Kidney Medicine

CKD Prevalence and Incidence in Older Adults Using Estimated GFR With Different Filtration Markers: The Atherosclerosis Risk in Communities Study

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Rationale & Objective: The prevalence of chronic kidney disease (CKD) is known to increase with age; however, creatinine may be a less reliable filtration marker in older adults. Few studies have investigated the prevalence and progression of CKD using different filtration markers for estimating glomerular filtration rate (GFR).

Study Design: A prospective observational cohort study.

Setting & Participants: 6,393 White and African American participants aged 65-100 years from the Atherosclerosis Risk in Communities Study (ARIC) at Visit 5, followed longitudinally at Visits 6 and 7.

Exposure and Outcome: The eGFR was estimated either by creatinine (eGFRcr), cystatin C (eGFRcys), creatinine and cystatin C (eGFRcr-cys), or using creatinine, cystatin C, and β-2-microglobulin (eGFRcr-cys-b2m). CKD progression was defined as 30% decline in eGFR at follow-up visits.

Analytical Approach: Logistic regression models, adjusted for sex, race and study center, diabetes, blood pressure, body mass index, prevalent cardiovascular disease, and heart failure.

Results: At Visit 5, the mean age in the study population was 75.8 years, and the mean eGFR ranged from 71.2 to 61.2 mL/min/1.73m^2 using eGFRcr or eGFRcys, respectively. The proportion with eGFR < 60 mL/min/1.73m^2 was lowest with eGFRcr and highest with eGFRcys for all age groups, and prevalence increased with age for all markers. For example, the prevalence of eGFRcr < 60 mL/min/1.73m^2 in ages 70-74 years ranged from 15% to 21% and in ages 85-89 years ranged from 38% to 46% at the different visits. The proportion with a 30% eGFR decline over a mean of 8 years in people who were originally aged 65-69 years ranged from 9% (eGFRcr)-18% (eGFRcys). More people with eGFRcr ≥ 60 mL/min/1.73m^2 were reclassified to < 60 mL/min/1.73m^2 when using eGFRcys (33%) compared with eGFRcr-cys (12%) or eGFRcr-cys-b2m (18%). The proportion with 30% eGFR decline was lowest with eGFRcr and highest with eGFRcys, with greater incidence in older age groups for all markers.

Limitations: No direct measurement of GFR. Not all participants survived or attended subsequent follow-up visits.

Conclusions: The prevalence and progression of CKD increase with age, but estimates vary with the filtration marker used. The eGFRcr gave the lowest estimate of CKD at 15% for people aged 65-69 years at Visit 5 while eGFRcys gave the highest estimates of CKD at 26% for that same population.

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The prevalence of chronic kidney disease (CKD) is high, with an estimated 14.4% of the US population having CKD based on low eGFR or high albuminuria.[1] The prevalence of CKD is known to increase with age,[2] and some studies estimate a >50% prevalence at age 70 years and older.[3] However, the primary biomarker used to estimate GFR clinically (creatinine) can be affected by muscle mass, which decreases with age. Thus, eGFR based solely on creatinine may underestimate the prevalence of CKD in older adults.

In the past several years, interest in using additional markers to estimate GFR has increased. An updated estimating equation that incorporates cystatin C was developed by the Chronic Kidney Disease Epidemiology (CKD-EPI) Collaboration,[4] and the use of equations incorporating β-2 microglobulin equations has also been explored.[5] Cystatin C has been recommended for use in estimating GFR by multiple organizations since its levels do not vary by race or muscle mass, and it is more strongly associated with adverse outcomes than creatinine.[6,7] However, cystatin C can also be affected by non-GFR determinants, including inflammation, adiposity, type 2 diabetes, and thyroid dysfunction.[8,9] Similarly, β-2 microglobulin does not vary by muscle mass but is thought to be affected by inflammation, body mass index, and serum albumin levels.[5,10,11] Differences in the prevalence of CKD using these new equations have not been investigated, particularly in subgroups by age.

In this prospective cohort study, we sought to describe the prevalence and progression of CKD as estimated by different endogenous markers of GFR in participants from the community-based Atherosclerosis Risk in Communities (ARIC) Study. We specifically followed how creatinine, cystatin C, and β-2 microglobulin estimate GFR in older adults over time.

METHODS

Study Population

The Atherosclerosis Risk in Communities Study (ARIC) is a community-based sample of mostly White and African

PLAIN LANGUAGE SUMMARY

The study examines different filtration markers for glomerular filtration rate (GFR) equations in older adults. Filtration markers can be affected by age-varying characteristics like muscle mass, so it is important to investigate potential discrepancies in eGFR with different markers. We evaluated eGFR using creatinine, cystatin C, both, and alongside β-2-microglobulin to determine kidney disease prevalence and progression. The main takeaway from this study is that there is variation in prevalence of kidney disease in older adults depending on what filtration marker is used in estimating GFR. Our study falls in line with international kidney guidelines to measure cystatin C more in clinical care, as we may be missing some older adults with kidney disease.

American participants recruited in 1987 for the purpose of investigating myocardial infarction incidence and chronic heart disease mortality in 4 US locations: Forsyth County, North Carolina; Jackson, Mississippi; suburban Minneapolis, Minnesota; and Washington County, Maryland.[12] This study analyzed data from 6,393 participants who attended ARIC Visit 5 (2011-2013) and Visit 6 (2016-2017) or Visit 7 (2018-2019) and had their serum creatinine, cystatin C, and β-2 microglobulin recorded at each visit. Data from Visit 6 or Visit 7 were used to assess follow-up measures. There were no participants who were assessed at Visit 6 or Visit 7 who did not have Visit 5 data. This research was covered under the ARIC IRB. The ARIC protocol was approved by the institutional review board associated with each field center, and all participants provided informed consent.

Study Measures and Outcomes

The eGFR was calculated using the 2021 race free creatinine equation (eGFRcr),[4] the 2012 cystatin C equation (eGFR-cys),[7] the 2021 race free creatinine cystatin C equation (eGFRcr-cys),[4] and a multimarker approach using creatinine, cystatin C, and β-2-microglobulin (eGFRcr-cys-b2m).[13] Both serum and urine levels of creatinine were measured using the Roche enzymatic method. Cystatin C was measured using the Gentian immunoassay. β-2 microglobulin was measured using a particle-enhanced immunonephelometric assay. Albumin-to-creatinine ratio (ACR) is the ratio of urine levels

Table 1. Baseline Characteristics Stratified by Visit

Variable	Visit 5	Visit 6	Visit 7
N	6,393	3,597	3,201
Age, y	75.8 ± 5.3	79.6 ± 4.8	80.9 ± 4.6
Female	3,752 (58.7%)	2,093 (58.2%)	1,867 (58.3%)
African American	1,464 (22.9%)	796 (22.1%)	714 (22.3%)
Race by study center[a]			
African American: Jackson County	1,367 (21.4%)	744 (20.7%)	660 (20.6%)
African American: Forsyth County	97 (1.5%)	52 (1.4%)	54 (1.7%)
White: Forsyth County	1,304 (20.4%)	765 (21.3%)	653 (20.4%)
White: Minnesota	1,895 (29.6%)	1,091 (30.3%)	1,008 (31.5%)
White: Washington County	1,730 (27.1%)	945 (26.3%)	826 (25.8%)
Total cholesterol, mg/dL	4.7 ± 1.1	4.5 ± 1.0	4.6 ± 1.1
HDL, mg/dL	1.3 ± 0.4	1.4 ± 0.4	1.3 ± 0.4
BMI	28.7 ± 5.8	28.3 ± 5.4	28.0 ± 5.4
Systolic blood pressure, mm Hg	130.6 ± 18.5	135.1 ± 19.0	134.3 ± 19.1
Antihypertensive use	4,245 (67.5%)	2,414 (69.2%)	2,165 (68.6%)
Diabetes	2,061 (33.3%)	1,150 (32.8%)	998 (32.2%)
Current smoker	357 (5.9%)	239 (6.8%)	161 (5.1%)
Former smoker	2,925 (51.9%)	1,779 (53.5%)	1,666 (57.9%)
eGFRcr, mL/min/1.73m^2	71.2 ± 17.7	68.8 ± 17.6	66.9 ± 17.4
eGFRcys, mL/min/1.73m^2	61.2 ± 19.7	57.5 ± 18.7	54.3 ± 18.0
eGFRcr-cys, mL/min/1.73m^2	68.3 ± 19.3	65.1 ± 18.8	62.3 ± 18.3
eGFRcr-cys-b2m, mL/min/1.73m^2	64.5 ± 17.0	62.1 ± 16.6	59.5 ± 16.0
ACR, mg/g	10.9 (6.4-23.9)	7.6 (3.6-20.0)	8.8 (4.0-25.0)
Hypertension	4,709 (74.6%)	2,798 (79.4%)	2,488 (78.6%)
Prevalent CHD	1,058 (16.5%)	498 (13.8%)	414 (14.1%)
Prevalent stroke	858 (16.5%)	568 (15.8%)	492 (15.4%)
Prevalent heart failure	877 (13.7%)	287 (8.0%)	665 (20.8%)

Note: Values are n (%), mean (SD), or median (IQI). Percentage of missing data at each visit detailed in Table S2.
Abbreviations: ACR, albumin-creatinine ratio; BMI, body mass index; CHD, coronary heart disease; eGFRcr, eGFRcreatinine; eGFRcys, eGFRcystatin C; eGFRcr-cys, eGFRcreatinine-cystatin C; eGFRcr-cys-b2m, eGFRcreatinine-cystatin C-β-2-microglobulin; HDL, high-density lipoprotein.
[a]Distribution across center and race reflects the ARIC recruitment strategy. Jackson County recruitment was restricted to African American participants. There were no restrictions at the other sites and the cohort reflects the racial mix in those areas at the time.

Table 2. Prevalence of eGFR < 60 mL/min/1.73m^2 at each visit, stratified by age group

	Visit 5					Visit 6					Visit 7				
Age (y)	N	eGFRcr	eGFRcys	eGFRcr-cys	eGFRcr-cys-b2m	N	eGFRcr	eGFRcys	eGFRcr-cys	eGFRcr-cys-b2m	N	eGFRcr	eGFRcys	eGFRcr-cys	eGFRcr-cys-b2m
65-69	666	100 (15%)	171 (26%)	112 (17%)	140 (21%)										
70-74	2,317	439 (19%)	896 (39%)	559 (24%)	672 (29%)	514	106 (21%)	200 (39%)	127 (25%)	145 (28%)	96	14 (15%)	40 (42%)	21 (22%)	23 (24%)
75-79	1,794	464 (26%)	919 (51%)	584 (33%)	677 (38%)	1,493	367 (25%)	733 (49%)	476 (32%)	549 (37%)	1,355	385 (28%)	766 (57%)	485 (36%)	559 (41%)
80-84	1,152	429 (37%)	746 (65%)	547 (47%)	606 (53%)	963	318 (33%)	596 (62%)	421 (44%)	469 (49%)	1,051	356 (34%)	655 (62%)	477 (45%)	526 (50%)
85-89	459	210 (46%)	377 (82%)	276 (60%)	312 (68%)	504	194 (38%)	373 (74%)	254 (50%)	285 (57%)	531	221 (42%)	412 (78%)	297 (56%)	338 (64%)
90-94[a]						123	62 (50%)	111 (90%)	88 (72%)	93 (76%)	163	93 (57%)	151 (93%)	122 (75%)	131 (80%)

Abbreviations: eGFRcr, eGFRcreatinine; eGFRcys, eGFRcystatin C; eGFRcr-cys, eGFRcreatinine-cystatin C; eGFRcr-cys-b2m, eGFRcreatinine-cystatin C-β-2-microglobulin.
[a]Age 90-94 years at Visit 5 not shown because of small denominator (N < 10).

of albumin to urine levels of creatinine, and albumin was measured from urine samples using an immunoturbidometric method on the ProSpec nephelometric analyzer. The CKD progression was defined as 30% or greater decline in eGFR at a subsequent ARIC study visit, either Visit 6 (2016-2017) or Visit 7 (2018-2019).

Statistical Analyses

Study characteristics were summarized across Visits 5, 6, and 7 as means and standard deviation for continuous variables, and proportions for binary variables. Skewed variables were summarized using median and interquartile intervals (IQI). The prevalence of eGFR <60 ml/min/1.73 m^2 by 5-year age strata (age 65-69, 70-74, 75-79, 80-84, 85-89, and 90-94) was determined at each visit. Kernel densities for the different eGFRs at each visit were plotted using a Gaussian kernel. The cross-classification of G-stage (eGFR ≥ 60 mL/min/1.73m^2, 45-60 mL/min/1.73m^2, 30-45 mL/min/1.73m^2, 15-30 mL/min/1.73m^2, and 0-15 mL/min/1.73m^2) was visualized for each estimating equation compared to eGFRcr at each visit. We also estimated prevalence of CKD including urine ACR > 30 mg/g and determined the CKD prevalence at each visit using the different estimating equations. Finally, we calculated the proportion of people who had a 30% decline in eGFR at subsequent visits using different eGFR equations in each age stratum. Percent change per year for each eGFR equation was plotted using kernel density estimation.

RESULTS

At Visit 5, average age was 75.8 years (SD, 5.3), 58.7% of the sample was female (n = 3,752), the median ACR was 10.9 mg/g (IQI 6.4-23.9), 33.3% of the sample had diabetes (n = 2,061), and the mean eGFRcr, eGFRcys, eGFRcr-cys, and eGFRcr-cys-b2m were 71, 61, 68, and 65 mL/min/1.73 m^2, respectively. The eGFR values decreased over time from Visit 5 to Visits 6 and 7, such that at Visit 7, the mean eGFRcr, eGFRcys, eGFRcr-cys, and eGFRcr-cys-b2m had decreased to 67, 54, 62, and 60 mL/min/1.73 m^2, respectively (Table 1).

The proportion of patients in the sample with eGFR < 60 mL/min/1.73m^2 was lowest when estimated with eGFRcr and highest when estimated with eGFRcys for all age groups at all visits. Prevalence increased with age for all markers (Table 2). At Visit 5, 15% (n = 100) of patients aged 65-69 years, 19% (n = 439) of patients aged 70-74 years, 26% (n = 464) of patients aged 75-79 years, 37% (n = 429) of patients aged 80-84 years, and 46% (n = 210) of patients aged 85-89 years had an eGFR of <60 mL/min/1.73m^2 when using eGFRcr.

The prevalence of CKD increased over time as participants aged. When considering both eGFR < 60 mL/min/1.73m^2 or ACR > 30 mg/g, the prevalence of CKD was higher at Visit 7 than Visit 5 for all filtration markers. The proportion of patients at Visit 7 (n = 3,201) who had eGFR < 60 mL/min/1.73m^2 and ACR > 30 mg/g by eGFRcr was 10%

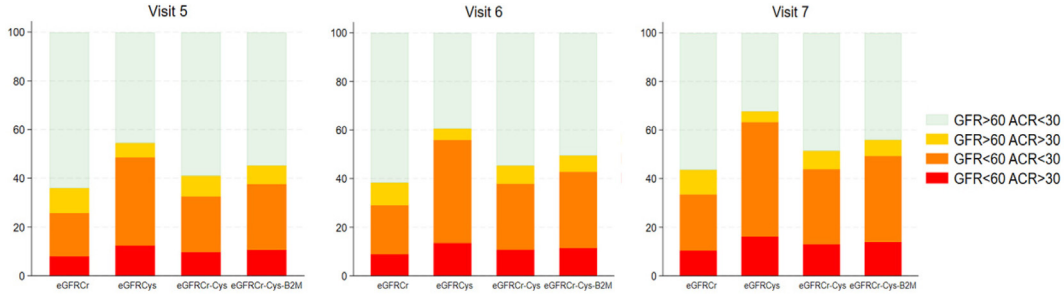


Figure 1. Prevalence of CKD stratified by visit. CKD is defined as either GFR < 60 mL/min/1.73m^2 or ACR > 30 mg/g. CKD, chronic kidney disease; eGFRcr; eGFRcreatinine, eGFRcys; eGFRcystatin C, eGFRcr-cys; eGFRcreatinine-cystatin C, eGFRcr-cys-b2m; eGFRcreatinine-cystatin C-β-2-microglobulin.

(n = 332), eGFRcys 16% (n = 517), eGFRcr-cys 13% (n = 416), and eGFRcr-cys-b2m 14% (n = 447) (Fig 1).

The eGFRcr had a higher estimation of GFR and lower estimations of CKD when compared with other equations. At Visit 5, when compared with eGFRcr ≥ 60 mL/min/1.73m^2, 26% (n = 1,249) of the participants were reclassified to 45-60 mL/min/1.73m^2 when using eGFR-cys, 12% (n = 575) when using eGFRcr-cys, and 17% (n = 823) when using eGFRcr-cys-b2m (Fig 2; Table S1). The extent of reclassification was highest when evaluating GFR stages of 45-60 mL/min/1.73m^2 and 30-45 mL/min/1.73m^2. The directions of reclassification were consistent and increased in prevalence at each subsequent visit. At Visit 6, among people with eGFRcr 45-60 mL/min/1.73m^2, 46% (n = 309) of the participants were reclassified to 30-45 mL/min/1.73m^2 when using eGFR-cys, 28% (n = 187) when using eGFRcr-cys, and 28% (n = 191) when using eGFRcr-cys-b2m. By Visit 7, when evaluating people with eGFRcr 45-60 mL/min/1.73m^2, 50% (n = 345) of the participants were reclassified to 30-45 mL/min/1.73m^2 when using eGFRcys, 28% (n = 195) when using eGFRcr-cys, and 30% (n = 206) when using eGFRcr-cys-b2m.

The proportion with 30% eGFR decline was lowest when estimated with eGFRcr and highest when estimated with eGFRcys, with greater incidence of decline in older age groups for all markers (Table 3). When examining the percent change in eGFR per year per filtration marker, eGFRcys showed the greatest decline in eGFR per year with a median percent change to -2.41 mL/min/1.73m^2 (IQI −0.80 to −4.14). Whereas, eGFRcr showed less decline in eGFR per year with a median percent change of −1.10 mL/min/1.73m^2 (IQI −0.07 to −2.70) (Table 4).

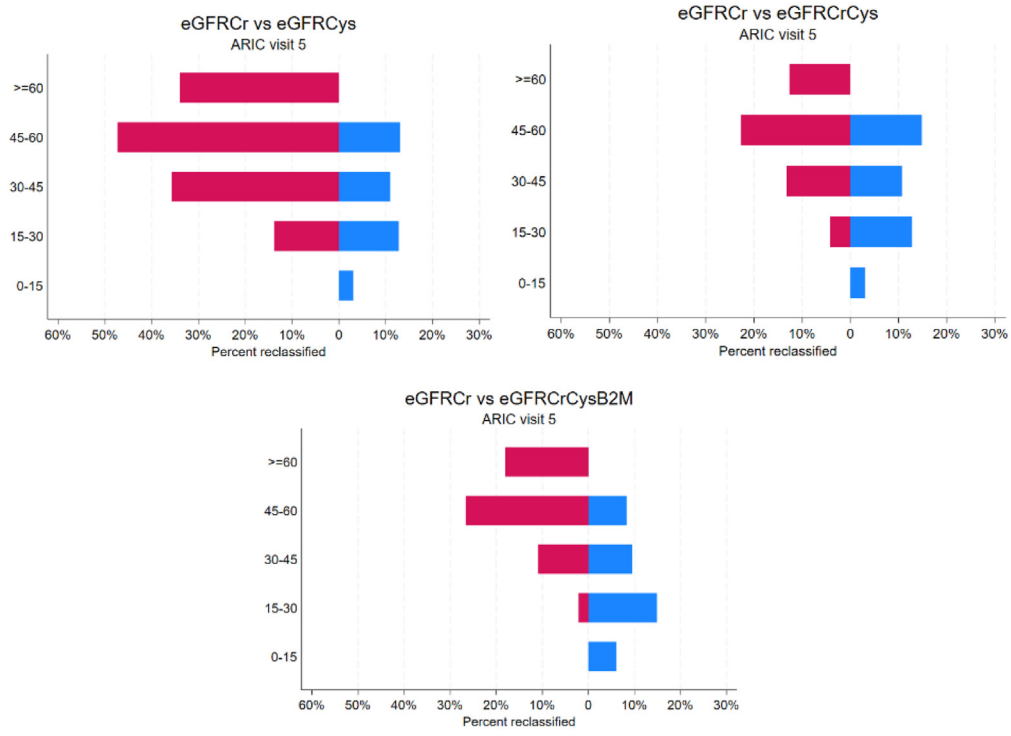
DISCUSSION

In this cohort of older adults participating in the ARIC study, we found significant differences in the prevalence and progression of CKD when GFR was estimated using creatinine, cystatin C, and β-2 microglobulin. Overall, the prevalence of CKD was greater with older age, regardless of the filtration marker used in GFR estimating equations. Across filtration markers, however, the prevalence of CKD could vary substantially: in some subgroups of age, the prevalence of CKD when determined using eGFRcys was twice that determined using eGFRcr. Prevalence of CKD based on eGFRcr-cys or eGFRcr-cys-b2m was generally intermediate between that with eGFRcr and eGFRcys. Similarly, 30% decline in eGFR was more common in older age categories, with greatest decline when determined using eGFRcys and lowest when using eGFRcr.

Our study provides strong evidence that the prevalence of CKD is high in older populations, and that using creatinine as the sole biomarker in estimating equations may underestimate the CKD prevalence.[14] Although our results are in line with the literature on CKD prevalence, rates of CKD progression within older age subgroups has not been well-studied. The few previous studies have conflicted in terms of the progression of CKD in older ages, with one study showing that regression of CKD may be at least as common as progression of CKD in older age[15] while another showed that more than half of older adults in the study experienced a decline in kidney function.[16] Previous studies were limited by different definitions of CKD progression and a sole focus on CKD defined by eGFRcr. Our results add to this literature by showing a consistent increase in CKD progression with older age, irrespective of filtration marker used.

The study results are consistent with statements from the KDIGO 2023 CKD guideline[17] on special consideration of filtration markers in older adults. Specifically, the guideline advises that the interpretation of CKD staging solely based on serum creatinine should be approached cautiously in older adults and should be taken with consideration of their physical build. Creatinine is likely to overestimate GFR in those who have lost muscle mass, a common occurrence in older age. This has several potential consequences for older populations, including an increased risk for the misclassification of CKD stage and potential for inappropriate drug dosing. Furthermore, the guideline recommends measuring eGFRcr-cys following initial testing, if available and not previously done. Indeed, we see greater differences in prevalence of eGFR < 60 mL/min/1.73 m^2 when estimated using eGFRcr versus eGFRcys or eGFRcr-cys in older

Visit 5



Visit 6

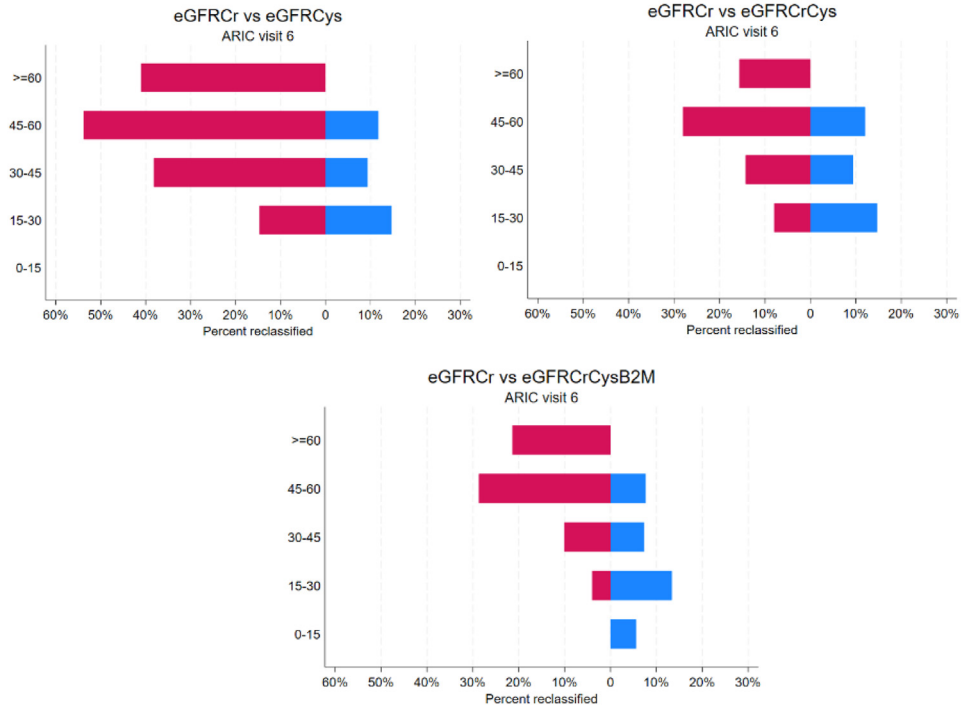


Figure 2. The eGFR reclassification graph stratified by visit. Red: percent of people in the GFR category according to eGFRcr that are classified as being in a lower GFR category by the other marker. Blue: percent of people in the GFR category according to eGFRcr that are classified as being in a higher GFR category by the other marker. GFR, glomerular filtration rate; eGFRcr; eGFRcreatinine, eGFRcys; eGFRcystatin C, eGFRcr-cys; eGFRcreatinine-cystatin C, eGFRcr-cys-b2m; eGFRcreatinine-cystatin C-β-2-microglobulin.

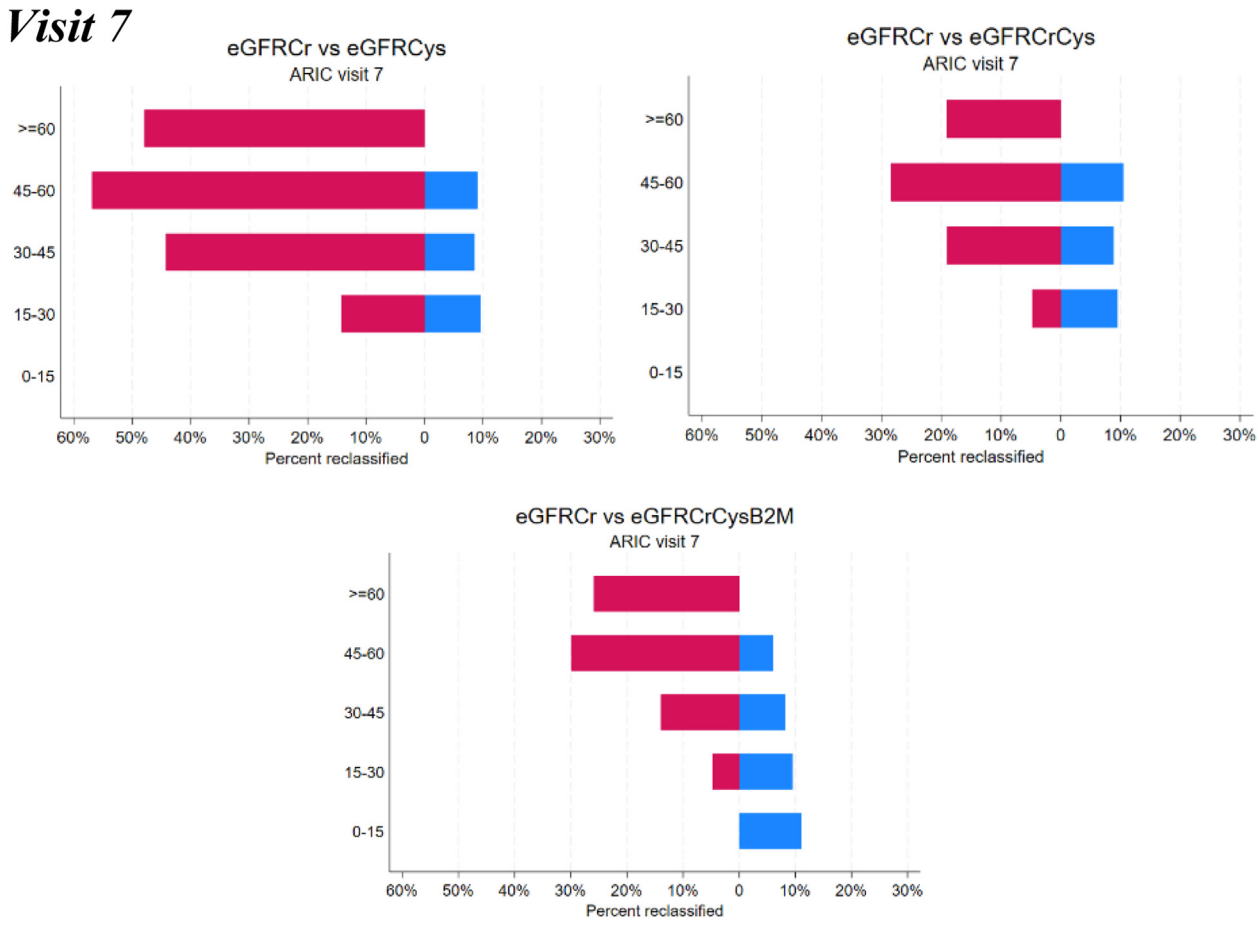


Figure 2. Continued.

subgroups. Although measurement of cystatin C may initially increase costs for health care systems, one expects that more widespread testing will reduce costs per assay, and there may be further savings when providing more appropriate care, especially in terms of medication management, for older adults.

Other work has focused on how using additional biomarkers may help reclassify risk in older adults. Previous studies have shown that among older adults, eGFR based on serum cystatin C better predicted all-cause mortality when compared with eGFR based on serum creatinine[18] and that even among patients who did not yet have CKD, elevated cystatin C levels were associated with a significantly greater risk of developing CKD in the following 4 years.[6,19-21] In addition, including cystatin C for GFR estimation has the potential to greatly improve the sensitivity and specificity for identifying risk in mild CKD. A 2022 study showed eGFR measured with cystatin C to be more accurate for cardiovascular disease and mortality risks.[22] Taken together with work demonstrating more accurate assessment of measured GFR when using both creatinine and cystatin in GFR estimates,[23] this research further supports the more widespread implementation of testing for additional biomarkers when screening for CKD, especially in older adults.

To our knowledge, this study is the first that compares creatinine and cystatin-based equations with equations

Table 3. Proportion with 30% or Greater Decline in eGFR Within 8 Years, by eGFR Estimating Equation, Stratified by Age Group

Age at visit 5, y	N	eGFRcr	eGFRcys	eGFRcr-cys	eGFRcr-cys-b2m
65-69	522	45 (9%)	92 (18%)	60 (11%)	50 (10%)
70-74	1,642	170 (10%)	329 (20%)	233 (14%)	184 (11%)
75-79	1,109	117 (11%)	223 (20%)	158 (14%)	127 (11%)
80-84	560	74 (13%)	131 (23%)	98 (18%)	82 (15%)
85-89	148	17 (11%)	32 (22%)	24 (16%)	19 (13%)

Note: 30% decline in eGFR by Visit 6 (2016-2017) or Visit 7 (2018-2019). Needed at least 1 follow-up measure for inclusion.
Abbreviations: eGFRcr, eGFRcreatinine; eGFRcys, eGFRcystatin C; eGFRcr-cys, eGFRcreatinine-cystatin C; eGFRcr-cys-b2m, eGFRcreatinine-cystatin C-β-2-microglobulin.

Table 4. Percent Change in eGFR per Year

eGFR Filtration Marker	Percent Change in eGFR
eGFRcr	−1.10 (−0.07 to −2.70)
eGFRcys	−2.41 (−0.80 to −4.14)
eGFRcr-cys	−1.86 (−0.52 to −3.42)
eGFRcr-cys-b2m	−1.63 (−0.43 to −3.05)

Note: Percent change per year calculated per ID and represented as median (IQI). Needed at least 1 follow-up measure for inclusion.
Abbreviations: eGFRcr; eGFRcreatinine, eGFRcys; eGFRcystatin C, eGFRcr-cys; eGFRcreatinine-cystatin C, eGFRcr-cys-b2m; eGFRcreatinine-cystatin C-β-2-microglobulin.

containing β-2 microglobulin specifically in older adults. β-2 microglobulin is a low molecular weight protein that is widely studied in kidney failure research,[24] especially as a potential marker of dialysis adequacy.[25] β-2 microglobulin is filtered by the glomeruli and metabolized by proximal tubular cells, but with decreased filtration, β-2 microglobulin levels circulating in the blood rise. Previous studies examining eGFR based on β-2 microglobulin as compared with eGFR based on serum creatinine alone found β-2 microglobulin to better predict outcomes, such as kidney failure,[10] sudden cardiac death,[26] and fracture risk.[27] In addition, alternative filtration markers like β-2 microglobulin may improve risk associations with all-cause mortality beyond eGFR based on creatinine alone.[28] Previous work has shown multiple filtration markers used together may more accurately estimate GFR and decrease the influence of non-GFR determinants of each marker.[29]

Our study also adds to the literature regarding the prevalence of albuminuria in older adults. The prevalence of albuminuria is greatest in older age,[30] and previous research demonstrated consistent risks across age associated with albuminuria. For example, in a 2023 meta-analysis of more than 27 million adults, even slightly elevated albuminuria was significantly associated with a range of adverse outcomes including all-cause mortality, cardiovascular mortality, and kidney failure, irrespective of age.[31] Despite these risks, ACR measurement is often overlooked in routine medical care.[32] Our results suggest that older adults constitute an at-risk population for albuminuria and, when considered with the availability of medications that reduce albuminuria-related risks, underlie the importance of ACR testing in this population.

Our study strengths include a large sample size of older adults with data collected at multiple timepoints over up to 8 years. To our knowledge, few general population studies measured multiple filtration markers longitudinally in an older population.

However, our study has several limitations. We estimate prevalence of CKD at each visit using a single measurement of the filtration marker to estimate GFR because laboratory tests were not repeated in the short-term. We do not have a direct measurement of GFR, so we are not able to define which biomarker was most accurately capturing GFR. Finally, the risk of death was high in this older population, and not all participants survived or attended subsequent follow-up visits, precluding assessment of the development of CKD progression in many participants. The ARIC study is a community-based sample which is not necessarily generalizable to those in long-term care settings, and our study population includes only White and African American participants.

This community-based research study of older adults showed large increases in the prevalence of CKD, both based on eGFR and based on albuminuria, with age. Moreover, the prevalence of CKD varied depending on the biomarker used to estimate GFR, with lowest prevalence using creatinine alone, highest prevalence using cystatin alone, and intermediate values when using a combination of creatinine and cystatin with or without B2M. Given recent studies suggesting that equations based on a combination of markers are most accurate,[4,23,33] our results provide additional evidence that cystatin C may be a useful adjunct test to creatinine. Increasing use of cystatin C in clinical practice may have profound implications on CKD diagnoses and eligibility for medications and guideline-directed therapy, particularly in older adults.

SUPPLEMENTARY MATERIALS

Supplementary File (PDF)

Table S1: Percent eGFR Reclassification Stratified by Visit.

Table S2: Missing Data.

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