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Prevalence, Demographics, and Clinical Characteristics of Nephroptosis in Kyrgyzstan: A Three-Year Retrospective Study

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Abstract: Nephroptosis (NP), which is marked by excessive movement of the kidneys, has attracted renewed attention due to advancements in imaging technology. This retrospective study aimed to determine the prevalence, demographics, and clinical characteristics of NP in Kyrgyzstan using ultrasound Doppler examinations. Data from 13,235 patients at the Salymbekov University Clinic Network were analyzed over a period of three years. NP was detected in 378 (2.9%), with a higher prevalence in females (79.4%) than in males (20.6%). The most affected age group was 20–40 years (58.5%), and right-sided NP predominated (75.1%). The number of NP cases increased annually, suggesting improved detection or changing trends. Comorbidities were found present in 57.9% of patients, with lupus nephritis (LN) being the most common (16.4%). Multivariate logistic regression analysis indicated that sex was not a significant predictor of LN in patients with NP. Immunosuppressive therapy with prednisone and cyclophosphamide improved kidney function in patients with NP and LN, although persistent symptoms required additional management or surgery in some cases. This highlights the importance of early detection and multidisciplinary management of NP. This study provides insights into the epidemiological patterns and clinical implications of NP in Kyrgyzstan, emphasizing the need for targeted screening, standardized diagnostic criteria, and preventive strategies for high-risk groups.

Keywords: Nephroptosis; Ultrasound Doppler; Epidemiology; Kyrgyzstan; Prevalence; Lupus Nephritis

1. Introduction

Nephroptosis (NP), also known as a "wandering" or "floating" kidney, is a condition where the kidney moves downward by more than 2 vertebral bodies or 5 cm when transitioning from lying to standing position [1, 2]. This may occur due to insufficient renal fascia and perirenal fat, allowing the kidney to move back to its normal position during posture changes. Recent advances in diagnostic imaging, particularly ultrasound Doppler (USD) technology, have sparked renewed interest in exploring the global occurrence and health implications of this condition. Re-

search worldwide has shown varying rates of incidence, with significant differences influenced by genetic factors, lifestyle choices, and access to healthcare. NP is more frequently observed in women and primarily affects the right kidney [3, 4]. This highlights the need for region-specific epidemiological studies to accurately assess the impact of NP in different cultural and geographical settings.

NP symptoms can range from none to significant clinical manifestations such as flank pain, urinary tract infections, and orthostatic proteinuria. Epidemiological data suggest that NP is more common in younger adults, particularly those between 20 and 40 years of age, with a higher incidence in females [4, 5].

Understanding the interplay between NP and its comorbidities is crucial for providing effective patient care. NP often coexists with lupus nephritis (LN), a severe kidney inflammation linked to systemic lupus erythematosus (SLE), complicating treatment owing to immune and mechanical issues. Immunosuppressive therapy is essential for LN while managing kidney displacement without exacerbating inflammation. LN management involves immunosuppressive regimens combining corticosteroids with medications, such as mycophenolate mofetil and cyclophosphamide, to reduce kidney inflammation. Contemporary approaches minimize glucocorticoid exposure while maintaining efficacy, often incorporating biologics and calcineurin inhibitors [6, 7]. These treatments require monitoring for effectiveness and adverse effects [8, 9].

Obesity has an impact on the treatment of nephropathy (NP). Increased intra-abdominal pressure can worsen symptoms, and altered drug metabolism may affect the medication efficacy. Given that obesity is a major risk factor for chronic kidney disease, a multifaceted approach involving lifestyle changes and pharmacological interventions is necessary [10–12]. Managing dyslipidemia is vital in patients with NP because of its association with cardiovascular risks, particularly in relation to chronic kidney disease and autoimmune disorders such as SLE [13]. Careful monitoring is essential when statins are used. Hypertension frequently accompanies NP, requiring effective blood pressure management using medications, such as angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, which reduce blood pressure and protect the kidneys [10, 12, 14].

Diabetes mellitus increases the risk of kidney and cardiovascular complications in patients undergoing NP. Maintaining strict blood glucose control is crucial to prevent the nephropathy progression, emphasizing a holistic approach incorporating lifestyle modifications and pharmacotherapy such as sodium-glucose cotransporter-2 inhibitors for kidney protection [15]. Patients with NP have an elevated risk of urinary tract infections due to potential urine stasis due to kidney mobility. Prompt urinary tract infection management is crucial to avoid complications, such as pyelonephritis [11]. Kidney stone disease, resulting from altered urine flow dynamics in NP, requires preventive strategies such as hydration and dietary modifications [14]. Bowel obstruction in patients with NP may occur due to abdominal structural changes, underscoring the importance of surgical evaluation in symptomatic patients [6, 8, 16].

Modern imaging methods, especially USD examinations [17, 18], have transformed NP diagnosis. This noninvasive technique allows real-time visualization of kidney movement and blood flow, enabling precise diagnosis and treatment. Research supports the right-sided NP prevalence, as noted in Kyrgyzstan, while showing female predisposition and regional variations in epidemiological characteristics [3, 4].

Understanding NP in the context of Kyrgyzstan can significantly enhance diagnostic practices and healthcare interventions. Such insights have the potential to improve the overall kidney health outcomes in the region by informing healthcare policy decisions and enhancing patient management. Addressing underlying socioeconomic factors, such as those affecting the quality of diet among females, as highlighted in regional studies, could indirectly impact the prevalence and outcomes of NP [19].

Globally, many studies have shown significant differences in NP prevalence due to variations in demographics, anatomy, and research methods. Although often undiagnosed, NP has important clinical consequences, particularly with functional issues such as orthostatic proteinuria, hydronephrosis, or renovascular hypertension. These links highlight the need to assess NP beyond structural irregularities as a possible factor in chronic kidney disease.

There is a lack of population-specific data on NP prevalence and its clinical spectrum in Central Asia, particularly in Kyrgyzstan. The literature often focuses on symptomatic cases or surgical interventions without integrating epidemiological patterns or comorbid profiles. This study addresses this gap by evaluating the epidemiological characteristics and clinical outcomes, particularly between NP and autoimmune kidney disorders such as LN.

This study aimed to assess the prevalence, demographics, and comorbidities associated with NP in Kyrgyzstan using USD imaging. The aim of this study was to identify high-risk populations and guide diagnostic and manage-

ment strategies for the region.

2. Methods

This retrospective observational study examined the epidemiological features of NP in patients seeking care at the Salymbekov University's clinic network in Bishkek, Kyrgyzstan. Despite being conducted at a single center, the Salymbekov University Medical Network serves a diverse population from both urban and peri-urban areas of Bishkek and its vicinity. The dataset did not include stratification based on residence type (urban or rural).

This study covered a three-year timeframe from December 2021 to December 2023, utilizing USD examinations to evaluate renal mobility and identify NP. This study aimed to determine the prevalence of NP, analyze patient characteristics and clinical manifestations, and identify concurrent diseases. This study collected patient data, including age, sex, and the affected kidney laterality. We also assessed whether NP occurred in the left kidney, right kidney, or bilaterally. Additionally, this study explored concurrent diseases by analyzing patients' clinical records.

The research involved participants aged 16 years and older who underwent USD examinations at participating medical facilities. Patients diagnosed with NP based on ultrasonographic criteria were included in the analysis, while those under 16 years of age or without a NP diagnosis were excluded. NP diagnosis was determined by observing kidney displacement of 5 cm or two vertebral bodies when moving from the lying to the standing position, with Doppler signs of renal blood flow changes. All the USD tests followed standard protocols. The procedure included imaging the kidneys with the patient lying down and standing, and observing kidney movement and blood flow. An abdominal curvilinear transducer (3.5–5 MHz) was positioned at the flank and subcostal areas, and measurements were taken longitudinally to evaluate kidney descent. The evaluations were conducted by two experienced radiologists with over five years of sonography experience, who reviewed uncertain cases together to reach a consensus. Only cases in which the kidney showed positional mobility without obstruction, tumors, or abnormal positioning were identified as true NP. Throughout the three-year period, 13,235 patients were examined, consisting of 7256 females (54.8%) and 5979 males (45.2%). NP was detected in 378 individuals, accounting for 2.9% of the total examined population.

NP diagnosis relies on USD imaging, which assesses kidney displacement in supine and upright positions. A substantial downward shift in the kidney upon standing, indicative of NP, was deemed a conclusive diagnostic indicator. Demographic information, including age, sex, and affected kidney laterality, was systematically documented for each NP case. The yearly incidence of NP was further scrutinized to identify potential trends in disease occurrence over time.

Data were collected from electronic medical records using structured forms. The recorded variables included patient age, sex, affected kidney side (right, left, or both), and comorbid conditions, including LN, obesity, high blood pressure, diabetes mellitus, dyslipidemia, urinary tract infections, kidney stone disease, and bowel obstruction. For patients with both NP and LN, details were collected on treatment methods, including immunosuppressive therapies (e.g., prednisone and cyclophosphamide), dosages, duration of treatment, and follow-up results, such as estimated glomerular filtration rate (eGFR), proteinuria, symptom resolution, and surgical procedures, such as nephropexy.

This study conducted a multicollinearity assessment to enhance the validity of the explanatory variables. Variance Inflation Factor (VIF) analysis was used to assess collinearity among the comorbid variables and demographic predictors. Variables with VIF values above 5 were identified as multicollinear and were either transformed or excluded from the final model. This approach ensured that the associations between NP and predictors were not artifacts of inter-variable dependence, thereby strengthening our findings.

Statistical analysis was conducted to assess the distribution of NP across the various demographic groups. The gathered data were categorized by age interval, with particular emphasis on identifying high-risk age groups. This study compared the prevalence of NP between male and female patients and determined the frequency of right-sided, left-sided, and bilateral NP.

For the Statistical analysis, version 11.5 of the Statistical Package for the Social Sciences was employed. The results are presented as n (%). Statistical significance was set at $p < 0.05$. This study conducted a logistic regression analysis to determine whether LN occurrence in patients with NP was linked to clinical or demographic factors. LN was the dependent variable, while the independent variables included age, sex, obesity, hypertension, diabetes, dyslipidemia, urinary tract infections, and renal stones. The variables were coded in binary form with a constant.

The Logit function of the StatsModels library was used to build a propensity score estimation model using logistic regression, with significance set at $p < 0.05$. A chi-square test was used to assess NP prevalence between sexes relative to their proportion in the patient sample, with significance at $p < 0.05$.

Confidentiality was maintained for data collected from patients who gave informed consent. This study was approved by the Bioethical Committee of the Kyrgyz-Russian Slavic University named after B. N. Yeltsin (Protocol No. 3, dated 05/10/2021) and was conducted in compliance with the criteria outlined in the Declaration of Helsinki.

3. Results

The Salymbekov University Medical Network conducted a study over three years involving 13,235 patients who underwent USD tests. Of these, 7256 were females (54.8%), and 5979 were males (45.2%). Among 378 patients diagnosed with NP, 300 were females (79.4%) cases ($p < 0.001$) and 78 were males (20.6%), resulting in a 3.8:1 female-to-male ratio (Table 1). This indicates that NP occurs more frequently in females than in the overall group.

Table 1. Demographic distribution of NP.

Variable	n (%)	*p*-Value
Sex Distribution		<0.001
Female	300 (79.4%)	
Male	78 (20.6%)	
Age Distribution (years)		<0.05
16–20	22 (5.8%)	
21–30	104 (27.5%)	
31–40	117 (31.0%)	
41–50	75 (19.8%)	
51+	60 (15.9%)	

NP: Nephroptosis. Values are presented as the n (%). $p < 0.05$.

The number of NP cases has increased annually, with 55 cases in 2020 (14.6%), 94 in 2021 (24.9%), 109 in 2022 (28.8%), and 120 in 2023 (31.7%). The proportion of female patients remained high throughout the study, ranging from 76.8% to 83.6%. Affected females were younger on average (35.28 ± 10.74 years) compared to males (40.79 ± 11.68 years), suggesting hormonal and structural factors might play a role in the condition's prevalence among females.

Age distribution analysis revealed that NP was most frequently diagnosed in the 20–40 year age group, accounting for 221 cases (58.5%) ($p < 0.05$). This condition was less common in individuals over 41 years of age (135 cases, 35.7%) and least frequent in patients under 20 years of age (22 cases, 5.8%). A detailed breakdown showed 104 cases (27.5%) in patients aged 21–31 years, 117 cases (31.0%) in those aged 31–41 years, 75 cases (19.8%) in those aged 41–51 years, and 60 cases (15.9%) in individuals aged 51 years and older (Table 1).

Examination of the affected kidney showed that right-sided NP was the most common, occurring in 284 patients (75.1%), followed by left-sided NP in 77 patients (20.4%) and bilateral NP in 17 patients (7.2%) (Table 2). The predominance of right-sided NP was consistent across all age groups and sexes ($p = 1.000$), suggesting a possible anatomical predisposition.

Table 2. Distribution of kidney laterality and NP incidence.

Kidney Laterality	n (%)	*p*-Value
Right-sided NP	284 (75.1%)	1.000
Left-sided NP	77 (20.4%)	
Bilateral NP	17 (4.5%)	

NP: Nephroptosis. Values are presented as the n (%). $p < 0.05$.

The yearly distribution of NP cases across age groups demonstrated a consistent pattern, with the highest proportion of diagnoses occurring in the 20–40-year age range each year. This age group represented 63.6% of cases in 2020, 58.5% in 2021, 56.9% in 2022, and 57.5% in 2023 ($p = 1.000$). These data indicate that NP primarily

affects young and middle-aged adults, with a notable female predominance and a strong tendency for right-sided kidney involvement (Table 3). From 2020 to 2023, the number of NP cases rose consistently, increasing from 55 to 120 cases. This suggests a possible trend in enhanced detection methods or shifts in clinical patterns (Figure 1).

Table 3. Distribution of yearly incidence of NP.

Year	n (%)	*p*-Value
2020	55 (14.6%)	1.000
2021	94 (24.9%)	
2022	109 (28.8%)	
2023	120 (31.7%)	

Values are presented as the n (%). $p < 0.05$.

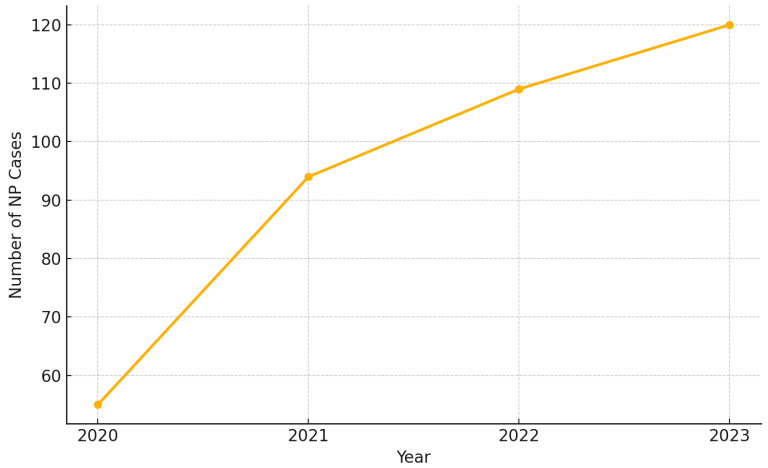

Figure 1. Year-wise distribution of NP cases diagnosed from 2020 to 2023.

As shown in Table 4, 57.9% of the patients (219 individuals) had concurrent medical conditions, including LN (16.4%), obesity (16.0%), dyslipidemia (15.1%), hypertension (14.6%), diabetes mellitus (14.6%), urinary tract infections (13.7%), renal stone disease (6.8%), and bowel obstruction (2.7%) ($p < 0.05$). The notable frequency of LN among patients with NP suggests a potential autoimmune component, indicating the need for further research on immune-related mechanisms affecting kidney mobility.

Table 4. Distribution of concurrent medical conditions in patients with NP.

Condition	n (%)	*p*-Value
Lupus Nephritis	36 (16.4%)	<0.05
Obesity	35 (16.0%)	
Dyslipidemia	33 (15.1%)	
Hypertension	32 (14.6%)	
Diabetes Mellitus	32 (14.6%)	
Urinary Tract Infections	30 (13.7%)	
Renal Stone Disease	15 (6.8%)	
Bowel Obstruction	6 (2.7%)	

NP: Nephroptosis. Values are presented as the n (%). $p < 0.05$.

A multicollinearity diagnostic using VIF analysis was conducted to evaluate the association between the NP and explanatory variables. The analysis included age, sex, LN, obesity, hypertension, diabetes mellitus, dyslipidemia, urinary tract infection, and renal stones. The VIF values ranged from 1.12 to 2.84, indicating no significant

multicollinearity, as all values were below the threshold of 5. The VIF values for the key predictors were as follows: LN, 2.41; obesity, 2.17; hypertension, 1.88; diabetes mellitus, 1.91; dyslipidemia, 2.03; urinary tract infections, 1.76; renal stones, 1.34; age, 2.84; and sex, 1.12. These findings confirm that the independent variables were sufficiently distinct and did not show overlapping effects on NP occurrence. Thus, the statistical models used to interpret the relationships between NP and demographic/clinical variables were stable and reliable.

Of the 378 patients with NP, 16.4% (n = 62) had LN. Multivariate logistic regression analysis was performed to assess this association after adjusting for sex and comorbidities. Sex was not significantly associated with LN (Odds Ratio = 0.76, $p = 0.33$), suggesting that the higher LN occurrence in females with NP is not solely gender-related. Obesity showed a near-significant inverse relationship (Odds Ratio = 0.42, $p = 0.055$). Other factors (age, hypertension, diabetes, dyslipidemia, UTI, and renal stones) were not significant predictors of LN in patients with NP. These results suggest that although LN is more common in females, other biological or immunological factors may be involved.

All 36 patients with NP and LN received immunosuppressive therapy with prednisone and cyclophosphamide. Prednisone was administered at a median dose of 30 mg/day, reduced over six months, whereas cyclophosphamide was administered intravenously at 500 mg/m^2 every four weeks for six months, followed by maintenance therapy. Patient outcomes were assessed at 12 months, with a focus on kidney function, alleviation of NP symptoms, and complications. The group was predominantly female (86.1%), with an average age of 34.7 ± 9.5 years. Right-sided kidney displacement was the most prevalent, occurring in 75.0% of the cases.

Post-treatment, kidney function improved significantly, with mean eGFR rising from 64.2 ± 8.7 to 79.4 ± 6.9 mL/min/1.73 m^2 ($p < 0.01$) after 12 months. Proteinuria decreased from 3.1 ± 1.4 to 0.9 ± 0.5 g/day ($p < 0.001$). Symptom improvement was reported in 63.9% of patients (n = 23). However, 25.0% of the patients (n = 9) required additional symptom management, including nonsteroidal anti-inflammatory drugs and postural therapy. Despite treatment, 16.7% of the patients (n = 6) had persistent NP symptoms, necessitating surgical nephropexy. Patients with moderate-to-severe LN (n = 13, 36.1%) were more prone to developing ongoing NP symptoms ($p < 0.05$).

Treatment-related side effects were common but manageable. Corticosteroid-associated adverse reactions were observed in 66.7% of the patients (n = 24), with weight gain (44.4%), hyperglycemia (25.0%), and hypertension (16.7%) being the most frequent. The cyclophosphamide-related side effects included nausea (19.4%), leukopenia (13.9%), and temporary liver enzyme elevation (11.1%), all of which were addressed through dose adjustments and supportive care. No severe drug-related toxicities that required treatment discontinuation were reported.

The epidemiological patterns observed in Tables 1 and 2 underscore the importance of targeted diagnostic approaches, especially for young adult females presenting with persistent flank pain. Given the strong association between NP and the physical constitution, preventive measures such as core-strengthening exercises and weight management should be considered for high-risk groups.

The findings show a distinct epidemiological pattern of NP in the Kyrgyz population, with a higher occurrence in females, predominance in ages 20–40, and right-sided kidney involvement. Over half of the affected patients have other conditions, particularly LN, highlighting the clinical complexity of NP and the need for a thorough diagnosis. Positive outcomes in patients receiving immunosuppressive therapy demonstrate its effectiveness for NP linked to autoimmune disorders, although symptom persistence in some cases suggests that surgery may be necessary. These results emphasize the importance of early detection, personalized treatment, and multidisciplinary management of patients with NP. The increase in NP diagnoses over the three-year study period may indicate an increasing prevalence and improved detection through expanded USD imaging use.

4. Discussion

This study provides an overview of NP in Kyrgyzstan, highlighting demographic patterns and clinical observations aligned with global trends. Females are more likely to experience symptomatic NP, with a female-to-male ratio of 5–10:1 [20]. This condition occurs more frequently on the right side, accounting for 70% of cases [1, 21].

The high occurrence of NP in adults aged 20–40 calls for an investigation into lifestyle factors, such as physical activity and weight fluctuations. This age group, characterized by significant physiological changes and increased activity levels, may experience heightened symptoms that require medical attention. Changes in the body mass index and waist circumference can affect kidney stability [11].

Exploring balanced physical activity may help alleviate kidney displacement without exacerbating the condition [5, 18]. A nuanced approach to exercise, considering the specific types and intensity levels for individuals prone to NP, might assist in managing this condition. Weight fluctuations are associated with the supportive structures of the kidneys. Significant weight reduction may decrease perirenal fat deposits, lessen support, and increase the risk [22, 23]. Excess weight can create pressure within the abdominal cavity, thereby affecting the kidney position. Controlling weight fluctuations via lifestyle modifications may reduce the risk of NP.

The multicollinearity diagnostic underscored the strength of our statistical models. Through VIF analysis, we verified that all explanatory variables, such as age, sex, LN, obesity, hypertension, diabetes mellitus, dyslipidemia, urinary tract infections, and renal stones, showed VIF values below the threshold of 5, indicating no significant multicollinearity. This implies that the relationship between NP and potential risk factors is not skewed by variable redundancy. The distinct nature of these variables enhances the validity of our findings regarding the epidemiological and clinical characteristics of NP. The independence of autoimmune, metabolic, and demographic factors enables understanding of NP pathogenesis, emphasizing the need for multifactorial screening and personalized management.

This study revealed a significant prevalence (75.1%) of right-sided NP. This aligns with anatomical data regarding the lower position of the right kidney and less stabilization owing to its proximity to the liver, resulting in greater movement and descent [3, 5]. Understanding these anatomical predispositions is crucial for guiding accurate diagnostic assessments and treatment strategies, particularly regarding lateral differences in symptomatology and clinical outcomes.

Radiological confirmation of NP is achieved through erect and supine intravenous urography (IVU), which shows the downward movement of the kidney. Urography in the lateral decubitus position indicates medial NP [2, 24]. Diagnosis is based on patient symptoms and confirmed using an IVU with upright and recumbent imaging. IVU visualizes the morphology and drainage of the ptotic kidney. Recently, nuclear scans using 99mTc-MAG3, and Diethylene triamine pentaacetic acid renal agents have been used for the diagnosis, evaluation of kidney function and drainage, and nephropexy procedures [25]. This is relevant in cases with decreased renal blood flow, reduced eGFR, obstructive drainage, and symptomatic presentation.

The increasing use of USD in resource-limited settings, such as in Kyrgyzstan, indicates its effectiveness in enhancing NP diagnosis and management. As physicians become proficient with these tools, integrating comprehensive diagnostic modules may further standardize NP diagnosis in clinical settings [5].

In this study, 16.4% of patients with NP had LN, suggesting a potential autoimmune mechanism. As both groups were predominantly female, multivariate logistic regression analysis was performed to account for confounding variables. Gender did not emerge as an independent predictor of LN, indicating that the NP-LN link may not be sex-related. The results suggest that NP and LN could be linked through shared pathophysiological mechanisms, such as immune-driven tissue changes or inflammatory processes. The nearly significant inverse relationship with obesity indicates complex interactions between body composition and autoimmune disorders, highlighting the need for future studies with immune markers and longitudinal follow-ups to clarify causality.

This study demonstrated the effectiveness of combined prednisone and cyclophosphamide treatment of LN in patients with NP. Significant improvements in kidney function were observed, with mean eGFR increasing from 64.2 ± 8.7 to 79.4 ± 6.9 mL/min/1.73 m^2, and proteinuria levels decreasing from 3.1 ± 1.4 to 0.9 ± 0.5 g/day. These results indicate successful immune activity modulation and underscore the value of immunosuppressive therapy in maintaining kidney function in patients with LN [6, 9, 16]. Moreover, 16.7% of the patients required surgical nephropexy, emphasizing the need for mechanical intervention when pharmacological approaches fail. These findings were evident in patients with moderate-to-severe LN, who showed a higher likelihood of ongoing NP symptoms [8, 26].

The clinical manifestations of LN with NP present a challenging scenario that requires the management of both immunological and mechanical factors. Immunosuppressive treatments are essential for reducing autoimmune kidney damage; however, their side effects affect patient adherence and treatment success [27]. Corticosteroids can cause weight gain and increased blood pressure, requiring careful monitoring [28]. Monitoring is crucial for preventing leukopenia and liver enzyme irregularities, with dose adjustments as needed. These overlapping treatment effects necessitate a comprehensive plan that addresses both immunological and mechanical aspects.

Laparoscopic nephropexy has emerged as a less invasive surgical method for treating symptomatic NP [29,

30]. This technique relieves symptoms associated with abnormal kidney movement by repositioning the kidney to its normal anatomical location and reducing mechanical strain and vascular issues. While immunotherapy treats immune-related kidney conditions in LN, NP requires mechanical interventions to address structural issues [31].

Retroperitoneoscopic nephropexy with dual-point renal fixation effectively manages symptomatic NP [32]. Laparoscopic retroperitoneal nephropexy has been performed since the early 1990s [33]. When the oncologic risk is minimal, partial nephrectomy is preferred to preserve the renal parenchyma and prevent chronic kidney disease [34]. Percutaneous nephrostomy provides access for kidney stabilization [35]. Hybrid operating rooms integrate surgical and interventional radiology capabilities. However, surgical procedures carry risks of bleeding, infection, and anesthesia-related complications.

The management of LN in patients with NP requires collaboration among nephrologists, surgeons, and healthcare professionals. Assessment of symptoms, imaging results, and kidney function helps determine the treatment strategy. The choice between radical or partial nephrectomy involves weighing risks such as bleeding and infection against the benefits of pain relief and kidney function [36]. The benefits of nephropexy must be balanced against the surgical risks and the possibility of recurrence. The management of LN with NP requires an approach based on clinical symptoms, disease severity, and overall health. While immunotherapy is the primary treatment for LN, mechanical interventions such as nephropexy may benefit patients with NP symptoms. The combination of immunological and mechanical approaches optimizes outcomes and improves patient quality of life.

The association between NP and modifiable lifestyle factors suggests that public health programs should prioritize education and early detection strategies. Encouraging preventive healthcare measures, such as regular checkups including USD assessments, may mitigate the adverse effects of NP. Training healthcare providers in new diagnostic technologies will improve patient outcomes and facilitate more effective disease management approaches [5, 22].

This study identified high-risk groups, particularly young adult females with health conditions, providing insights to guide targeted screening strategies and public health programs. This study highlights the need to integrate cost-effective diagnostics into primary healthcare systems in resource-limited regions and offers policy recommendations for clinical guidelines incorporating mechanical and immunological treatment modalities for NP.

5. Limitations

his study has limitations that could affect the interpretation of its results. The study's retrospective nature and focus on a single center within the Salymbekov University Medical Network might have led to selection bias, as the data only included patients who underwent USD tests due to clinical suspicion. Asymptomatic cases and those from distant areas may not have been adequately represented. Electronic medical records could introduce information bias due to documentation differences, affecting the accuracy of reporting comorbidities and outcomes.

The lack of geographic classification and lifestyle factors, such as diet, physical activity, and socioeconomic status, restricts the analysis of environmental factors influencing NP. The study excluded patient variables such as body mass index, parity, and perirenal fat measurements, which affect kidney mobility in young female patients.

While multicollinearity diagnostics validated the statistical model, advanced techniques such as multivariate regression or spatial epidemiological mapping were not used, which could have offered deeper insights. The absence of longitudinal follow-up limits the evaluation of recurrence rates, long-term outcomes, and progression to complications.

The diagnosis of LN in patients with NP relies on clinical criteria without histological confirmation, affecting diagnostic accuracy. The small number of NP-LN cases (n = 62) could reduce the statistical power, and potential interaction effects between sex hormones and autoimmune mechanisms were not assessed.

Future multicenter prospective studies with longitudinal follow-up, histological confirmation, and comprehensive lifestyle and genetic data are needed to validate these findings.

6. Clinical Implications

This study provides insights into the clinical characteristics, demographic trends, and comorbidities of NP within a Central Asian population, particularly its prevalence among young adult females. These findings have key implications for clinical practice in resource-limited settings, such as Kyrgyzstan. The high incidence of NP

in females aged 20–40 years necessitates targeted screening of this demographic. Primary care physicians should maintain vigilance for NP in women presenting with chronic flank pain, orthostatic proteinuria, or recurrent urinary tract infection.

Dynamic ultrasound Doppler imaging can facilitate early diagnosis, particularly in clinics with limited resources. The strong association between NP and systemic comorbidities, such as LN, obesity, hypertension, and diabetes mellitus, necessitates a multidisciplinary approach to management. Urologists, nephrologists, endocrinologists, and rheumatologists should collaborate to manage patients with NP and concurrent disorders. Early detection of these comorbidities may help prevent renal deterioration. The data support a tiered treatment strategy, with immunosuppressive therapy being effective for NP patients with LN, while some patients require surgical intervention. Laparoscopic nephropexy should be considered for persistent symptom management.

The increasing number of NP diagnoses over the study period indicates the need for healthcare policies to standardize the criteria and promote training in ultrasound evaluation. Community education on preventive measures may help reduce NP incidence in high-risk groups. These findings advocate for integrated approaches to NP diagnosis and management, with implications for improving nephrological care in low- and middle-income countries.

7. Recommendations

Based on the study results, key recommendations are proposed to improve NP diagnosis and management in Kyrgyzstan and other low-resource settings. The implementation of targeted screening is recommended for high-risk groups, particularly women aged 20–40 with flank pain, urinary issues, or orthostatic proteinuria. Dynamic USD should be the primary diagnostic method because of its cost efficiency and noninvasiveness. A multidisciplinary approach involving urologists, nephrologists, rheumatologists, and endocrinologists is essential for patients with coexisting conditions such as LN, obesity, or diabetes.

Nationally standardized guidelines should be developed for NP diagnosis and treatment, including criteria for dynamic imaging and nephropexy indications. Patients with persistent symptoms should be considered for laparoscopic nephropexy. Public health initiatives should promote preventive strategies, such as core muscle strengthening and weight management, with healthcare providers educating at-risk individuals during clinical visits.

Future studies should prioritize longitudinal research that incorporates patient-level data to gain a deeper insight into the risk factors associated with NP. National registries and machine learning models can help identify disease clusters in the population. Training healthcare professionals in dynamic USD, especially in rural areas, is crucial for improving NP diagnosis accuracy. These recommendations can significantly reduce the NP burden and improve kidney health outcomes in similar settings.

8. Conclusions

This research presents the inaugural comprehensive evaluation of NP occurrence, demographics characteristics, and clinical manifestations in Kyrgyzstan, thereby addressing a previously neglected urological concern. The results showed a higher NP occurrence among young adult women aged 20–40, with predominant right-sided kidney involvement. The increase in NP diagnoses over three years may reflect greater awareness and the use of USD imaging.

This study revealed strong links between NP and systemic comorbidities, particularly LN, obesity, and hypertension. These associations highlight the complexity of NP and the need for multidisciplinary care incorporating nephrology, urology, rheumatology, and internal medicine. While immunosuppressive therapy improves kidney function in patients with NP and LN, persistent mechanical symptoms sometimes require surgery, emphasizing the need for personalized treatment addressing both immunological and structural aspects.

Despite its strengths, including a substantial sample size and standardized diagnostic criteria, the retrospective nature of the study limits causal conclusions. However, it establishes a foundation for region-specific NP guidelines in the future. NP is significant and potentially underdiagnosed in women of childbearing age. Early detection through USD, management of comorbidities, and surgical intervention when needed, can improve outcomes. Future investigations should adopt prospective multicenter designs with long-term follow-up to refine risk prediction, optimize treatment, and inform healthcare policy in resource-limited settings such as Kyrgyzstan.

Author Contributions

Conceptualization, C.I., and G.S.; methodology, A.I.; software, Y.V.; validation, C.I., and G.S.; formal analysis, Y.V.; investigation, C.I., G.S., A.I., N.M., and A.K.; data curation, A.K.; writing—original draft preparation, A.I., and N.M.; writing—review and editing, Y.V. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Bioethical Committee of the Kyrgyz-Russian Slavic University named after B. N. Yeltsin (Protocol No. 3, dated 05/10/2021).

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

Data are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflict of interest.

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