MDRD-GFR underestimates GFR-related complications in racial minorities: The NHANES III Study

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Introduction

- Several national guidelines have recommended the use of serum creatinine levels to measure GFR, with 60 mL/min per 1.73 m^2 considered a watershed value, in part because treatable renal abnormalities become increasingly prevalent as GFR falls below this level.
- At the level of public health policy, demonstrating a GFR value below this threshold before embarking on an exhaustive search for renal complications would seem to be a rational use of these guidelines.
- Surprisingly, it is unknown whether such a two-stage strategy performs similarly in minority and non-minority populations. In particular, if GFR thresholds are to become the gatekeeper to more intensive investigation and intervention, it would seem important to know whether renal abnormalities develop at similar GFR values among individuals of different races and ethnicities.

Methods

- The Third National Health and Nutrition Examination Survey (NHANES III), conducted between 1988 and 1994, used stratified, multistage, probability sampling methods to assemble a nationwide sample of the non-institutionalized population of the US.
- Renal abnormalities were defined by the 5th or 95th percentiles of the values observed in the overall population. The defining threshold values were
  - systolic blood pressure ≥ 156.0 or diastolic blood pressure ≥ 90.7 mm Hg
  - potassium ≥ 4.6 mmol/L
  - hemoglobin ≤ 11.8g/dL (118 g/L)
  - bicarbonate ≤ 22.2 mmol/L
  - calcium ≤ 8.5 mg/dL (2.23 mmol/L)
  - phosphorus ≥ 4.2 mg/dL (1.36 mmol/L)
  - uric acid ≥ 7.9 mg/dL (0.47 mmol/L).

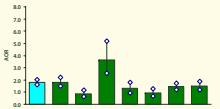
Results

- Of the 15,837 study subjects, 76.88% were white, 10.38% African American, and 5.09% Hispanic.
- The corresponding MDRD GFR values were 96.64, 111.45 and 115.49 mL/min per 1.73 m^2 ($P < 0.0001$).
- Renal abnormalities were present in 31.49% of white, 44.48% of African American, and 34.67% of Hispanic participants ($P < 0.0001$), reflecting disparities in blood pressure, potassium, hemoglobin, bicarbonate, phosphorus, and uric acid.
- Among subjects with GFRs below 60, adjusted odds ratios for the presence of one or more renal abnormalities were 1 among white participants (reference), 2.45 among Hispanics, and 1.91of participants of other race/ethnicity ($P < 0.0001$).
- Adjusted odds ratios of high blood pressure and low hemoglobin levels exceeded 1 in African American participants with GFR < 60 ml/min per 1.73 m^2; a similar pattern was seen in Hispanic participants with low GFR, with an additional association with high phosphorus levels.

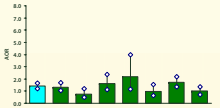
Population Characteristics

Characteristic	White	AA	HA	P Value
GFR	96.64	111.45	115.49	< 0.0001
GFR < 60 (%)	4.94	3.44	1.13	< 0.0001
Creatinine (mg/dL)	0.84	0.92	0.76	< 0.0001
ACR ≥ 30 (%)	9.68	13.37	9.91	< 0.0001
Age	45.96	41.60	37.57	< 0.0001
Female sex (%)	51.87	55.81	47.63	< 0.0001
Body mass index	26.38	27.80	27.44	< 0.0001
Born outside US (%)	5.10	6.95	54.86	< 0.0001
Self-reported diabetes (%)	5.16	7.55	6.83	0.0001
Self reported HTN (%)	24.11	29.06	16.37	< 0.0001
Renal Abnormalities (%)				
≥1 renal abnormality	31.49	44.48	34.67	< 0.0001
SBP ≥ 156.0 or DBP ≥ 90.7	9.03	13.52	7.09	< 0.0001
Potassium ≥ 4.6 mmol/L	5.40	4.08	3.49	0.0145
Hemoglobin ≤ 11.8 g/dL	4.98	15.18	6.70	< 0.0001
Bicarbonate ≥ 22.2 mmol/L	3.74	5.56	7.31	0.0043
Calcium ≤ 8.5 mg/dL	3.81	3.79	4.48	0.1632
Phosphorus ≤ 4.2 mg/dL	6.43	9.10	9.46	0.0001
Uric acid ≥ 7.9 mg/dL	5.18	7.21	4.13	0.0017

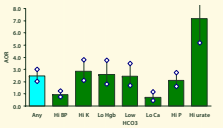
Odds ratios of renal complications in African Americans, adjusted for GFR and demography. *White is the reference category.*



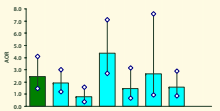
Odds ratios of renal complications in Hispanic Americans , adjusted for GFR and demography. *White is the reference category.*



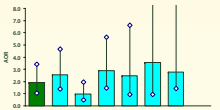
Odds ratios of renal complications with GFR < 60, adjusted for race and demography. GFR > 60 is the reference category.



Odds ratios of renal complications in African Americans with GFR < 60, adjusted for demography. *White with GFR < 60 is the reference category.*



Odds ratios of renal complications in Hisanic Americans with GFR < 60, adjusted for demography. *White with GFR < 60 is the reference category.*



Adjustment variables for multivariate analyses: age, gender, ethnicity, education, income-poverty ratio, body mass index, diabetes, cardiovascular disease, hypertension.

Conclusions

- Renal abnormalities were more common in minority populations, irrespective of GFR level, and CKD appeared to have a multiplicative effect on this association.
- Use of a single GFR threshold to define CKD may be disadvantageous for minority populations, because treatable renal abnormalities are present at higher GFR levels than in white adults.
- Race and ethnicity-specific GFR thresholds may be needed for equitable detection of renal abnormalities.

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