Appendix

Construction and validation of the FAS-equation

Construction of the FAS-equation

We start from the published and validated eGFR-equation for children, adolescents and young adults, which has the form:

$$eGFR = 107.3 / (Scr/Q) \qquad (eq.1)$$

and which is valid for subjects aged between 2 and 25 years.[4,5]

This equation has been introduced by Pottel et al [4] as a simple height-independent equation for children, up to 14 years of age. The simple equation for children (eq.1) has been extended to adolescents and young adults (up to 25 years of age) by Hoste et al [5]. Scr/Q is the normalized Scr-concentration. The normalization values Q are the median Scr-concentrations of 1-year age-intervals for healthy children, adolescents and adults presented in Table 1 [5,10], or polynomial equations for Q-age and Q-height can be used [4,5]. The Q-values for (young) adults were published in 2008 [10] and are simply 0.70mg/dL for females and 0.90mg/dL for males, exactly like the normalization constants in the CKD-EPI-equation, published in 2009.[7]

This simple equation (eq.1) has been validated externally [4,5,27-29] and can be applied in two different ways: the same Q-values from Table 1 can either be matched with age or height. In case of this last application, eq.1 becomes height-dependent and is here called FAS-height. To match Q-values with height, we used the Belgian growth curves for children and adolescents (which we consider representative for the European population) and used 'age' as the matching factor. These Q-values can also be matched with height using national growth curves, but reference intervals and median (Q) values were independently obtained by two research groups in 2008 [10,49] and are considered universally valid for whites [49].

It has been shown in previous research that the normalized Scr-value, Scr/Q, has interesting properties [4,5] for healthy populations, independent of age and sex: Scr/Q is normally distributed (bell-shaped curve) with mean 'Scr/Q=1' which corresponds to the average healthy person and with 2.5th and 97.5th percentile of Scr/Q=0.67 and Scr/Q=1.33 respectively.

In this study, we further extended this simple paediatric equation, based on normalized Scr, to ages beyond 25 years, by multiplying equation (eq.1) with an age-decline factor of the form $C^{(Age-AgeCO)}$, where AgeCO is defined as the age-knot where renal decline begins. In other words, we propose an extension of equation (eq.1) for adults of the form:

$$eGFR = A\,[Scr/Q]^{B}\,C^{(Age-AgeCO)} \qquad \text{(eq.2)}$$

Eq.1 can be seen as a special form of (eq.2) with A = 107.3, B = -1, C = 1. This form of equation can also be seen as a more extended form (with AgeCO as an extra parameter) of the CKD-EPI equation. E.g. for A = 141, B = -1.209, C = 0.993, Q = 0.90 and AgeCO = 0, the above equation becomes

$$eGFR = 141 \times [Scr/0.90]^{-1.209} \times 0.993^{Age}$$

which is exactly the CKD-EPI-equation for white males and Scr>0.90mg/dL.

Eq.2 has 4 unknown parameters: A, B, C and AgeCO. Instead of using statistical modelling of log(mGFR) against log(Scr/Q), Age and sex, we propose a different approach to obtain the unknown parameters A, B, C and AgeCO.

By requiring continuity (that is, equality between eq.1 and eq.2) at the age-knot (Age=AgeCO) for the 'average' healthy subject (Scr/Q=1) we are able to calculate A and B in eq.2.

Thus, we require that our simple equation of the form eGFR = 107.3 / [Scr/Q] is valid up to the age-knot, Age = AgeCO. Beyond the AgeCO, the age decline begins, and therefore, the extended equation $eGFR = A\,[Scr/Q]^{B}\,C^{(Age-AgeCO)}$ is valid from thereon.

At Age = AgeCO, we expect that both equations predict the same eGFR, or, we require continuity when going from the paediatric equation to the adult form. Therefore, at Age = AgeCO:

$$107.3 / [Scr/Q] = A\,[Scr/Q]^{B}\,C^{0} = A\,[Scr/Q]^{B}$$

because $C^0 = 1$.

By requiring that the paediatric equation equals the adult equation at the age-knot (Age = AgeCO) for the average healthy subject, that is, for the subject with Scr/Q = 1, it follows that

$$107.3 / 1 = A \times 1^{B} \rightarrow A = 107.3$$

When A = 107.3, then for whatever value of Scr/Q, we have (at Age = AgeCO):

$$107.3 / [Scr/Q] = 107.3 \times [Scr/Q]^{B} \times C^{0}$$

This can only be true if B = -1.

So, eq.2 becomes:

$$eGFR=107.3\ [Scr/Q]^{-1}\ C^{(Age-AgeCO)}$$

We now consider the other end of the age-spectrum. The BIS1-equation is the only Scr-based equation designed and validated for older adults [8,30-32]. By requiring continuity between eq.2 and the BIS1-equation, we want to determine the two other parameters C and AgeCO.

A difficulty in setting the above equation equal to the BIS1-equation is that the form of the BIS1-equation is of the MDRD-style and not the CKD-EPI-style.

Therefore, we reshape the BIS1-equation into the CKD-EPI-style. To do this, we follow the procedure that has been explained by Pottel et al.[11] The BIS1-equation is known in the following form:

$$eGFR = 3736 \times Scr^{-0.87} \times Age^{-0.95} \times (0.82 \text{ if female})$$

First, we absorb the gender correction factor in the Q-value. This results in a new form for the BIS1-equation of:

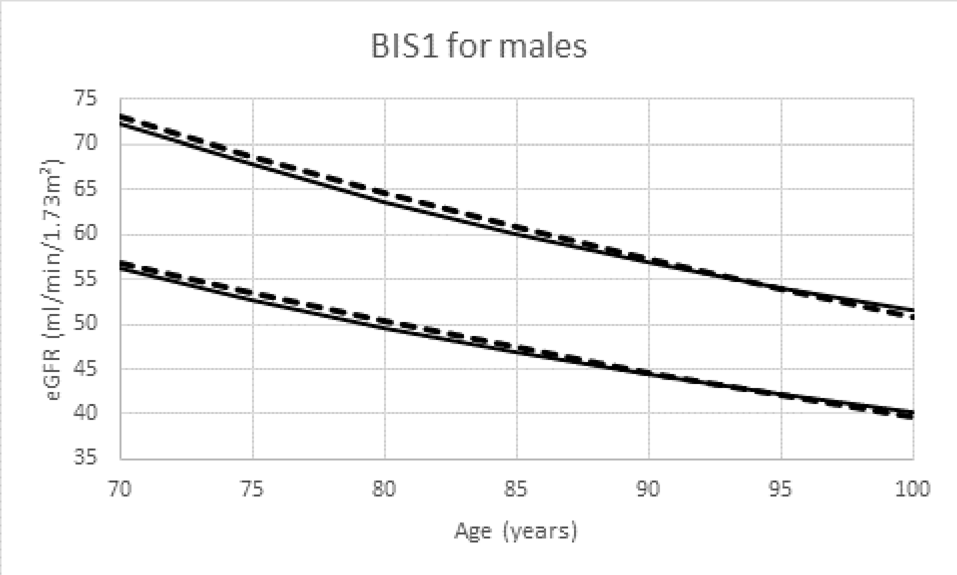
$$eGFR = 4095 \times [Scr/Q]^{-0.87}\ Age^{-0.95}$$

with Q=0.70mg/dL for females and Q=0.90mg/dL for males.

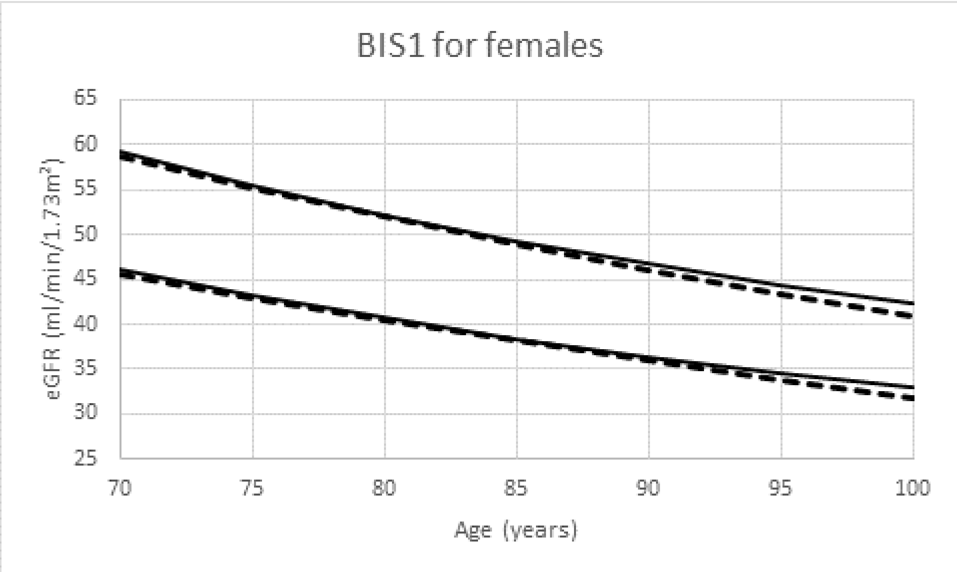
And, by changing the Age^{C} into C^{age}, we have

$$eGFR = 173 \times [Scr/Q]^{-0.87}\ 0.988^{Age} \qquad \text{(eq.3)}$$

Appendix Figure 1 and 2 show the original BIS1-equation and the reshaped equation (eq.3) giving both approximately the same predictions for the cases Scr=0.90mg/dL and Scr=1.20mg/dL, for both males and females.



Appendix Figure 1. Original BIS1-equation (solid line) and reshaped BIS1-equation (dashed line) for Scr = 0.90 mg/dL (median for healthy males) and Scr = 1.20 mg/dL (97.5th Percentile for healthy males)



Appendix Figure 2. Original BIS1-equation (solid line) and reshaped BIS1-equation (dashed line) for Scr = 0.90 mg/dL and Scr = 1.20 mg/dL, with the correction for sex (x 0.82 if female, for the original equation and using Q = 0.70 mg/dL for the reshaped equation)

Matching the adult equation with the unknown parameters C and AgeCO with the reshaped BIS1-equation, for the average healthy adult (Scr/Q=1), results in:

$$107.3 \times C^{(Age-AgeCO)} = 173 \times [1]^{-0.87}\ 0.988^{Age} = 173 \times 0.988^{Age}$$

Taking the logarithm of both sides, we have:

$$\log(107.3) + (Age-AgeCO) \times \log(C) = \log(173) + Age \times \log(0.988)$$

To make this equality independent of age, we set C = 0.988. Then it follows that the terms Age x log(0.988) cancel out, which leaves us with:

log(107.3) - AgeCO x log(0.988) = log(173)

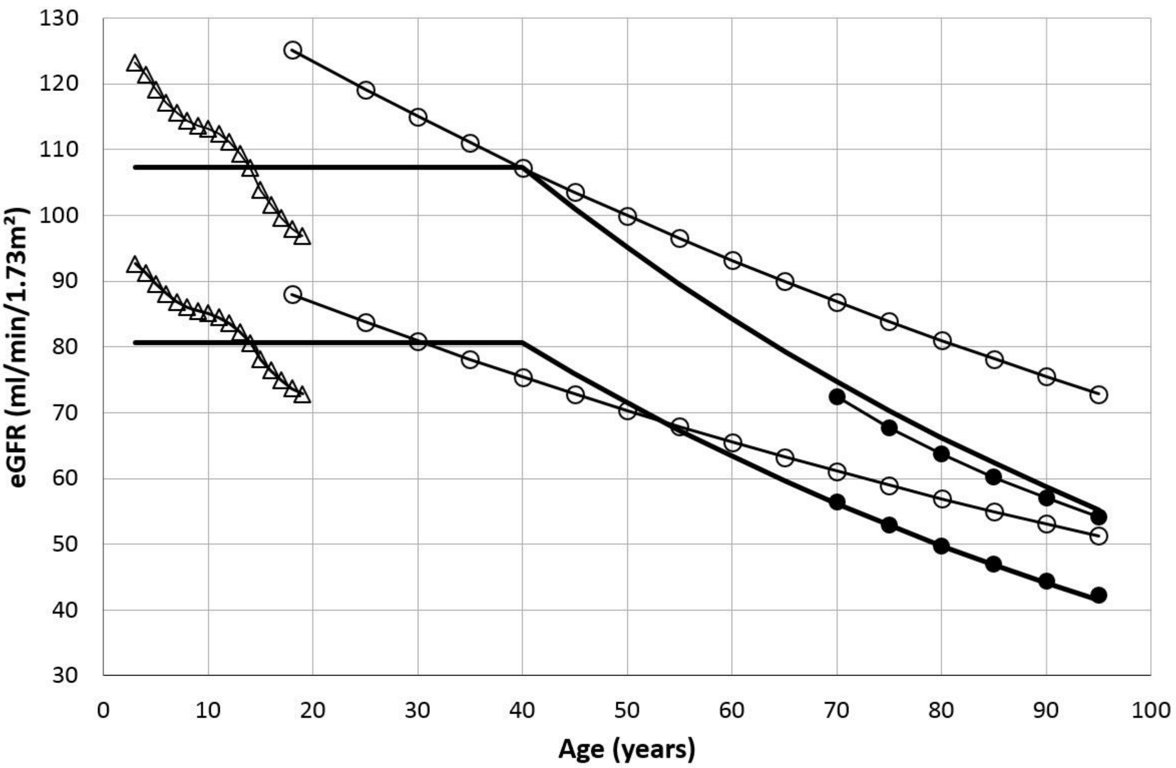
Or AgeCO = log(107.3/173) / log(0.988) = 39.6 year ≈ 40 year

Therefore, the full-age-spectrum (FAS)-equation becomes:

eGFR = 107.3 x / [Scr/Q] for 2 year < age ≤ 40 year

eGFR = 107.3 x $0.988^{(Age-40)}$ / [Scr/Q] for age > 40 year

Appendix Figure 3 demonstrates that the new equation can be seen as a combination of the extrapolated or extended simple paediatric equation (eq.1) up to AgeCO=40 years at one side of the age-spectrum and the extrapolated (back to AgeCO) reshaped BIS1-equation (eq.3) at the other side of the age-spectrum. Both extrapolated equations meet at the age-knot, which assures continuity across the full age-spectrum. This is shown for the 'average' healthy subject (Scr/Q=1) and for the 'borderline' healthy subject (Scr/Q=1.33).



Appendix Figure 3: Comparison between the FAS-equation (solid lines), Schwartz (Δ), CKD-EPI (o) and BIS1 (●) for the special case that Scr/Q = 1 (upper curves) and Scr/Q = 1.33 (lower curves). The Schwartz results are obtained using 0.413 x L/Scr where L (height) and Scr (= Q values) were taken from Table 1 (for children and for female adolescents).

Validation of the FAS-equation

Patient characteristics of each validation dataset are presented in **Appendix Table 1**. Performance results of the FAS-equation, compared to the Schwartz, CKD-EPI and BIS1-equation, have been presented in a pooled way in the main body of the article, but are here presented for each separate validation dataset (**Appendix Table 2**).

In **Appendix Tables 3, 4 and 5**, we present the comparison of GFR categorization between the FAS-equation and the Schwartz or CKD-EPI-equation on the pooled dataset, but for each age-group separately.

In the age <18 years subgroup, Schwartz shows the best correspondence with the GFR categorization according to mGFR in the >90mL/min/1.73m^2 category (90.6%) compared to FAS (79.3%), but FAS is better than Schwartz in the [60-90mL/min/1.73m^2[category (64.5% vs. 59.2%), in the [30-60 mL/min/1.73m^2[category (79.3% vs. 64.4%) and in the [15-30mL/min/1.73m^2[category (72.7% vs. 54.5%). The <15mL/min/1.73m^2 category has only one subject. Overall, and because of the larger sample size in the >90mL/min/1.73m^2 subgroup, Schwartz agrees in 77.8% of the cases with the mGFR categorization and FAS agrees in 74.8% of the cases (p = 0.037).

In the age 18-70 years subgroup, CKD-EPI shows the best correspondence with the GFR categorization according to mGFR in the >90mL/min/1.73m^2 category (87.8%) compared to FAS (74.2%), and in the [15-30mL/min/1.73m^2[category (52.5% vs. 35.4%), but FAS is better than CKD-EPI in the [60-90mL/min/1.73m^2[category (47.8% vs. 67.6%) and comparable in the [30-60mL/min/1.73m^2[category (53.9% vs. 53.5%). Overall, FAS correctly classifies subjects into GFR categories according to mGFR, in 65.7% of the cases, compared to 63.6% for CKD-EPI (p = 0.0003).

In the age >70 years subgroup, CKD-EPI shows the best correspondence with the GFR categories according to mGFR in the >90mL/min/1.73m^2 category (41.0%) compared to FAS (28.2%) (small sample size!), CKD-EPI is better than FAS in the [60-90mL/min/1.73m^2[category (83.0% vs. 72.3%), but FAS is better than CKD-EPI in the [30-60mL/min/1.73m^2[category (79.7 vs. 64.6%), and FAS is better in the [15-30mL/min/1.73m^2[category (60.4% vs. 55.9%). Overall, FAS correctly classifies subjects into GFR categories according to mGFR, in 71.5% of the cases, compared to 69.4% for CKD-EPI ($p = 0.038$).

In summary, the FAS-equation is slightly more accurate than the recommended equations (Schwartz, CKD-EPI) across various study populations, clinical conditions and measurement conditions. Bias is improved, although precision remains suboptimal. The main advantages of the FAS-equation are its simplicity and its applicability across the full age spectrum, avoiding discontinuous jumps at specific age cut-offs, where switching from currently available equations is now required.

Table 1: Patient and method characteristics of the validation datasets

DataBase	Dataset	Source	Characteristic	Mean	SD	Min	Max
DB1	Children	Lyon	Age (years)	9.2	3.0	2.8	13.9
	iohexol		Height (cm)	130.3	17.9	76.5	169.8
		(n = 153)	Weight (kg)	30.1	12.3	9.0	87.0
		66 male	GFR (ml/min/1.73m²)	86.6	31.0	23.0	188.0
		87 female	Scr (mg/dL)	0.63	0.31	0.19	1.98
DB2	Children	Lyon	Age (years)	9.0	2.6	4.4	13.8
	Inulin		Height (cm)	129.2	14.3	99.4	159.0
		(n = 185)	Weight (kg)	28.3	8.8	13.4	64.2
		105 male	GFR (ml/min/1.73m²)	101.9	33.5	19.0	204.0
		80 female	Scr (mg/dL)	0.56	0.31	0.19	2.96
DB3	Children	Lyon (5)	Age (years)	11.6	1.4	10	14
	Inulin		Height (cm)	145.5	13.0	117.2	183.5
		(n = 273)	Weight (kg)	39.0	11.2	17	75
		163 male	GFR (ml/min/1.73m²)	96.5	30.0	13	194
		110 female	Scr (mg/dL)	0.66	0.25	0.32	2.65
DB4	Adolescents	Lyon (5)	Age (years)	16.2	1.1	15	18
	Inulin		Height (cm)	162.9	10.1	129.4	185.5
		(n = 151)	Weight (kg)	54.8	12.5	31	107
		68 male	GFR (ml/min/1.73m²)	89.7	27.9	16	158
		83 female	Scr (mg/dL)	0.85	0.31	0.41	2.30
DB5	Young adults	Lyon (5)	Age (years)	21.7	2.0	19	25
	Inulin		Height (cm)	167.6	10.3	140.5	196.0
		(n = 326)	Weight (kg)	60.4	13.2	33	141.5
		173 male	GFR (ml/min/1.73m²)	89.7	30.7	18	168
		153 female	Scr (mg/dL)	0.99	0.41	0.44	3.25
DB6	Adult Kidney donors	Lyon	Age (years)	48.8	11.6	21.3	71.0
	Inulin		Height (cm)	166.6	9.8	146.0	188.5
		(n = 169)	Weight (kg)	68.7	13.7	45.5	110.0
		59 male	GFR (ml/min/1.73m²)	97.1	18.1	47.7	182.9
		110 female	Scr (mg/dL)	0.76	0.14	0.48	1.27
DB7	Adult HIV patients	St-Etienne	Age (years)	48.7	10.3	22	84
	iohexol		Height (cm)	172.3	7.5	155	195
		(n = 203)	Weight (kg)	71.3	12.6	42	108
		166 male	GFR (ml/min/1.73m²)	94.7	24.4	18.1	188.9
		37 female	Scr (mg/dL)	0.87	0.19	0.51	1.89
DB8	Mid-aged adults	Tromsø	Age (years)	58.1	3.8	50.0	63.4
	RENIS-T6 Cohort		Height (cm)	170.6	8.7	144.3	196.3
	Iohexol	(n = 1627)	Weight (kg)	79.7	14.4	43.6	135.8
		801 male	GFR (ml/min/1.73m²)	91.7	14.4	21.9	138.6
		826 female	Scr (mg/dL)	0.76	0.14	0.41	1.64
DB9	Adults and elderly	Rochester	Age (years)	64.8	8.8	38.3	86.9
	GENOA Cohort		Height (cm)	167.5	9.2	147.6	202.7
	Iothalamate	(n = 687)	Weight (kg)	87.5	19.2	44.4	159.7
		278 male	GFR (ml/min/1.73m²)	80.4	21.3	17.0	162.0
		409 female	Scr (mg/dL)	0.85	0.23	0.45	2.09
DB10	Adults and elderly	Rochester	Age (years)	65.9	9.2	39.0	86.1
	Iothalamate		Height (cm)	168.7	9.6	146.2	200.0
	ECAC Cohort	(n = 406)	Weight (kg)	82.1	16.6	40.6	139.8
		196 male	GFR (ml/min/1.73m²)	79.5	20.7	20.0	208.0
		210 female	Scr (mg/dL)	0.84	0.18	0.46	1.89
DB11	Elderly	Lyon	Age (years)	75.4	4.2	69.4	92.2
	Inulin		Height (cm)	162.7	9.9	135.0	196.0
		(n = 310)	Weight (kg)	71.5	16.4	30.5	125.0
		171 male	GFR (ml/min/1.73m²)	40.8	17.1	10.0	88.9
		139 female	Scr (mg/dL)	1.51	0.69	0.48	4.62
DB12	Elderly	Berlin	Age (years)	78.5	6.2	69.8	96.7
	Iohexol		Height (cm)	166.3	8.5	143.0	192.0
		(n = 570)	Weight (kg)	77.3	13.9	47.0	136.2
		326 male	GFR (ml/min/1.73m²)	60.3	16.4	15.5	116.7
		244 female	Scr (mg/dL)	0.99	0.37	0.46	4.77
DB13	Adults and elderly	Lyon	Age (years)	54.4	12.8	25.0	92.2
	Inulin and iohexol		Height (cm)	166.5	9.8	136.0	197.0
		(n = 1416)	Weight (kg)	69.9	15.5	31.0	144.0
		860 male	GFR (ml/min/1.73m²)	49.2	18.0	7.4	89.9
		556 female	Scr (mg/dL)	1.39	0.63	0.44	8.13
		Kent	Age (years)	80.4	4.6	74.0	97.0
DB14	Adults and elderly		Height (cm)	166.9	9.8	167.0	193.5
	iohexol	(n = 394)	Weight (kg)	74.9	15.0	31.8	126.1
		205 males	GFR (ml/min/1.73m²)	52.5	19.0	7.2	100.9
		189 females	Scr (mg/dL)	1.30	0.66	0.39	4.32

DBi = Database; SD = standard deviation; Min = minimum, Max = maximum; GFR = glomerular filtration rate; Scr = serum creatinine (multiply by 88.4 to get it in µmol/L)

Table 2: prediction performance results of different eGFR equations, for various age groups, obtained from different sources, using different mGFR methods.

DB	eGFR eq.	RMSE	Constant Bias	Proportional Bias	P10 (%)	P30 (%)
DB1 3-14y	FAS	18.4 [14.2; 21.2]	-3.8 [-6.7; -0.9]*	1.06 [1.03; 1.10]*	38.6 [30.8; 46.4]	88.9 [83.9; 93.9]*
	FAS-height	18.9 [14.2; 22.7]	-4.4 [-7.4; -1.5]†	1.06 [1.03; 1.10]†	43.8 [35.8; 51.7]	86.9 [81.5; 92.3]†
	Schwartz	24.4 [18.6; 28.3]	-13.8 [-17.0; -10.6]*,†	1.17 [1.14; 1.21]*,†	35.3 [27.8; 43.0]	80.4 [74.0; 86.8]*,†
DB2 4-14y	FAS	23.3 [19.4; 26.0]	1.7 [-1.7; 5.2]*	1.00 [0.97; 1.04]*	46.5 [39.2; 53.7]	85.4 [80.3; 90.5]
	FAS-height	23.8 [19.7; 26.6]	1.2 [-2.3; 4.7]†	1.00 [0.97; 1.04]†	41.6 [34.5; 48.8]	85.4 [80.3; 90.5]
	Schwartz	27.2 [22.0; 31.0]	-9.1 [-12.8; -5.3]*,†	1.11 [1.07; 1.14]*,†	40.0 [32.9; 47.1]	81.1 [75.4; 86.8]
DB3 10-14y	FAS	18.3 [16.7; 20.0]	-1.0 [-3.1; 1.1]*	1.04 [1.02; 1.07]*	39.6 [33.7; 45.4]*	89.0 [85.3; 92.7]
	FAS-height	16.9 [15.4; 18.4]	-0.6 [-2.6; 1.5]†	1.04 [1.02; 1.06]†	47.6 [41.7; 53.6]*	90.1 [86.5; 93.7]
	Schwartz	16.9 [15.5; 18.3]	-3.1 [-5.1; -1.1]*,†	1.07 [1.04; 1.09]*,†	42.5 [36.6; 48.4]	87.2 [83.2; 91.2]
DB4 15-18y	FAS	22.4 [19.0; 25.8]	-11.2 [-14.3; -8.1]*,†	1.16 [1.12; 1.21]*,†	38.4 [30.6; 46.3]	76.8 [70.0; 83.6]*,†
	FAS-height	17.5 [15.1; 20.1]	-2.4 [-5.2; 0.4]*,‡	1.06 [1.02; 1.09]*,‡	41.1 [33.1; 50.0]	85.4 [81.6; 89.3]*
	Schwartz	17.4 [15.2; 19.7]	2.5 [-0.2; 5.3]†,‡	1.01 [0.97; 1.04]†,‡	40.4 [32.5; 48.3]	86.1 [82.3; 89.8]†
DB5 19-25y	FAS	21.0 [18.8; 23.0]	-6.6 [-8.8; -4.3]*,†	1.12 [1.09; 1.15]*,†	35.3 [30.1; 40.5]	77.9 [73.4; 82.4]*,†
	FAS-height	19.3 [17.6; 21.0]	2.1 [0.0; 4.2]*,‡	1.01 [0.98; 1.04]*,‡	31.6 [26.5; 36.7]	83.4 [79.4; 87.5]*,‡
	CKD-EPI	21.5 [19.7; 23.3]	-12.7 [-14.6; -10.8]†,‡	1.19 [1.16; 1.22]†,‡	32.5 [27.4; 37.6]	73.9 [69.1; 78.7]†,‡
DB6 21-71y	FAS	14.9 [12.6; 17.3]	-1.4 [-3.7; 0.8]	1.02 [1.00; 1.04]	53.3 [45.7; 60.9]	97.0 [94.5; 99.6]
	CKD-EPI	14.0 [11.7; 16.7]	-1.5 [-3.6; 0.4]	1.03 [1.01; 1.05]	53.8 [46.3; 61.4]	97.0 [94.5; 99.6]
DB7 22-84y	FAS	24.3 [21.8; 27.1]	-4.4 [-7.7; -1.1]*	1.10 [1.05; 1.14]*	34.5 [27.9; 41.1]	78.3 [72.6; 84.0]*
	CKD-EPI	21.7 [19.4; 24.0]	-2.5 [-5.5; 0.4]*	1.08 [1.04; 1.12]*	37.4 [30.7; 44.2]	82.3 [77.0; 87.6]*
DB8 50-63y	FAS	13.5 [12.9; 14.1]*	-1.2 [-1.8; -0.6]*	1.03 [1.02; 1.04]*	53.7 [51.3; 56.2]	95.1 [94.0; 96.1]
	CKD-EPI	12.1 [11.5; 12.7]*	-3.2 [-3.8; -2.6]*,†	1.06 [1.05; 1.06]*	57.3 [54.8; 59.6]	95.4 [94.3; 96.3]
DB9 38-87y	FAS	16.2 [15.2; 17.2]	2.7 [1.5; 3.9]*	0.99 [0.98; 1.01]*	38.3 [34.6; 41.9]	88.4 [86.0; 90.8]*
	CKD-EPI	15.5 [14.6; 16.5]	-2.3 [-3.4; -1.1]*	1.06 [1.05; 1.08]*	41.6 [37.9; 45.3]	85.6 [83.0; 88.2]*
DB10 39-86y	FAS	17.5 [15.2; 20.3]	1.9 [0.2; 3.6]*	1.02 [0.99; 1.04]*	39.2 [34.4; 43.9]	87.7 [84.5; 90.9]
	CKD-EPI	17.5 [15.1; 20.3]	-4.1 [-5.7; -2.4]*	1.10 [1.08; 1.13]*	44.1 [39.2; 48.9]	85.0 [81.5; 88.5]
DB11 69-92y	FAS	10.1 [8.9; 11.3]*	-3.2 [-4.3; -2.1]*,†	1.13 [1.10; 1.17]*,†	35.8 [30.4; 41.2]	78.7 [74.1; 83.3]*,†
	BIS1	10.0 [8.9; 11.0]†	-4.4 [-5.4; -3.3]†,‡	1.19 [1.15; 1.22]†	34.2 [28.9; 39.5]	75.2 [70.3; 80.0]*,‡
	CKD-EPI	12.8 [11.4; 14.1]*,†	-6.8 [-8.0; -5.6]*,‡	1.20 [1.17; 1.24]*	32.3 [27.0; 37.5]	70.3 [65.2; 75.4]†,‡
DB12 70-97y	FAS	9.5 [8.5; 10.5]*	-0.4 [-1.2; 0.4]*	1.01 [0.99; 1.02]*	50.9 [46.8; 55.0]*	93.9 [91.9; 95.9]*
	BIS1$^{\$}$	9.1 [8.1; 10.1]	-0.2 [-1.0; 0.5]	1.02 [1.01; 1.03]	52.1 [48.0; 56.2]	94.7 [92.9; 96.5]
	CKD-EPI	15.4 [14.3; 16.5]*	- 8.2 [-9.1; -7.4]*	1.15 [1.13; 1.17]*	34.2 [30.3; 38.1]*	79.5 [76.2; 82.8]*
DB13 25-92y	FAS	18.4 [17.1; 19.5]	-12.0 [-12.8; -11.3]*	1.28 [1.26; 1.30]*	23.6 [21.4; 25.8]	61.1 [58.5; 63.6]
	CKD-EPI	17.5 [16.6; 18.4]	-11.4 [-12.1; -10.7]*	1.25 [1.24; 1.27]*	24.3 [22.1; 26.5]	61.9 [59.3; 64.4]
DB14 74-97y	FAS	10.3 [9.5; 11.1]	4.0 [3.0; 4.9]*,†	0.94 [0.92; 0.96]*,†	37.3 [32.5; 42.1]	85.0 [81.5; 88.6]
	CKD-EPI	10.9 [10.0; 11.7]	-2.6 [-3.6; -1.5]*,‡	1.05 [1.03; 1.07]*,‡	40.1 [35.2; 45.0]	83.0 [79.3; 86.7]*
	BIS1	10.0 [9.2; 10.7]	3.7 [2.8; 4.6]†,‡	0.96 [0.94; 0.98]†,‡	40.9 [36.0; 45.7]	87.6 [84.3; 90.8]*

FAS = Full-age-spectrum equation; FAS-height has the same global form as the FAS-equation, but Q(height) is considered rather than Q(age); eGFR eq. = estimated glomerular filtration rate equation; DB = database; CKD-EPI = Chronic Kidney Disease Epidemiology Collaboration; BIS = Berlin Initiative Study

Constant Bias = eGFR – mGFR; Proportional bias = eGFR/mGFR; [..] = 95% Confidence Interval

P10 and P30 = percentage of subjects within 10% and 30% of the measured GFR; RMSE = root mean square error

Equal symbols in each column within each DB denote statistically significant differences ($P < 0.05$; paired t-test for constant and proportional bias; exact McNemar's test for P10 and P30). (e.g. for DB1, superscript '*' for constant bias indicates a significant difference between FAS and Schwartz).

$^{\$}$BIS1 has been developed with the data in DB12 and is not part of the validation. The performance results are presented as information only.

Table 3: Comparison of GFR category classification according to mGFR between the FAS and Schwartz equation for children aged < 18 years

mGFR > 90 mL/min/1.73m²

	Schwartz						
FAS	> 90	60-89	30-59	15-29	< 15	Total	% Total
> 90	337	0	0	0	0	**337**	**79.3%**
60-89	48	38	0	0	0	86	20.2%
30-59	0	2	0	0	0	2	0.5%
15-29	0	0	0	0	0	0	0.0%
< 15	0	0	0	0	0	0	0.0%
Total	**385**	40	0	0	0	425	100.0%
% Total	**90.6%**	9.4%	0.0%	0.0%	0.0%	100.0%	

mGFR = [60-90[mL/min/1.73m²

	Schwartz						
FAS	> 90	60-89	30-59	15-29	< 15	Total	% Total
> 90	51	0	0	0	0	51	24.2%
60-89	25	111	0	0	0	**136**	**64.5%**
30-59	0	14	10	0	0	24	11.4%
15-29	0	0	0	0	0	0	0.0%
< 15	0	0	0	0	0	0	0.0%
Total	76	**125**	10	0	0	211	100.0%
% Total	36.0%	**59.2%**	4.7%	0.0%	0.0%	100.0%	

mGFR = [30-60[mL/min/1.73m²

	Schwartz						
FAS	> 90	60-89	30-59	15-29	< 15	Total	% Total
> 90	1	0	0	0	0	1	1.1%
60-89	0	17	0	0	0	17	19.5%
30-59	0	13	56	0	0	**69**	**79.3%**
15-29	0	0	0	0	0	0	0.0%
< 15	0	0	0	0	0	0	0.0%
Total	1	30	**56**	0	0	87	100.0%
% Total	1.1%	34.5%	**64.4%**	0.0%	0.0%	100.0%	

mGFR = [15-30[mL/min/1.73m²

	Schwartz						
FAS	> 90	60-89	30-59	15-29	< 15	Total	% Total
> 90	0	0	0	0	0	0	0.0%
60-89	0	0	0	0	0	0	0.0%
30-59	0	0	3	0	0	3	27.3%
15-29	0	0	2	6	0	**8**	**72.7%**
< 15	0	0	0	0	0	0	0.0%
Total	0	0	5	**6**	0	11	100.0%
% Total	0.0%	0.0%	45.5%	**54.5%**	0.0%	100.0%	

mGFR < 15 mL/min/1.73m²

	Schwartz						
FAS	> 90	60-89	30-59	15-29	< 15	Total	% Total
> 90	0	0	0	0	0	0	0%
60-89	0	0	0	0	0	0	0%
30-59	0	0	0	0	0	0	0%
15-29	0	0	0	1	0	1	100%
< 15	0	0	0	0	0	**0**	**0%**
Total	0	0	0	1	**0**	1	100%
% Total	0%	0%	0%	100%	**0%**	100%	

Table 4: Comparison of GFR category classification according to mGFR between the FAS and CKD-EPI equation for adults (18 ≤ Age < 70 years)

mGFR > 90 mL/min/1.73m²

	CKD-EPI						
FAS	> 90	60-89	30-59	15-29	< 15	Total	% Total
> 90	1178	0	0	0	0	**1178**	**74.2%**
60-89	215	194	0	0	0	409	25.8%
30-59	0	0	0	0	0	0	0.0%
15-29	0	0	0	0	0	0	0.0%
< 15	0	0	0	0	0	0	0.0%
Total	**1393**	194	0	0	0	1587	100.0%
% Total	**87.8%**	12.2%	0.0%	0.0%	0.0%	100.0%	

mGFR = [60-90[mL/min/1.73m²

	CKD-EPI						
FAS	> 90	60-89	30-59	15-29	< 15	Total	% Total
> 90	514	3	0	0	0	517	30.5%
60-89	348	792	5	0	0	**1145**	**67.6%**
30-59	0	15	18	0	0	33	1.9%
15-29	0	0	0	0	0	0	0.0%
< 15	0	0	0	0	0	0	0.0%
Total	862	**810**	23	0	0	1695	100.0%
% Total	50.9%	**47.8%**	1.4%	0.0%	0.0%	100.0%	

mGFR = [30-60[mL/min/1.73m²

	CKD-EPI						
FAS	> 90	60-89	30-59	15-29	< 15	Total	% Total
> 90	36	4	0	0	0	40	4.4%
60-89	21	321	29	0	0	371	40.7%
30-59	0	25	458	8	0	**491**	**53.9%**
15-29	0	0	0	9	0	9	1.0%
< 15	0	0	0	0	0	0	0.0%
Total	57	350	**487**	17	0	911	100.0%
% Total	6.3%	38.4%	**53.5%**	1.9%	0.0%	100.0%	

mGFR = [15-30[mL/min/1.73m²

	CKD-EPI						
FAS	> 90	60-89	30-59	15-29	< 15	Total	% Total
> 90	1	0	0	0	0	1	0.6%
60-89	2	4	1	0	0	7	4.4%
30-59	0	0	66	28	0	94	59.5%
15-29	0	0	0	55	1	**56**	**35.4%**
< 15	0	0	0	0	0	0	0.0%
Total	3	4	67	**83**	1	158	100.0%
% Total	1.9%	2.5%	42.4%	**52.5%**	0.6%	100.0%	

mGFR < 15 mL/min/1.73m²

	CKD-EPI						
FAS	> 90	60-89	30-59	15-29	< 15	Total	% Total
> 90	0	0	0	0	0	0	0.0%
60-89	0	0	0	0	0	0	0.0%
30-59	0	0	1	3	0	4	20.0%
15-29	0	0	0	11	3	14	70.0%
< 15	0	0	0	0	2	**2**	**10.0%**
Total	0	0	1	14	**5**	20	100.0%
% Total	0.0%	0.0%	5.0%	70.0%	**25.0%**	100.0%	

Table 5: Comparison of GFR category classification according to mGFR between the FAS and CKD-EPI equation for older adults (Age ≥ 70 years)

mGFR > 90 mL/min/1.73m²

	CKD-EPI						
FAS	> 90	60-89	30-59	15-29	< 15	Total	% Total
> 90	22	0	0	0	0	**22**	**28.2%**
60-89	10	43	0	0	0	53	67.9%
30-59	0	2	1	0	0	3	3.8%
15-29	0	0	0	0	0	0	0.0%
< 15	0	0	0	0	0	0	0.0%
Total	**32**	45	1	0	0	78	100.0%
% Total	**41.0%**	57.7%	1.3%	0.0%	0.0%	100.0%	

mGFR = [60-90[mL/min/1.73m²

	CKD-EPI						
FAS	> 90	60-89	30-59	15-29	< 15	Total	% Total
> 90	19	0	0	0	0	19	2.7%
60-89	42	464	0	0	0	**506**	**72.3%**
30-59	0	117	58	0	0	175	25.0%
15-29	0	0	0	0	0	0	0.0%
< 15	0	0	0	0	0	0	0.0%
Total	61	**581**	58	0	0	700	100.0%
% Total	8.7%	**83.0%**	8.3%	0.0%	0.0%	100.0%	

mGFR = [30-60[mL/min/1.73m²

	CKD-EPI						
FAS	> 90	60-89	30-59	15-29	< 15	Total	% Total
> 90	3	0	0	0	0	3	0.4%
60-89	0	103	0	0	0	103	13.5%
30-59	0	131	475	1	0	**607**	**79.7%**
15-29	0	0	17	32	0	49	6.4%
< 15	0	0	0	0	0	0	0.0%
Total	3	234	**492**	33	0	762	100.0%
% Total	0.4%	30.7%	**64.6%**	4.3%	0.0%	100.0%	

mGFR = [15-30[mL/min/1.73m²

	CKD-EPI						
FAS	> 90	60-89	30-59	15-29	< 15	Total	% Total
> 90	0	0	0	0	0	0	0.0%
60-89	0	2	0	0	0	2	1.0%
30-59	0	2	67	4	0	73	36.1%
15-29	0	0	8	109	5	**122**	**60.4%**
< 15	0	0	0	0	5	5	2.5%
Total	0	4	75	**113**	10	202	100.0%
% Total	0.0%	2.0%	37.1%	**55.9%**	5.0%	100.0%	

mGFR < 15 mL/min/1.73m²

	CKD-EPI						
FAS	> 90	60-89	30-59	15-29	< 15	Total	% Total
> 90	0	0	0	0	0	0	0.0%
60-89	0	0	0	0	0	0	0.0%
30-59	0	0	1	0	0	1	4.5%
15-29	0	0	0	15	1	16	72.7%
< 15	0	0	0	0	5	**5**	**22.7%**
Total	0	0	1	15	**6**	22	100.0%
% Total	0.0%	0.0%	4.5%	68.2%	**27.3%**	100.0%	

FAS = Full Age Spectrum; CKD-EPI = Chronic Kidney Disease Epidemiology Collaboration; CKD = Chronic Kidney Disease; mGFR = measured glomerular filtration rate

REFERENCES

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