region for the above-mentioned diseases of OUS (Figure 1). It should be noted that throughout the study, the incidence of OUS pathology has increased by 1.17 times both from 2017 to 2018 and from 2018 to 2019. The growth is linear, and the adjusted square of the value R is close to 1 ($R^2 = 9964$). The latter can be used for predicting the incidence rate in epidemiological studies.

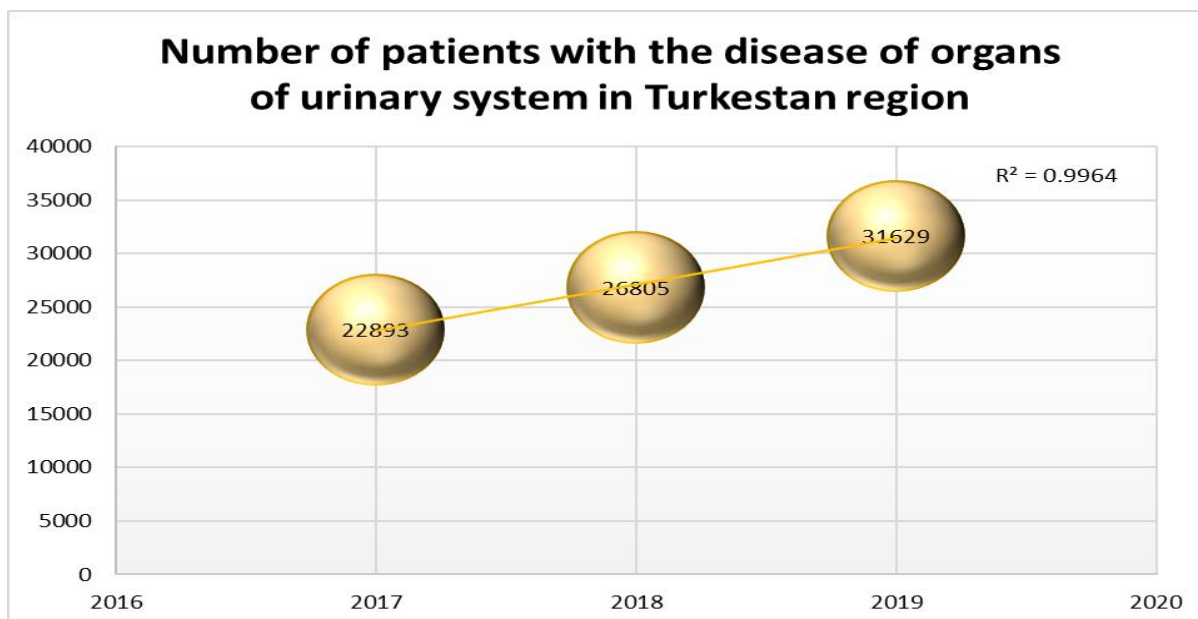


Figure 1. Linear regression analysis of the number of patients with OUS.

An analysis of the number of patients for OUS pathologies and their gender and age characteristics showed that females and adults over 17 years of age are more likely to be affected (Figure 2). If the number of

patients with OUS among men remains stable (about 6-7 thousand), then the overall growth is provided by the growth of female patients: 16566 in 2017, 20076 in 2018 and 24351 in 2019.

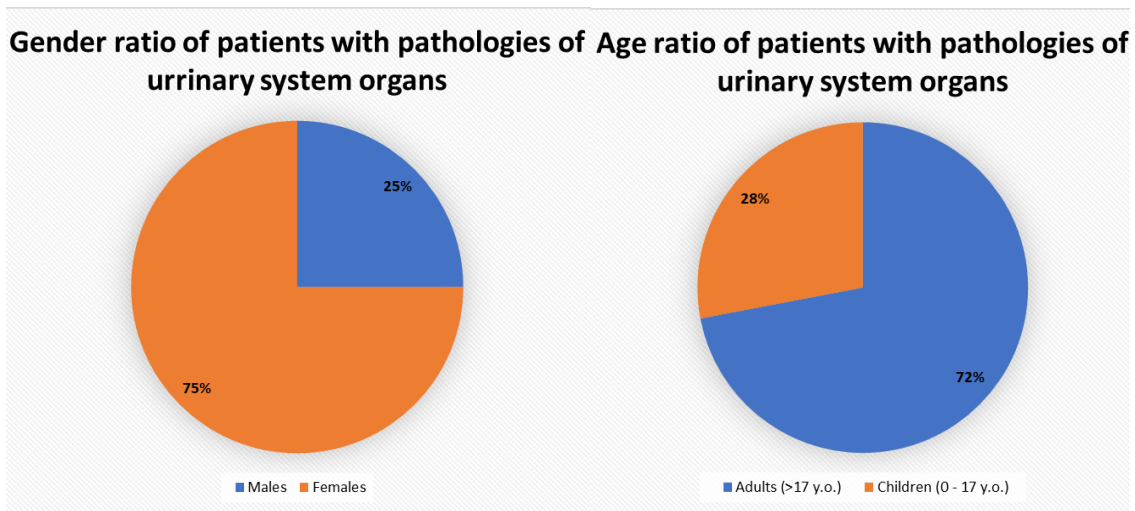


Figure 2. Gender and age ratios in the epidemiology of diseases of the urinary system.

Among the pathologies of the urinary system, chronic tubulointerstitial nephritis, as expected, was widespread: 73.6% of all pathologies of OUS. The second and third places are occupied by chronic obstructive pyelonephritis (11.2%) and non-obstructive chronic pyelonephritis associated with reflux (4.1%). The picture of the epidemiological data for individual diseases of OUS is shown in Figure 3.

In almost all components of the incidence of OUS pathologies, a relatively gradual increase in the number of patients from 2017 to 2019 can be observed. Particular attention is drawn to tubulointerstitial renal lesions and acute tubulointerstitial nephritis. If the first one grew 2 times from 2018 to 2019, then the situation with acute nephritis is even worse: a threefold increase in the incidence over the last year of the study period.

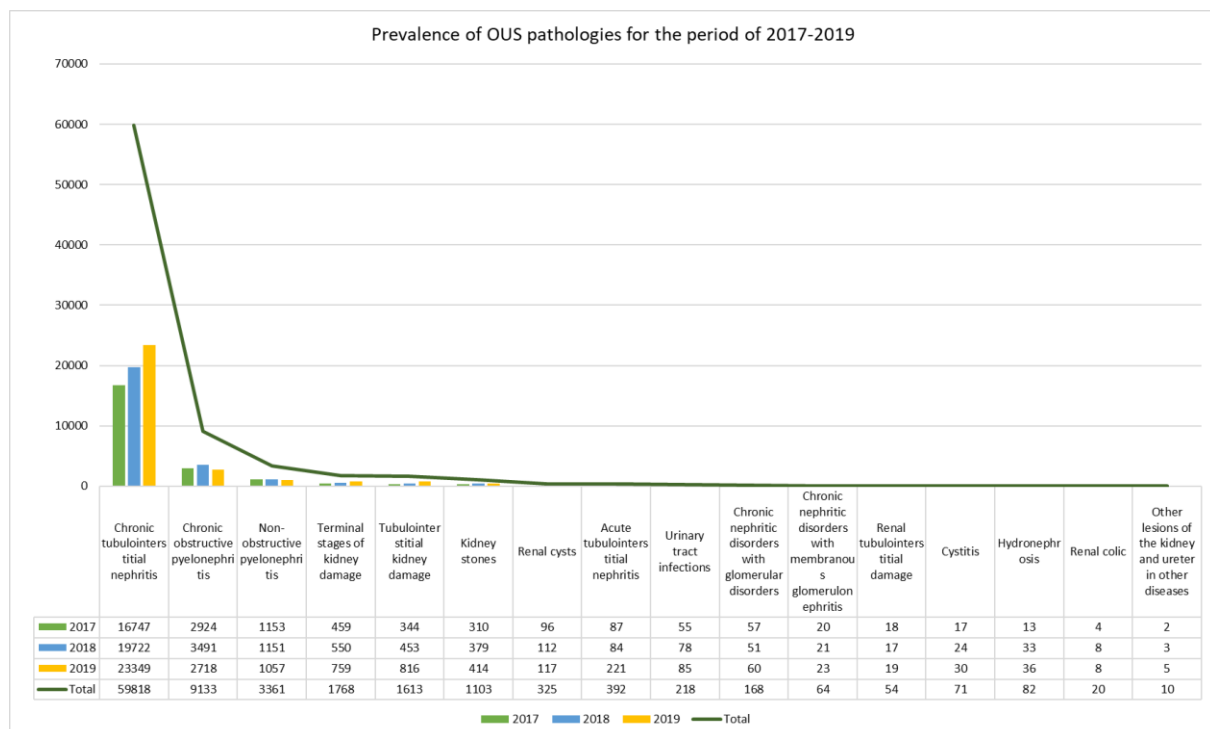


Figure 3. Prevalence of individual components of OUS diseases for the period 2017-2019.

Kidney stones with a prevalence of 1.4% among the pathology of OUS are in 7th place. It is worth considering the fact that this includes only the N20 categories according to the International Classification of Diseases 10 (ICD-10). According to the International Statistical Classification of Diseases and Related Health Problems, 10th revision, adopted by the 43rd World Health Assembly, amended and supplemented by the World Health Organization 1990-2021 (link to the source of ICD-10: <https://icd.who.int/browse10/2019/en>), the list of "Urolithiasis" includes:

- N20 – Kidney and ureteral stones (included: calculous pyelonephritis, excluded: hydronephrosis (N13.2))
- N21 – Lower urinary tract stones (included: cystitis and urethritis)
- N22 – Urinary tract stones in diseases classified elsewhere
- N23 – Renal colic, unspecified

Among these categories, kidney and ureteral stones were more prevalent: 1103 cases over the entire study period (Figure 4).

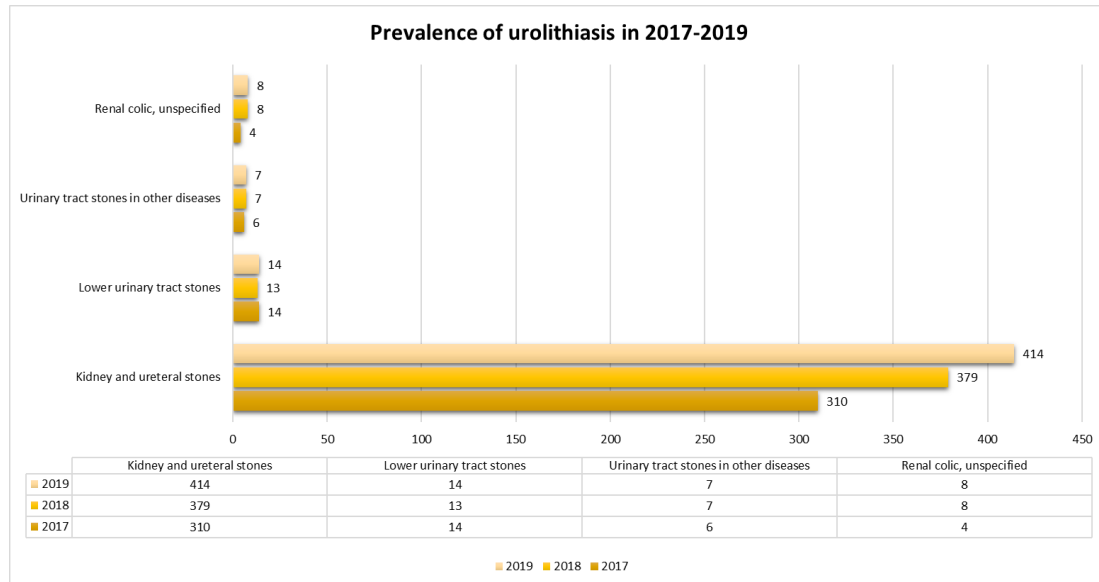


Figure 4. Prevalence of urolithiasis and its components in 2017-2019.

The remaining 81 patients were diagnosed with urolithiasis from other categories (N21-N23) in 2017-2019. Of these, 50% were patients with stones in the lower urinary tract. Here, there can be noted a progressive increase in the incidence of urolithiasis, in particular, an increase in kidney and ureteral stones, the adjusted square of the value R of which is equal to $R^2 = 0.9656$ with positive linear

regression slope. With such an indicator, a further increase in the incidence of urolithiasis is expected and this prognostic index requires further study of the causes of such a picture, the identification of early signs of the disease, a decrease in modifiable risk factors, an improvement in the prevention and treatment of both OUS diseases and urolithiasis.

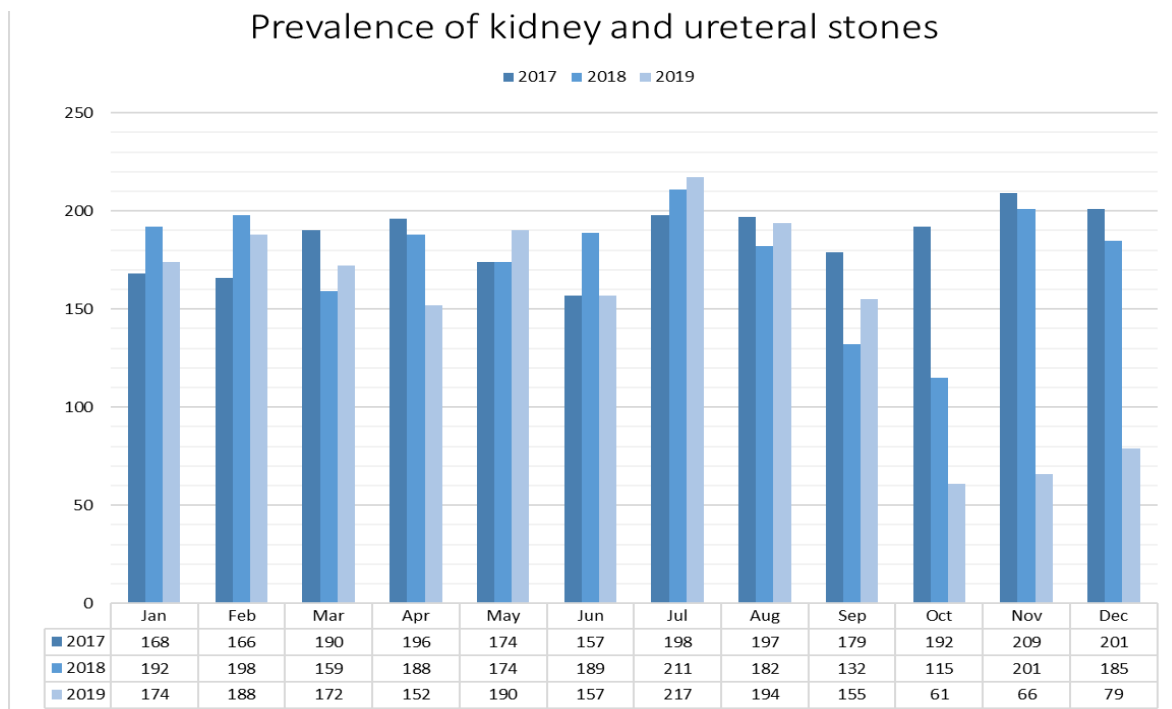


Figure 5. Prevalence of kidney and ureteral stones by month for the period 2017-2019.

We were also interested in the similarities and differences in the prevalence of urolithiasis by the months of 2017-2019, the possible influence of the climate seasons on the incidence of the disease. The data obtained by statistical analyses provided data on the stability and uniformity of cases of kidney and ureteral calculi in 2017 (Figure 5). However, there is a slight decline in the number of patients in September-October 2018 and a significant decrease in this indicator by the end of 2019. It is not possible to explain the reasons for this phenomenon in 2019, but this may be due to a decrease in hospitalization of patients of most profiles due to the onset of the COVID-19 coronavirus pandemic.

Discussion

Urolithiasis is defined as a metabolic disease caused by various exogenous and endogenous factors, often hereditary in nature and determining the presence of calculus in the urinary system. Recent studies have shown metabolic disorders in urolithiasis as obesity, diabetes mellitus, hyperuricemia and metabolic syndrome. The symptoms of urolithiasis are pain, haematuria, dysuria and discharge of calculi and manifestations of both; renal colic caused by occlusion of the ureter, increased intracavitary pressure, impaired intrarenal blood flow with a pronounced edema of the renal parenchyma. Urolithiasis can be asymptomatic, but often manifests itself as excruciating pain, emanating, or radiating from the side to the genitals [9]. The pain usually occurs as a result of blockage by calculi in the urethral-pelvic junction, the edges of the pelvis and vesicoureteral junction.

Obstruction also causes spasms in the lower abdomen, dysuria, urge to urinate and stranguria, and increases intrarenal pressure, which induces synthesis of prostaglandins, which again causes spasm of the smooth muscles of the ureter. Renal colic is usually accompanied by nausea and vomiting. Hematuria and infection are also common symptoms associated with urolithiasis. A urinary tract infection (UTI) may result from a stone obstruction, or the infection itself may be responsible for the formation of magnesium ammonium phosphate (or struvite) stones.

The results of our study show a high prevalence of not only pathology of OUS, but also urolithiasis in the studied region. Also, alertness causes a rapid increase in the number of patients with kidney stones and the lower urinary tract with positive linear regression and high R^2 (0.9656). The latter indicates that more than 500 people will require hospitalizations in the coming years. It should also be noted that urolithiasis often accompanies other diseases of both the organs of the urinary system and systemic metabolic disorders, in general. These problems require further study of the etiopathogenesis of urolithiasis, early diagnosis of symptoms using ultrasound and computed tomography, as well as chemical and histological examination of the composition of stones and kidney tissue. In addition, due to the COVID-19 pandemic, the epidemiological picture of urolithiasis may change due to the policy of reducing hospitalization of non-emergency patients, which may lead to a surge in the number of patients in the future and the burden on nephrologists and urologists.

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Contribution of the authors to the study: Sh. M. Seidinov was responsible for conceptualization, methodology, investigation, data curation, formal analysis and project administration. R. A. Fatkhi was responsible for visualization, writing, reviewing, and editing. All authors attest that they meet the current ICMJE requirements to qualify as authors.

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