

Review of the CKiD U25 eGFR Calculator

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I. HOW TO USE

When to Use

This calculator is appropriate for estimating the glomerular filtration rate (GFR) of children and young adults aged 1-25 years who have mild to moderate chronic kidney disease (CKD).

eGFR is an estimate of kidney function and can be tracked over time to assess a patient's kidney function and risk of CKD progression.

These U25 equations can be used when the individual's age, sex, and height, as well as recent serum creatinine and/or cystatin C values, are known. If both creatinine and cystatin C are available, averaging the results of the U25_{sCr} and U25_{cysC} GFR estimates improves precision compared with either equation alone. The U25 equations should not be used in acute kidney injury (AKI), where kidney function is rapidly changing.¹

Pearls / Pitfalls

The CKiD U25 formula tends to overestimate GFR for underweight children and adolescents, but performs well for those in normal, overweight, and obese habitus categories.² Otherwise, it is statistically unbiased with respect to age and sex.³

Abstract

The CKiD U25 eGFR equations estimate glomerular filtration rate (GFR) in individuals aged 1-25 years with mild to moderate chronic kidney disease (CKD). They use age, height, sex, serum creatinine, and cystatin C values to provide creatinine-based, cystatin C-based, and combined estimates of kidney function for children and adolescents. This review gives an overview of the appropriate use cases, strengths, limitations, and supporting evidence for their clinical application.

The U25_{sCr} and U25_{cysC} equations can be appropriate in different contexts. The U25 equations were derived in children and young adults with CKD and may be less accurate in individuals with normal kidney function (eGFR >90 mL/min/1.73 m²). It is also important to note that serum creatinine values can be erroneously influenced by decreased muscle mass and certain medications. Thus, cystatin C-based estimates may be helpful when muscle mass is reduced or creatinine reliability is questioned.¹

When clinically available, both the U25_{sCr} and U25_{cysC} can be used to average the eGFR of the two equations, producing a result that is both more accurate and precise for patients with mild to moderate CKD.¹

When interpreting results, clinicians should consider the laboratory assays used to measure sCr and cystatin C. Although the Jaffe and enzymatic creatinine assays generally produce comparable results, the same assay should be used for longitudinal monitoring whenever possible to minimize variability.⁴ In the United States, cystatin C assays became standardized to International Federation of Clinical Chemistry (IFCC) reference material beginning in 2018. Because the current CKiD U25 equations were developed using IFCC-standardized cystatin C measurements, values obtained prior to standardization may not be directly comparable.⁵

Why Use

The CKiD U25 equations were developed with data from CKiD, a large North American pediatric CKD cohort. Compared with the 2009 CKiD “bedside” equation, the U25 equations provide improved performance across a broader age range (1 - 25 years), particularly in children under 5 years and young adults over 18 years.³

The U25 equations provide flexibility by allowing use of creatinine, cystatin C, or both. In accordance with current National Kidney Foundation and American Society of Nephrology guidance, the CKiD U25 calculator does not use race as a variable in its estimations.⁶

Some data suggest that the U25 equations may outperform CKD-EPI in young adults with childhood-onset CKD.³

II. NEXT STEPS

Advice

As always, defer to clinical judgement. In children and adolescents over the age of 2 years, KDIGO guidelines consider an eGFR <90 mL/min/1.73 m² to be decreased, and cause for further evaluation. Chronic kidney disease is defined by abnormalities in kidney function or structure persisting ≥3 months. eGFR is just one metric describing renal health, and should be contextualized using an appropriate kidney failure risk prediction equation when considering treatment options for patients with CKD.⁷ The U25 equation should not be used for management of acute kidney injury.

Management

Patients with persistently reduced eGFR should undergo repeat eGFR testing to monitor longitudinal change. Further evaluation of relevant history, physical examination (blood pressure, growth parameters) and relevant diagnostic testing (urine albumin-to-creatinine ratio (ACR) or protein quantification) may be appropriate. Existing medications should be evaluated for nephrotoxins and doses adjusted based on most recent eGFR. A key element of pediatric CKD management is annual, or more frequent, monitoring of eGFR and albuminuria. Children with CKD should be encouraged to undertake ≥60 minutes of appropriate physical activity daily and maintain a healthy weight.⁷ Refer to KDIGO 2024 guidelines for comprehensive CKD management recommendations.

Critical Actions

- Repeat measurements if abnormal
- Monitor GFR trends to track CKD progression
- Adjust medication dosing based on most recent eGFR

- Consider referral to nephrology for persistently abnormal GFR (<90 mL/min/1.73 m²) or for significant kidney damage markers (i.e., urine ACR ≥ 30mg/g, urine PCR ≥ 200mg/g, persistent hematuria).⁷

III. EVIDENCE

Evidence Appraisal

The CKiD U25 eGFR equations have been developed using 2655 observations from 928 participants in the Chronic Kidney Disease in Children (CKiD) study. CKiD is a large, well-established, multicenter, prospective cohort of children and young adults with mild to moderate CKD across the United States and Canada.¹ The equations have been externally validated in European and North American cohorts and compared with CKD-EPI and other pediatric formulas.^{2,8,9,10} However, their performance is less certain for infants, those with normal kidney function (eGFR > 90), and populations outside studied cohorts. The U25 CKiD eGFR equations are supported for clinical use by the current 2024 KDIGO guidelines.⁷

Formula

CKiD U25 Creatinine

$$\text{eGFR} = k \times (\text{height, m} / \text{sCr, mg/dL})$$

CKiD U25 Creatinine: eGFR = k × (height, m / sCr, mg/dL)		
k values by sex and age		
	Males	Females
1 to <12 years	39.0 × 1.008 ^(age-12)	36.1 × 1.008 ^(age-12)
12 to <18 years	39.0 × 1.045 ^(age-12)	36.1 × 1.023 ^(age-12)
18 to 25 years	50.8	41.4

CKiD U25 Cystatin C

$$\text{eGFR} = k \times (1 / \text{cysC, mg/L})$$

CKiD U25 Cystatin C: eGFR = k × (1 / cysC, mg/L)	
k values by sex and age	
	Males
1 to <15 years	87.2 × 1.011 ^(age-15)
15 to <18 years	87.2 × 0.96 ^(age-15)
18 to 25 years	77.1
	Females
1 to <12 years	79.9 × 1.004 ^(age-12)
12 to <18 years	79.9 × 0.974 ^(age-12)
18 to 25 years	68.3

CKiD U25 Creatinine-Cystatin C

$$\text{eGFR} = (\text{sCr-based eGFR} + \text{cysC-based eGFR})/2$$

Facts & Figures

Precision of eGFR equations is commonly expressed as P30, the percentage of estimates within 30% of measured GFR. The table below shows the P(30) values for the U25 CKiD equations for children and young adult age groups.^{1,3}

	<18 y	18-25 y
U25 eGFR _{sCr}	86.2	90.7
U25 eGFR _{cysC}	86.6	85.7
U25 eGFR _{sCr-cysC}	91.5	87.6

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