

# Package ‘nephro’

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**Description** Set of functions to estimate kidney function and other traits of interest in nephrology.

**License** GPL (>= 3)

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nephro-package	<i>Biostatistics utilities for nephrology</i>
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## Description

Set of tools for the estimation of kidney function and related traits.

Included are the following glomerular filtration rate (GFR) estimating functions: the Modification of Diet in Renal Disease (MDRD) study equations based on four ([MDRD4](#)) or six ([MDRD6](#)) parameters (Levey 1999; Levey 2006); the CKD-Epi equations for serum creatinine with the race coefficient ([CKDEpi.creat](#)) and without the race coefficient ([CKDEpi2021.creat](#)); the CKD-Epi equation for cystatin C ([CKDEpi.cys](#)); the CKD-Epi equation for the combination of creatinine and cystatin C with ([CKDEpi.creat.cys](#)) and without ([CKDEpi2021.creat.cys](#)) the race coefficient (Inker 2012; Inker 2021); the three equations proposed by Stevens 2008 based on cystatin C only ([Stevens.cys1](#)), age- and sex-weighted cystatin C ([Stevens.cys2](#)), and a combination of cystatin C and creatinine ([Stevens.creat.cys](#)); the classic Cockcroft and Gault 1976 equation for creatinine clearance estimation ([CG](#)); the equation by Virga (2007) ([Virga](#)); the race-free equations developed by the European Kidney Function Consortium (EKFC) including sex and age based on serum creatinine ([EKFC.creat](#)) (Pottel 2021) and based on serum cystatin C with ([EKFC.cys](#)) and without ([EKFC\\_SF.cys](#)) the sex coefficient (Pottel 2023); the full age spectrum (FAS) equations using serum creatinine ([FAS.creat](#)) (Pottel 2016), cystatin C ([FAS.cys](#)), and their combination ([FAS.creat.cys](#)) (Pottel 2017); the Schwartz bedside formula ([Schwartz.Bedside](#)) (Schwartz 2009).

A comparative description of several GFR-estimating functions included in the initial version of the package can be found in Pattaro (2013). Extensive literature does exist that compares the methods described.

Additional serum biomarkers are the blood urea nitrogen (BUN)-to-creatinine ratio ([BCR](#)) and the urea-to-creatinine ratio [UCR](#).

Urine biomarkers included are the albumin-to-creatinine ratio [UACR](#) and the protein-to-creatinine ratio [UPCR](#)

Some unit conversion functions are provided to facilitate operations.

## Details

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Type: Package  
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## Author(s)

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## References

Citing this package:

- Pattaro C, Riegler P, Stifter G, Modenese M, Minelli C, Pramstaller PP. Estimating the glomerular filtration rate in the general population using different equations: effects on classification and association. *Nephron Clin Pract* 2013; **123**(1-2):102-11.

Formulas:

- Cockcroft DW, Gault MH. Prediction of creatinine clearance from serum creatinine. *Nephron* 1976; **16**: 31-41.

- Inker LA, *et al.* Estimating glomerular filtration rate from serum creatinine and cystatin C. *N Engl J Med* 2012; **367**: 20-9.

- Inker LA, *et al.* New Creatinine- and Cystatin C-based Equations to Estimate GFR without Race. *N Engl J Med* 2021; **385**: 1737-1749.

- Levey AS, *et al.* A more accurate method to estimate glomerular filtration rate from serum creatinine: a new prediction equation. Modification of Diet in Renal Disease Study Group. *Ann Intern Med.* 1999; **130**(6): 461-70.

- Levey AS, *et al.* Using standardized serum creatinine values in the modification of diet in renal disease study equation for estimating glomerular filtration rate. *Ann Intern Med.* 2006; **145**: 247-54.

- Stevens LA, *et al.* Estimating GFR using serum cystatin C alone and in combination with serum creatinine: a pooled analysis of 3,418 individuals with CKD. *Am J Kidney Dis* 2008; **51**: 395-406.

- Virga G, *et al.* A new equation for estimating renal function using age, body weight and serum creatinine. *Nephron Clin Pract* 2007; **105**: c43-53.

- Pottel H, *et al.* Development and Validation of a Modified Full Age Spectrum Creatinine-Based Equation to Estimate Glomerular Filtration Rate: A Cross-sectional Analysis of Pooled Data. *Ann Intern Med* 2021; **174**: 183-191.

- Pottel H, *et al.* Cystatin C-Based Equation to Estimate GFR without the Inclusion of Race and

Sex. *N Engl J Med* 2023; **388**: 333-343.

- Pottel H, *et al.* An estimated glomerular filtration rate equation for the full age spectrum. *Nephrol Dial Transplant* 2016; **31**:798-806.

- Pottel H, *et al.* Estimating glomerular filtration rate for the full age spectrum from serum creatinine and cystatin C *Nephrol Dial Transplant* 2017; **32**: 497-507.

- Schwartz GJ, *et al.* New equations to estimate GFR in children with CKD. *J Am Soc Nephrol* 2009; **20**:629-637.

On IDMS calibration:

- Levey AS, *et al.* Expressing the Modification of Diet in Renal Disease Study equation for estimating glomerular filtration rate with standardized serum creatinine values. *Clin Chem* 2007; **53**:766-72.

- Matsushita K, *et al.* Comparison of risk prediction using the CKD-EPI equation and the MDRD study equation for estimated glomerular filtration rate. *J Am Med Assoc* 2012; **307**:1941-51.

- Skali H, *et al.* Prognostic assessment of estimated glomerular filtration rate by the new Chronic Kidney Disease Epidemiology Collaboration equation in comparison with the Modification of Diet in Renal Disease Study equation. *Am Heart J* 2011; **162**:548-54.

## Examples

```
# Comparison between different equations

creat <- c(0.8, 0.9, 1.0, 1.1, 1.2, 1.3)
cyst <- c(1.1, 0.95, 1.1, 1.0, 1.3, 1.2)
sex <- c(1, 1, 1, 0, 0, 0)
age <- c(60, 65, 43, 82, 71, 55)
ethn <- round(runif(6))
wt <- c(70, 80, 60, 55, 87, 71)

eGFR <- data.frame(creat, cyst)
eGFR$MDRD4 <- MDRD4(creat, sex, age, ethn, 'IDMS')
eGFR$CKDEpi.creat <- CKDEpi.creat(creat, sex, age, ethn)
eGFR$CKDEpi2021.creat <- CKDEpi2021.creat(creat, sex, age)
eGFR$CKDEpi.cys <- CKDEpi.cys(cyst, sex, age)
eGFR$CKDEpi.creat.cys <- CKDEpi.creat.cys(creat, cyst, sex, age, ethn)
eGFR$CKDEpi2021.creat.cys <- CKDEpi2021.creat.cys(creat, cyst, sex, age)
eGFR$Stevens.cys1 <- Stevens.cys1(cyst)
eGFR$Stevens.cys2 <- Stevens.cys2(cyst, sex, age, ethn)
eGFR$Stevens.creat.cys <- Stevens.creat.cys(creat, cyst, sex, age, ethn)
eGFR$cg <- CG(creat, sex, age, wt)
eGFR$virga <- Virga(creat, sex, age, wt)

pairs(eGFR[,3:13])

# For use with non-IDMS calibrated creatinine
# several authors (see references) suggested
# a 5% creatinine adjustment

creat <- c(0.8, 0.9, 1.0, 1.1, 1.2, 1.3)
sex <- c(1, 1, 1, 0, 0, 0)
```

```
age <- c(60, 65, 43, 82, 71, 55)
ethn <- round(runif(6))
gfr <- CKDEpi.creat(0.95*creat, sex, age, ethn)
```

---

BCR

*BUN-to-creatinine ratio*

---

### Description

Calculate the plasma or serum BUN-to-creatinine ratio

### Usage

```
BCR(BUN, creatinine)
```

### Arguments

BUN	Numeric vector in mg/dL
creatinine	Numeric vector in mg/dL; 0s will be automatically converted into NAs

### Value

A numeric vector with BCR values.

### Author(s)

Cristian Pattaro

### References

Dossetor JB. Creatininemia Versus Uremia. The relative significance of blood urea nitrogen and serum creatinine concentrations in azotemia. *Ann Int Med.* 1966; **65**(6): 1287-1299.

### See Also

[UCR](#)

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CG	<i>Cockcroft and Gault equation</i>
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---

**Description**

Creatinine clearance is estimated with the Cockcroft and Gault formula.

**Usage**

CG(creatinine, sex, age, wt)

**Arguments**

creatinine	Numeric vector with serum or plasma creatinine values in mg/dl
sex	Numeric vector with 0 for females and 1 for males
age	Numeric vector with age in years
wt	Numeric vector with weight in kg

**Value**

A numeric vector with eGFR values in ml/min/1.73 m<sup>2</sup>.

**Author(s)**

Cristian Pattaro

**References**

Cockcroft DW, Gault MH. Prediction of creatinine clearance from serum creatinine. *Nephron* 1976; **16**: 31-41.

**See Also**

[CKDEpi.creat](#), [MDRD4](#), [Virga](#)

---

CKDEpi.creat	<i>CKD-EPI equation for serum creatinine</i>
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---

**Description**

GFR is estimated with the CKD-EPI Study equation based on IDMS serum or plasma creatinine.

**Usage**

```
CKDEpi.creat(creatinine, sex, age, ethnicity)
```

**Arguments**

creatinine	Numeric vector with serum or plasma creatinine values in mg/dl
sex	Numeric vector with 0 for females and 1 for males
age	Numeric vector with age in years
ethnicity	Numeric vector with 0 for non-Black and 1 for Black individuals

**Value**

A numeric vector with eGFR values in ml/min/1.73 m<sup>2</sup>.

**Author(s)**

Cristian Pattaro

**References**

Inker LA, *et al.* Estimating glomerular filtration rate from serum creatinine and cystatin C. *N Engl J Med* 2012; **367**: 20-29.

**See Also**

[CKDEpi.creat.cys](#), [CKDEpi.cys](#), [CKDEpi2021.creat](#)

---

CKDEpi.creat.cys      *CKD-EPI equation for creatinine and cystatin C*

---

**Description**

CKD-EPI equation to estimate GFR based on a combination of creatinine and cystatin C

**Usage**

CKDEpi.creat.cys(creatinine, cystatin, sex, age, ethnicity)

**Arguments**

creatinine	Numeric vector with serum or plasma creatinine values in mg/dl
cystatin	Numeric vector with serum or plasma cystatin C values in mg/dl
sex	Numeric vector with 0 for females and 1 for males
age	Numeric vector with age in years
ethnicity	Numeric vector with 0 for non-Black and 1 for Black individuals

**Value**

A numeric vector with eGFR values in ml/min/1.73 m<sup>2</sup>.

**Author(s)**

Cristian Pattaro

**References**

Inker LA, *et al.* Estimating glomerular filtration rate from serum creatinine and cystatin C. *N Engl J Med* 2012; **367**: 20-29.

**See Also**

[CKDEpi.creat](#), [CKDEpi.cys](#), [CKDEpi2021.creat.cys](#)

---

CKDEpi.cys	<i>CKD-EPI equation for cystatin C</i>
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---

**Description**

GFR is estimated with the CKD-EPI equation for cystatin C proposed by Inker et al., *N Engl J Med* 2012

**Usage**

```
CKDEpi.cys(cystatin, sex, age)
```

**Arguments**

cystatin	Numeric vector with serum or plasma cystatin C values in mg/l
sex	Numeric vector with 0 for females and 1 for males
age	Numeric vector with age in years

**Value**

The function returns a numeric vector with eGFR values in ml/min/1.73 m<sup>2</sup>.

**Author(s)**

Cristian Pattaro

**References**

Inker LA, *et al.* Estimating glomerular filtration rate from serum creatinine and cystatin C. *N Engl J Med* 2012; **367**: 20-29.

**See Also**

[CKDEpi.creat](#), [CKDEpi.creat.cys](#)

---

CKDEpi2021.creat	<i>Race-free CKD-EPI equation for serum creatinine</i>
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---

**Description**

GFR is estimated with the CKD-EPI Study equation based on serum creatinine without the ethnicity coefficient.

**Usage**

```
CKDEpi2021.creat(creatinine, sex, age)
```

**Arguments**

creatinine	Numeric vector with serum or plasma creatinine values in mg/dl
sex	Numeric vector with 0 for females and 1 for males
age	Numeric vector with age in years

**Value**

A numeric vector with eGFR values in  $\text{ml}/\text{min}/1.73 \text{ m}^2$ .

**Author(s)**

Ryosuke Fujii

**References**

Inker LA, *et al.* New creatinine- and cystatin C-based equations to estimate GFR without race. *N Engl J Med* 2021; **385**: 1737-1749.

**See Also**

[CKDEpi.creat](#), [CKDEpi.creat.cys](#), [CKDEpi.cys](#), [CKDEpi2021.creat.cys](#)

---

CKDEpi2021.creat.cys *Race-free CKD-EPI equation for serum creatinine and cystatin C*

---

**Description**

CKD-EPI equation to estimate GFR based on a combination of creatinine and cystatin C without the ethnicity coefficient

**Usage**

```
CKDEpi2021.creat.cys(creatinine, cystatin, sex, age)
```

**Arguments**

creatinine	Numeric vector with serum or plasma creatinine values in mg/dl
cystatin	Numeric vector with serum or plasma cystatin C values in mg/l
sex	Numeric vector with 0 for females and 1 for males
age	Numeric vector with age in years

**Value**

A numeric vector with eGFR values in  $\text{ml}/\text{min}/1.73 \text{ m}^2$ .

**Author(s)**

Ryosuke Fujii

**References**

Inker LA, *et al.* New creatinine- and cystatin C-based equations to estimate GFR without race. *N Engl J Med* 2021; **385**: 1737-1749.

**See Also**

[CKDEpi.creat](#), [CKDEpi.creat.cys](#), [CKDEpi.cys](#), [CKDEpi2021.creat](#)

---

Convert.mgdL.mmolL      *Conversion formula to change from mg/dL to mmol/L and vice versa*

---

**Description**

mg/dL <-> mmol/L conversion

**Usage**

```
Convert.mgdL.mmolL(mg.dL, mmol.L)
## If your variable X is expressed in mg/dL, use: Convert.mgdL.mmolL(mg.dL=X)
## If your variable X is expressed in mmol/L, use: Convert.mgdL.mmolL(mmol.L=X)
```

**Arguments**

mg.dL	Provide a numeric vector in mg/dL to be converted into mmol/L
mmol.L	Provide a numeric vector in mmol/L to be converted into mg/dL

**Value**

A numeric vector with the converted values.

**Author(s)**

Cristian Pattaro

**See Also**

[Convert.mgdL.umolL](#)

---

Convert.mgdL.umolL      *Conversion formula to change from mg/dL to umol/L and vice versa*

---

**Description**

mg/dL <-> umol/L conversion

**Usage**

```
Convert.mgdL.umolL(mg.dL, umol.L)
## If your variable X is expressed in mg/dL, use: Convert.mgdL.mmolL(mg.dL=X)
## If your variable X is expressed in umol/L, use: Convert.mgdL.mmolL(umol.L=X)
```

**Arguments**

mg.dL	Provide a numeric vector in mg/dL to be converted into umol/L
umol.L	Provide a numeric vector in umol/L to be converted into mg/dL

**Value**

A numeric vector with the converted values.

**Author(s)**

Cristian Pattaro

**See Also**

[Convert.mgdL.umolL](#)

---

EKFC.creat      *EKFC equation for serum creatinine*

---

**Description**

EKFC equation for serum creatinine modified from FAS equation

**Usage**

```
EKFC.creat(creatinine, sex, age)
```

**Arguments**

creatinine	Numeric vector with serum or plasma creatinine values in mg/dl
sex	Numeric vector with 0 for females and 1 for males
age	Numeric vector with age in years

**Value**

The function returns a numeric vector with eGFR values in ml/min/1.73 m<sup>2</sup>.

**Author(s)**

Janina Herold

**References**

Pottel, H, *et al.* Development and Validation of a Modified Full Age Spectrum Creatinine-Based Equation to Estimate Glomerular Filtration Rate : A Cross-sectional Analysis of Pooled Data. *N Engl J Med* 2021; **174**: 183-191.

**See Also**

[EKFC.cys](#), [CKDEpi.creat](#)

---

EKFC.cys

*EKFC equation for cystatin C*

---

**Description**

EKFC equation for cystatin C that includes the sex coefficient, as proposed by Pottel et al., *N Engl J Med* 2023

**Usage**

```
EKFC.cys(cystatin, sex, age)
```

**Arguments**

cystatin	Numeric vector with serum or plasma cystatin C values in mg/l
sex	Numeric vector with 0 for females and 1 for males
age	Numeric vector with age in years

**Value**

The function returns a numeric vector with eGFR values in ml/min/1.73 m<sup>2</sup>.

**Author(s)**

Janina Herold

**References**

Pottel, H, *et al.* Cystatin C-Based Equation to Estimate GFR without the Inclusion of Race and Sex. *N Engl J Med* 2023; **388**: 333-343.

**See Also**[EKFC\\_SF.cys](#)

---

`EKFC_SF.cys`*Sex-free EKFC equation for cystatin C*

---

**Description**

EKFC equation for cystatin C without the sex coefficient as proposed by Pottel et al., *N Engl J Med* 2023

**Usage**`EKFC_SF.cys(cystatin, age)`**Arguments**

<code>cystatin</code>	Numeric vector with serum or plasma cystatin C values in mg/l
<code>age</code>	Numeric vector with age in years

**Value**

The function returns a numeric vector with eGFR values in ml/min/1.73 m<sup>2</sup>.

**Author(s)**

Janina Herold

**References**

Pottel, H, *et al.* Cystatin C-Based Equation to Estimate GFR without the Inclusion of Race and Sex. *N Engl J Med* 2023; **388**: 333-343.

**See Also**[EKFC.cys](#)

---

FAS.creat	<i>FAS equation for serum creatinine</i>
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---

**Description**

Full age spectrum (FAS) equation to estimate GFR based on serum creatinine

**Usage**

```
FAS.creat(creatinine, sex, age)
```

**Arguments**

creatinine	Numeric vector with serum or plasma creatinine values in mg/dl
sex	Numeric vector with 0 for females and 1 for males
age	Numeric vector with age in years

**Value**

A numeric vector with eGFR values in ml/min/1.73 m<sup>2</sup>.

**Author(s)**

Janina Herold

**References**

Pottel, H., *et al.* An estimated glomerular filtration rate equation for the full age spectrum. *Nephrol Dial Transplant.* 2016; **5**: 798-806.

**See Also**

[FAS.creat.cys](#), [FAS.cys](#)

---

FAS.creat.cys	<i>FAS equation for creatinine and cystatin C</i>
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---

**Description**

Full age spectrum (FAS) GFR estimation based on serum creatinine and cystatin C

**Usage**

```
FAS.creat.cys(creatinine, cystatin, sex, age)
```

**Arguments**

creatinine	Numeric vector with serum or plasma creatinine values in mg/dl
cystatin	Numeric vector with serum or plasma cystatin C values in mg/l
sex	Numeric vector with 0 for females and 1 for males
age	Numeric vector with age in years

**Value**

The function returns a numeric vector with eGFR values in ml/min/1.73 m<sup>2</sup>.

**Author(s)**

Janina Herold

**References**

Pottel, H., *et al.* An estimated glomerular filtration rate equation for the full age spectrum from serum creatinine and cystatin C. *Nephrol Dial Transplant.* 2017; **32**: 497-507.

**See Also**

[FAS.cys](#)

---

FAS.cys

*FAS equation for cystatin C*

---

**Description**

Full age spectrum (FAS) GFR estimation based on cystatin C

**Usage**

```
FAS.cys(cystatin, sex, age)
```

**Arguments**

cystatin	Numeric vector with serum or plasma cystatin values in mg/l
sex	Numeric vector with 0 for females and 1 for males
age	Numeric vector with age in years

**Value**

A numeric vector with eGFR values in ml/min/1.73 m<sup>2</sup>.

**Author(s)**

Janina Herold

**References**

Pottel, H., *et al.* An estimated glomerular filtration rate equation for the full age spectrum from serum creatinine and cystatin C. *Nephrol Dial Transplant.* 2017; **32**: 497-507.

**See Also**

[FAS.creat](#), [FAS.creat.cys](#)

---

MDRD4

---

*Four-parameter MDRD study equation*


---

**Description**

GFR is estimated with the 4-parameter Modification of Diet in Renal Disease (MDRD) study equation.

**Usage**

```
MDRD4(creatinine, sex, age, ethnicity, method = "IDMS")
```

**Arguments**

creatinine	Numeric vector with serum or plasma creatinine values in mg/dl
sex	Numeric vector with 0 for females and 1 for males
age	Numeric vector with age in years
ethnicity	Numeric vector with 0 for non-Black and 1 for Black individuals
method	Defaults is 'IDMS' for IDMS-traceable creatinine; write 'other' if not IDMS

**Value**

A numeric vector with eGFR values in ml/min/1.73 m<sup>2</sup>.

**Author(s)**

Cristian Pattaro

**References**

Levey AS, *et al.* A more accurate method to estimate glomerular filtration rate from serum creatinine: a new prediction equation. Modification of Diet in Renal Disease Study Group. *Ann Intern Med.* 1999; **130**(6): 461-70.

Levey AS, *et al.* Using standardized serum creatinine values in the modification of diet in renal disease study equation for estimating glomerular filtration rate. *Ann Intern Med.* 2006; **145**: 247-254.

**See Also**

[CKDEpi.creat](#), [MDRD6](#), [CG](#)

MDRD6

*Six-parameter MDRD study equation***Description**

GFR is estimated with the 6-parameter Modification of Diet in Renal Disease (MDRD) study equation.

**Usage**

```
MDRD6(creatinine, sex, age, albumin, BUN, ethnicity, method = 'IDMS')
```

**Arguments**

creatinine	Numeric vector with serum or plasma creatinine values in mg/dl
sex	Numeric vector with 0 for females and 1 for males
age	Numeric vector with age in years
albumin	Numeric vector with serum or plasma albumin in g/dl
BUN	Numeric vector with blood urea nitrogen levels in mg/dl
ethnicity	Numeric vector with 0 for non-Black and 1 for Black individuals
method	Defaults is 'IDMS' for IDMS-traceable creatinine; write 'other' if not IDMS

**Value**

A numeric vector with eGFR values in ml/min/1.73 m<sup>2</sup>.

**Author(s)**

Cristian Pattaro

**References**

Levey AS, *et al.* A more accurate method to estimate glomerular filtration rate from serum creatinine: a new prediction equation. Modification of Diet in Renal Disease Study Group. *Ann Intern Med.* 1999; **130**(6): 461-70.

Levey AS, *et al.* Using standardized serum creatinine values in the modification of diet in renal disease study equation for estimating glomerular filtration rate. *Ann Intern Med.* 2006; **145**: 247-254.

**See Also**

[MDRD4](#)

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Schwartz.Bedside      *Bedside IDMS-traceable Schwartz GFR Calculator for Children*

---

**Description**

GFR is estimated with the Bedside Schwartz equation for Children based on IDMS serum or plasma creatinine.

This equation is valid in the 1-17 years age range.

**Usage**

Schwartz.Bedside(creatinine, ht, age)

**Arguments**

creatinine	Numeric vector with serum or plasma creatinine values in mg/dl
ht	Numeric vector with height in cm
age	Numeric vector with age in years

**Value**

A numeric vector with eGFR values in ml/min/1.73 m<sup>2</sup>.

**Author(s)**

Andrew Srisuwananukorn

**References**

Schwartz GJ, *et al.* New equations to estimate GFR in children with CKD. *J Am Soc Nephrol* 2009; **20**: 629-637.

---

Stevens.creat.cys      *Stevens' formula for a combination of serum creatinine and cystatin C*

---

**Description**

GFR estimation using the 3rd formula proposed by Stevens et al. (*Am J Kidney Dis* 2008), which combines creatinine and cystatin C

**Usage**

Stevens.creat.cys(creatinine, cystatin, sex, age, ethnicity)

**Arguments**

creatinine	Numeric vector with serum or plasma creatinine values in mg/dl
cystatin	Numeric vector with serum or plasma cystatin C values in mg/l
sex	Numeric vector with 0 for females and 1 for males
age	Numeric vector with age in years
ethnicity	Numeric vector with 0 for non-Black and 1 for Black individuals

**Value**

The function returns a numeric vector with eGFR values in  $\text{ml}/\text{min}/1.73 \text{ m}^2$ .

**Author(s)**

Cristian Pattaro

**References**

Stevens LA, *et al.* Estimating GFR using serum cystatin C alone and in combination with serum creatinine: a pooled analysis of 3,418 individuals with CKD. *Am J Kidney Dis* 2008; **51**: 395-406.

**See Also**

[CKDEpi.creat.cys](#)

---

Stevens.cys1

*GFR estimation using serum cystatin C*

---

**Description**

GFR is estimated with the 1st formula proposed by Stevens et al. (Am J Kidney Dis 2008), i.e.: as a simple transformation of cystatin C, without using any other information

**Usage**

```
Stevens.cys1(cystatin)
```

**Arguments**

cystatin	Numeric vector with serum or plasma cystatin C values in mg/l
----------	---

**Value**

A numeric vector with eGFR values in  $\text{ml}/\text{min}/1.73 \text{ m}^2$ .

**Author(s)**

Cristian Pattaro

**References**

Stevens LA, *et al.* Estimating GFR using serum cystatin C alone and in combination with serum creatinine: a pooled analysis of 3,418 individuals with CKD. *Am J Kidney Dis* 2008; **51**: 395-406.

**See Also**

[Stevens.cys2](#), [Stevens.creat.cys](#), [CKDEpi.cys](#)

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Stevens.cys2

*Stevens' formula for serum cystatin C, age, and sex*

---

**Description**

GFR is estimated with the 2nd formula proposed by Stevens et al. (*Am J Kidney Dis* 2008), where cystatin C is weighted by sex and age

**Usage**

`Stevens.cys2(cystatin, sex, age, ethnicity)`

**Arguments**

cystatin	Numeric vector with serum or plasma cystatin C values in mg/l
sex	Numeric vector with 0 for females and 1 for males
age	Numeric vector with age in years
ethnicity	Numeric vector with 0 for non-Black and 1 for Black individuals

**Value**

A numeric vector with eGFR values in ml/min/1.73 m<sup>2</sup>.

**Author(s)**

Cristian Pattaro

**References**

Stevens LA, *et al.* Estimating GFR using serum cystatin C alone and in combination with serum creatinine: a pooled analysis of 3,418 individuals with CKD. *Am J Kidney Dis* 2008; **51**: 395-406.

**See Also**

[Stevens.cys1](#), [Stevens.creat.cys](#), [CKDEpi.cys](#)

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UACR

*Urinary albumin-to-creatinine ratio*

---

**Description**

Calculate the urinary albumin-to-creatinine ratio

**Usage**

UACR(u.albumin, u.creatinine)

**Arguments**

u.albumin      Numeric vector in mg/dL

u.creatinine    Numeric vector in mg/dL; 0s will be automatically converted into NAs

**Value**

A numeric vector with UACR values.

**Author(s)**

Cristian Pattaro

**References**

Barratt TM, McLaine PN, Soothill JF. Albumin excretion as a measure of glomerular dysfunction in children. *Arch Dis Child*. 1970. **45**(242): 496-501

**See Also**

[UPCR](#)

---

UCR

*Urea-to-creatinine ratio*

---

**Description**

Calculate the plasma or serum urea-to-creatinine ratio

**Usage**

UCR(urea, creatinine)

**Arguments**

urea                    Numeric vector in mmol/L  
creatinine            Numeric vector in umol/L; 0s will be automatically converted into NAs

**Value**

A numeric vector with UCR values.

**Author(s)**

Cristian Pattaro

**References**

Kahn S, *et al.* The significance of serum creatinine and the blood urea/serum creatinine ratio in azotaemia *S. Afr. Med. J.* 1972; **46**: 1828-1832.

**See Also**

[BCR](#)

---

UPCR

*Urinary protein-to-creatinine ratio*

---

**Description**

Calculate the urinary protein-to-creatinine ratio

**Usage**

UPCR(u.protein, u.creatinine)

**Arguments**

u.protein            Numeric vector in mg/dL  
u.creatinine        Numeric vector in mg/dL; 0s will be automatically converted into NAs

**Value**

A numeric vector with UPCR values.

**Author(s)**

Cristian Pattaro

**See Also**

[UACR](#)

---

Virga

*Virga's formula*

---

**Description**

Virga's formula is based on serum creatinine, sex, age, and body weight.

**Usage**

Virga(creatinine, sex, age, wt)

**Arguments**

creatinine	Numeric vector with serum or plasma creatinine values in mg/dl
sex	Numeric 0/1 vector: 0 for females, 1 for males
age	Numeric vector with age in years
wt	Numeric vector with weight in kg

**Value**

A numeric vector with eGFR values in  $ml/min/1.73 m^2$

**Author(s)**

Cristian Pattaro

**References**

Virga G, *et al.* A new equation for estimating renal function using age, body weight and serum creatinine. *Nephron Clin Pract* 2007; **105**: c43-53.

**See Also**

[CG](#), [MDRD4](#)

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