



# ASSESSING THE VALIDITY OF DIFFERENT PREDICTION EQUATIONS FOR ESTIMATING GLOMERULAR FILTRATION RATE AMONG HEALTHY ADULT BANGLADESHI POPULATION

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## INTRODUCTION AND AIMS:

Glomerular filtration rate (GFR) is widely accepted as the best index of renal function, in health and disease. It can be measured by various complicated and costly procedures or can also be estimated by various proposed GFR estimating equations. Most of these equations derived from Caucasians suffering from different stages of chronic kidney disease. The anthropometry of different ethnic group has impact on estimated GFR. The aim of this study was to assess the validity of these equations on healthy adult Bangladeshi population.

## METHODS:

The study was conducted in the transplant unit of a tertiary care hospital of Bangladesh among 54 consecutive healthy kidney donors. Estimated GFR (eGFR) by Cockcroft-Gault (CG), Modification of Diet in Renal Disease (MDRD) and Chronic Kidney Disease Epidemiology (CKD-EPI) formula were compared against measured GFR (mGFR) by Tc-99m diethylenetriamine pentaacetic acid (DTPA) renogram.

### CG formula:

$$eGFR_{CG} \text{ (ml/min)} = (140 - \text{Age}) \times \text{Weight} \times 0.85 \text{ (if female)} / 72 \times s. Cr$$

### MDRD formula:

$$eGFR_{MDRD} \text{ (mL/min/1.73m}^2\text{)} = 175 \times (s. Cr)^{-1.154} \times (\text{Age})^{-0.203} \times 0.742 \text{ (if female)} \times 1.212 \text{ (if black)}$$

### CKD-EPI equation:

$$eGFR_{CKD-EPI} \text{ (mL/min/1.73m}^2\text{)} = 141 \times \min(s. Cr/k, 1)^a \times \max(s. Cr/k, 1)^{-1.209} \times 0.993^{age} \times 1.018 \text{ (if female)} \times 1.159 \text{ (if black)}$$

Where k is 0.7 for women and 0.9 for men, a is -0.329 for women and -0.411 for men, min indicates the minimum of s.cr/k or 1, and max indicates the maximum of s.cr/k or 1.

## CONCLUSION:

Though the results from the healthy Bangladeshi kidney donors suggests that the overall eGFR of CKD-EPI equation was relatively more accurate among the three but it has a tendency to underestimate normal renal function and overestimate decreased renal function which may influence erroneously a vital decision or give a false impression about a person's renal function status. So, like the other two, CKD-EPI equation is also sub-optimal for clinical use in this region and this situation warrants adaptive correction of the equation for this region or developing a newer predictive equation for estimating GFR.

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## RESULTS:

Total number of patients was 54 with equal number of male and female participants. Mean age, body weight, height and body surface area of the study population was  $37.2 \pm 10.4$  years,  $56.11 \pm 8.31$  kg,  $162.0 \pm 8.46$  cm and  $1.58 \pm 0.21$  m<sup>2</sup> respectively. Estimated GFR of CKD-EPI showed overall highest precision among three equations. The accuracy within 10% was 50%, 51.9%, 55.6% and within 30% was 29.6%, 40.7%, 42.6% for CG, MDRD and CKD-EPI respectively. But in 37 subjects with normal renal function (mGFR  $\geq 90$  mL/min/1.73m<sup>2</sup>) CKD-EPI equation of eGFR significantly (p-Value 0.007) underestimated mGFR and in 17 subjects with decreased renal function (mGFR  $\leq 90$  mL/min/1.73m<sup>2</sup>) it significantly (p-Value 0.006) overestimated mGFR.

Table I: Comparison between TcDTPA(mGFR), eGFR<sub>CG</sub>, eGFR<sub>MDRD</sub> and eGFR<sub>CKD-EPI</sub>

No of patients	GFR	Value (ml/min/1.73 m <sup>2</sup> )	Mean Difference to TcDTPA (mGFR)	p-value	Median Difference to TcDTPA	Standard deviation of mean bias	Accuracy within	
							10%	30%
All (54)	TcDTPA (mGFR)	99.54± 19.06	-----	-----	-----	-----	-----	-----
	eGFR <sub>CG</sub>	87.18±23.91	- 12.36	0.000	- 19.39	22.91	50%	29.6%
	eGFR <sub>MDRD</sub>	93.74±20.85	- 5.8	0.074	- 6.42	23.39	51.9%	40.7%
	eGFR <sub>CKD-EPI</sub>	97.78±19.86	- 1.76	0.579	0.33	23.19	55.6%	42.6%

Table II: Performance of Estimated GFR in study population with normal and below normal measured GFR

No of patients	GFR	Value (ml/min/1.73 m <sup>2</sup> )	Mean Difference to TcDTPA (mGFR)	p-value
mGFR $\geq 90$ ml/min/1.73 m <sup>2</sup> (37)	TcDTPA (mGFR)	109.67±13.15	-----	-----
	eGFR <sub>CG</sub>	91.79±25.83	- 17.88	<b>0.000</b>
	eGFR <sub>MDRD</sub>	96.27±22.56	- 13.41	<b>0.001</b>
	eGFR <sub>CKD-EPI</sub>	100.14±20.64	- 9.54	<b>0.007</b>
mGFR $\leq 90$ ml/min/1.73 m <sup>2</sup> (17)	TcDTPA (mGFR)	77.48±7.77	-----	-----
	eGFR <sub>CG</sub>	77.16±15.40	- 0.32	0.934
	eGFR <sub>MDRD</sub>	88.23±15.74	+ 10.75	<b>0.026</b>
	eGFR <sub>CKD-EPI</sub>	92.65±17.52	+ 15.16	<b>0.007</b>

Table III: Difference in Anthropometry of different ethnic group

	Mean Weight (kg)	p-value	Mean Height (cm)	p-value	Mean Body surface area(m <sup>2</sup> )	p-value
Study Population (54)	56.11 ± 8.31	-----	162.0 ± 8.46	-----	1.58 ± 0.21	-----
USA (43,334)*	73.46 ± 20.56	< 0.0001	165.75 ± 12.80	<b>0.0314</b>	1.80 ± 0.26	< 0.0001
Chinese (number of men 1,553)**	60.4 ± 9.5	<b>0.0011</b>	164.8 ± 6.4	<b>0.0018</b>	1.64 ± 0.19	<b>0.0232</b>
Chinese (number of women 1,870)**	54.0 ± 8.9	0.0855	154.5 ± 6.1	< 0.0001	1.51 ± 0.22	<b>0.0211</b>
White (number of men 1,490)***	85.1 ± 16.3	< 0.0001	176.8 ± 6.5	< 0.0001	2.02 ± 0.29	< 0.0001
White (number of women 1,712)***	71.7 ± 17.3	< 0.0001	163.0 ± 6.2	0.2494	1.77 ± 0.27	< 0.0001
Black (number of men 1,116)***	83.8 ± 18.4	< 0.0001	176.4 ± 6.9	< 0.0001	2.01 ± 0.26	< 0.0001
Black (number of women 1,362)***	79.8 ± 20.3	< 0.0001	163.3 ± 6.3	0.1431	1.85 ± 0.28	< 0.0001

\* Lowrie GE, Li Z, Ofsthun N, Lazarus JM. Body Size, Dialysis Dose and Death Risk Relationship Among Haemodialysis Patients. *Kidney International* 2002;62:1891-97. \*\* CHNS: China Health and Nutrition Survey; \*\*\* NHANES III: Third National Health and Nutrition Examination Survey.

