Letters

RESEARCH LETTER

Prevalence of Reduced Estimated Glomerular Filtration Rate Among the Oldest Old From 1988-1994 Through 2005-2010

Recent studies have shown that older adults with an estimated glomerular filtration rate (GFR) of less than 60 mL/min/1.73 m^2 have a high prevalence of concurrent complications of chronic kidney disease (CKD) and increased risk for adverse outcomes including mortality, cardiovascular disease, and kidney failure.[1,2] A prior study demonstrated an increase in CKD prevalence between 1988-1994 and 1999-2004 for the general US population.[3]

However, trends in CKD prevalence have not been reported for the oldest old (defined as ≥80 years). People aged 80 years or older often have complex medical, social, and psychological needs and substantial requirements for health care resources. This group represents an increasing challenge to the health care system.[4]

Methods | We used data from the National Health and Nutrition Examination Surveys (NHANES) 1988-1994 and 1999-2010.[5] NHANES includes cross-sectional, multistage, stratified probability samples of the US civilian, noninstitutionalized population that can be weighted to produce nationally representative prevalence estimates. We included participants aged 80 years or older who completed a medical evaluation in the NHANES mobile examination center (n = 3558). We excluded participants with missing serum creatinine measurements. Because reduced estimated GFR among older adults is primarily in the mild to moderate range, we excluded those with estimated GFR of less than 15 mL/min/1.73 m^2, yielding an analytic sample of 2986 participants. Among those aged 80 years or older, response rates for the NHANES examination were 55.0% to 60.0%.[5]

NHANES data were collected through interviews and a medical evaluation. Public use NHANES data do not provide exact age for participants aged 80 years or older. Therefore, all participants were assigned an age of 80 years. Estimated GFR was estimated using the Chronic Kidney Disease Epidemiology Collaboration equation. Serum creatinine values were corrected for NHANES 1988-1994, 1999-2000, and 2005-2006.[6] The protocol for each NHANES was approved by the US Centers for Disease Control and Prevention institutional review board. Written informed consent was obtained from each participant.

Table 1. Characteristics and Distribution of Estimated Glomerular Filtration Rate (GFR) of NHANES Participants Aged 80 Years or Older by Calendar Period

	Calendar Period, Mean (95% CI)			*P* Value for Trend
	1988-1994 (n = 1020)	1999-2004 (n = 995)	2005-2010 (n = 971)	
Female sex, %	64.8 (61.1-68.5)	64.2 (61.1-67.3)	62.0 (59.3-64.7)	.23
Race/ethnicity, %[a]				
Non-Hispanic white	88.8 (85.7-91.9)	86.1 (82.2-90.0)	87.4 (84.3-90.5)	Reference
Non-Hispanic black	6.3 (4.0-8.7)	6.5 (4.2-8.9)	5.5 (3.9-7.1)	.68
Mexican American	1.6 (1.2-2.0)	5.1 (2.0-8.2)	4.0 (2.8-5.2)	.002
Other[b]	3.3 (1.5-5.1)	2.2 (0.6-3.8)	3.1 (1.7-4.5)	.88
Current smoker, %	4.9 (3.1-6.7)	3.8 (2.6-5.0)	2.9 (1.9-3.9)	.04
Waist circumference, cm[c]	93.7 (92.9-94.5)	96.2 (95.6-96.8)	97.0 (96.2-97.8)	<.001
Blood pressure, mm Hg				
Systolic	148.2 (147.0-149.4)	148.7 (146.7-150.7)	139.6 (138.2-141.0)	<.001
Diastolic	71.5 (70.7-72.3)	61.4 (59.6-63.2)	59.1 (58.1-60.1)	<.001
Hypertension, %	73.0 (70.3-75.7)	75.6 (73.6-77.6)	75.7 (72.8-78.6)	.17
Antihypertension medication, %	48.4 (43.7-53.1)	63.9 (59.8-68.0)	76.6 (72.5-80.7)	<.001
Diabetes mellitus, %	12.3 (10.1-14.5)	13.6 (11.2-16.0)	16.1 (14.1-18.1)	.01
Prevalence (95% CI)[d]				
Estimated GFR, mL/min/1.73 m^2				
≥60	(n = 611) 59.5 (55.4-63.6)	(n = 518) 50.1 (46.4-53.8)	(n = 488) 48.8 (45.3-52.3)	Reference
<60	(n = 409) 40.5 (36.4-44.6)	(n = 477) 49.9 (46.2-53.6)	(n = 483) 51.2 (47.7-54.7)	<.001
45-59	(n = 279) 26.2 (23.3-29.1)	(n = 310) 31.3 (28.0-34.6)	(n = 291) 29.4 (26.3-32.5)	.01
<45	(n = 130) 14.3 (11.6-17.0)	(n = 167) 18.6 (15.9-21.3)	(n = 192) 21.7 (19.0-24.4)	<.001

Abbreviation: NHANES, National Health and Nutrition Examination Surveys.

[a] Self-reported based on defined options to determine national estimates.

[b] Individuals reporting race/ethnicity other than non-Hispanic white, non-Hispanic black, and Mexican American, including other Hispanic and multiracial.

[c] Of the 2986 participants included in the analysis, 230 had missing data for this variable. A complete case analytic approach was used.

[d] Sampling weights were applied to all calculations to obtain US nationally representative prevalence estimates for the population aged 80 years or older and calculations accounted for the complex sampling design of NHANES.

Table 2. Odds Ratios for Reduced Estimated Glomerular Filtration Rate (GFR) per Decade of Calendar Time for NHANES Participants Aged 80 Years or Older[a]

		Multivariable-Adjusted Odds Ratio (95% CI) for Each 10-y Calendar Period (2010 vs 2000)				
	Unadjusted Odds Ratio (95% CI) (n = 2986)	Demographic (n = 2986)[b]	Demographic + Hypertension (n = 2986)	Demographic + Diabetes (n = 2986)	Demographic + Waist Circumference (n = 2756)[c]	Demographic + Hypertension + Diabetes + Waist Circumference (n = 2756)[c]
Estimated GFR, mL/min/1.73 m^2						
≥60	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
<60	1.31 (1.14-1.51)	1.32 (1.14-1.53)	1.31 (1.13-1.52)	1.31 (1.14-1.51)	1.25 (1.08-1.45)	1.24 (1.07-1.44)
45-59	1.22 (1.05-1.42)	1.22 (1.05-1.42)	1.21 (1.04-1.41)	1.22 (1.05-1.41)	1.17 (1.01-1.36)	1.16 (1.00-1.35)[d]
<45	1.47 (1.20-1.81)	1.50 (1.22-1.85)	1.49 (1.21-1.84)	1.48 (1.21-1.82)	1.41 (1.13-1.76)	1.39 (1.11-1.74)

Abbreviation: NHANES, National Health and Nutrition Examination Surveys.

[a] Sampling weights were applied to all calculations to obtain US nationally representative estimates for the population aged 80 years or older. Calculations accounted for the complex sampling design of NHANES.

[b] Includes sex and race/ethnicity.

[c] There were 230 participants with missing data for waist circumference.

[d] P = .048 comparing individuals with estimated GFR of 45 to 59 mL/min/1.73 m^2 vs greater than or equal to 60 mL/min/1.73 m^2.

Participant characteristics and the distribution of estimated GFR for US adults aged 80 years or older were calculated for 1988-1994, 1999-2004, and 2005-2010. Linear trends in the prevalence of reduced estimated GFR (45-59 and <45 vs ≥60 mL/min/1.73 m^2) over calendar time were evaluated using multinomial logistic regression adjusting for sex, race/ethnicity, hypertension, diabetes, and waist circumference. Calendar time was entered as a continuous variable representing 10-year increments. All analyses were performed using SUDAAN version 10.1 (Research Triangle Institute) with 2-sided statistical tests. P values of less than .05 were considered statistically significant.

Results | The characteristics of participants aged 80 years or older by calendar period appear in **Table 1**. The prevalence of an estimated GFR of less than 60 mL/min/1.73 m^2 was 40.5% (95% CI, 36.4%-44.6%) in 1988-1994, 49.9% (95% CI, 46.2%-53.6%) in 1999-2004, and 51.2% (95% CI, 47.7%-54.7%) in 2005-2010 (P<.001 for each trend). The prevalence of an estimated GFR of less than 45 mL/min/1.73 m^2 was 14.3% (11.6%-17.0%) in 1988-1994, 18.6% (15.9%-21.3%) in 1999-2004, and 21.7% (19.0%-24.4%) in 2005-2010 (P<.001 for each trend).

For each 10 years of calendar time (eg, 2010 vs 2000) and compared with an estimated GFR of greater than or equal to 60 mL/min/1.73 m^2, the unadjusted odds ratio was 1.22 (95% CI, 1.05-1.42) for an estimated GFR of 45 to 59 mL/min/1.73 m^2 and 1.47 (95% CI, 1.20-1.81) for an estimated GFR of less than 45 mL/min/1.73 m^2 (**Table 2**). These trends were partly attenuated but remained statistically significant after adjustment for demographic factors, hypertension, diabetes, and waist circumference.

Discussion | Among US adults aged 80 years or older, the prevalence of an estimated GFR of less than 60 mL/min/1.73 m^2 increased from 1988-1994 through 2005-2010. Increases in the prevalence of more severe reductions in estimated GFR (ie, <45 mL/min/1.73 m^2) were especially pronounced.

Limitations of the current analysis included lack of data on exact age for NHANES participants and intraindividual longitudinal changes of kidney function and use of a single estimating equation. The increase in reduced estimated GFR may be explained by older US adults with reduced estimated GFR living longer. Along with studies suggesting increased risk for adverse outcomes at lower estimated GFR levels,[1,2] the current analysis suggests efforts to address CKD among the oldest old may be necessary.

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COMMENT & RESPONSE

Timing of Tracheostomy

To the Editor Dr Young and colleagues[1] conducted a multicenter, prospective study on tracheostomy timing involving 72 critical care units in the United Kingdom over an 8-year period. The authors randomized patients into early vs late tracheostomy groups and found comparable mortality, critical care unit length of stay, and tracheostomy complications. Although we agree with the major conclusion that study clinicians could not reliably predict who would need a tracheostomy, we suggest caution regarding other conclusions and those of the accompanying Editorial[2] based on study limitations and a narrow set of outcome measures.

The study represents 576 site-years, accruing 909 patients at a rate of less than 2 patients per site per year, leaving significant potential for inconsistent recruitment and variance in clinical practice. Nevertheless, mortality is not the only outcome when considering benefits to the patient and costs to the health care system. In a recent study, 592 patients from 1 institution were retrospectively studied over a 6-year period, with 128 undergoing early tracheotomy at a median of 4.4 days and 464 undergoing late tracheotomy at 14.4 days.[3] Overall hospital length of stay was 36 days for the early tracheotomy group vs 54 days in the late tracheotomy group (including a longer postintensive care unit course). Furthermore, severity of illness and risk of mortality were comparable in both groups.

Young et al[1] recognized that their study was not designed or powered to assess other complications, such as laryngotracheal stenosis, but these should be part of the greater discussion. Whited[4] followed up 200 patients with laryngoscopy within 24 hours of extubation and found 14% of patients intubated between 10 and 24 days had glottal stenosis compared with 4% of those intubated between 4 and 10 days and none intubated for less than 4 days. Weymuller[5] studied 10 intubated dogs with fluorescein perfusion to document mucosal ischemia. By 24 hours, he noted mucosal ulceration and by 14 days, there was arytenoid cartilage necrosis. It would therefore seem paramount to address outcomes in the 70% of patients that did not experience mortality because voice, swallowing, and airway rehabilitation begin with proper early airway management.

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Conflict of Interest Disclosures: The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Dr Altman reported being a board member of Watermark Research Partners; being a consultant to and receiving payment for lectures from Nestle; and providing expert testimony. Dr Merati is on the editorial board of *JAMA Otolaryngology*.

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To the Editor The TracMan (Tracheostomy Management) study[1] investigated the effect of early vs late tracheostomy placement on survival in patients receiving mechanical ventilation. In this study, no significant benefit was found for early tracheostomy. Although there were no significant differences for mortality or critical care unit length of stay between