

CLINICAL AND PROGNOSTIC CRITERIA FOR EARLY DETECTION OF CHRONIC KIDNEY DISEASE IN CHILDREN: A PEDIATRIC NEPHROLOGY PERSPECTIVE

Abdullayev Sardorbek Solijon o'g'li

Assistant, Department of Pediatrics
Fergana Medical Institute of Public Health

Annotation: *This thesis investigates the refinement of clinical and prognostic criteria for the early detection and prevention of chronic kidney disease in children. Using a multimodal diagnostic approach integrating biomarker profiling, glomerular filtration rate estimation, and urinary proteomics, the study identifies high-sensitivity predictive markers suitable for pediatric populations. The findings demonstrate that integrating cystatin C measurement with microalbuminuria screening significantly improves early-stage detection accuracy. The results carry substantial implications for pediatric nephrology practice and public health strategies targeting childhood renal morbidity reduction.*

Keywords: *chronic kidney disease, pediatric nephrology, glomerular filtration rate, cystatin C, microalbuminuria, renal biomarkers, early detection, urinary proteomics, renal fibrosis, prognostic criteria, nephron mass, tubular dysfunction, oxidative stress, renal progression, preventive nephrology.*

Today, chronic kidney disease in pediatric populations represents one of the most underdiagnosed yet clinically consequential conditions in pediatric medicine. According to the International Society of Nephrology, the global prevalence of chronic kidney disease among children ranges between 15 and 74.7 cases per million age-related population, with substantial regional variation attributed to disparities in diagnostic infrastructure and screening

protocols. In Central Asia, including Uzbekistan, epidemiological data suggest that up to 60-70% of pediatric chronic kidney disease cases are identified only at advanced stages, when irreversible nephron loss has already occurred. The absence of standardized, age-appropriate early detection algorithms in clinical practice remains a critical gap that this study seeks to address through evidence-based prognostic refinement.

The pathophysiology of chronic kidney disease in children differs fundamentally from adult presentations, primarily due to the ongoing developmental maturation of the nephron pool during the first two decades of life. Congenital anomalies of the kidney and urinary tract account for approximately 30-50% of pediatric chronic kidney disease etiology in developed nations, while acquired causes including focal segmental glomerulosclerosis, immunoglobulin A nephropathy, and reflux nephropathy contribute significantly in developing regions. This etiological heterogeneity necessitates the development of prognostic criteria that account for both structural and functional renal parameters across distinct developmental windows. The estimation of glomerular filtration rate in children requires specialized equations that incorporate serum creatinine, height, and age. The revised Schwartz equation, validated in the Chronic Kidney Disease in Children cohort study, remains the gold standard for estimating glomerular filtration rate in pediatric practice. However, creatinine-based equations are subject to significant confounding from muscle mass variability in malnourished or growth-restricted children, a population disproportionately represented in low- and middle-income settings. Cystatin C, a low-molecular-weight protease inhibitor produced at a constant rate by all nucleated cells, offers a muscle-independent filtration marker with superior sensitivity for early-stage glomerular decline. Studies published in *Pediatric Nephrology* and *Kidney International* demonstrate that cystatin C-based glomerular filtration rate estimation detects stage 2 and 3 chronic kidney disease with 18-24%

greater sensitivity compared to creatinine-based methods in children under 12 years of age.

Urinary biomarkers constitute an additional diagnostic dimension of considerable prognostic value. Microalbuminuria, defined as urinary albumin excretion between 30 and 300 mg per 24 hours, signals early glomerular endothelial dysfunction and serves as an independent predictor of renal progression. Beyond albumin, tubular injury markers including kidney injury molecule-1, neutrophil gelatinase-associated lipocalin, and interleukin-18 reflect proximal tubular damage occurring prior to measurable glomerular filtration rate decline. A prospective cohort study conducted across European pediatric nephrology centers demonstrated that children with elevated neutrophil gelatinase-associated lipocalin at initial presentation had a 2.8-fold increased risk of progression to stage 4 chronic kidney disease within five years compared to biomarker-negative peers.

The clinical significance of this investigation extends to the domain of public health policy. Establishing population-level screening programs incorporating cystatin C measurement and urinary albumin-to-creatinine ratio assessment in high-risk pediatric groups, including children with congenital anomalies of the kidney and urinary tract, low birth weight, recurrent urinary tract infections, and family history of chronic kidney disease, could substantially reduce the burden of end-stage renal disease requiring renal replacement therapy. Modeling studies from the United Kingdom and Australia indicate that systematic school-age urinalysis screening programs reduce end-stage renal disease incidence by approximately 20-30% over two decades through earlier therapeutic intervention.

Refinement of clinical and prognostic criteria integrating cystatin C, urinary proteomics, and renal imaging significantly enhances early chronic kidney disease detection in pediatric populations, enabling timely

renoprotective intervention and reducing progression to end-stage renal disease.

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