Age and the Association of Kidney Disease Measures with Mortality and End-Stage Renal Disease: A Meta-Analysis of 2 Million Participants from 46 Cohorts (for the CKD-PC Collaborators)

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BACKGROUND: Chronic kidney disease (CKD) is prevalent in the elderly, but the risk implications of low estimated glomerular filtration rate (eGFR) and high albuminuria across the full age range are controversial.

METHODS: We investigated 2,051,244 participants from 46 cohorts. Hazard ratios (HRs) of mortality (112,325 deaths) and ESRD (8,411 events) according to eGFR and albuminuria were meta-analyzed across age categories of 18-54, 55-64, 65-74 and 75+ years. Attributable risks were calculated using HRs and weighted average incidence rates.

RESULTS: Mortality and ESRD risk increased progressively as eGFR decreased and albuminuria increased in every age category. In general/high-risk cohorts, adjusted HRs of mortality for reduced eGFR were lower at older age (e.g., at eGFR 45 [vs. 80] ml/min/1.73m², 3.50 [95% CI, 2.55-4.81] in 18-54 years, 2.21 [2.02-2.41] in 55-64 years, 1.59 [1.42-1.77] in 65-74 years, and 1.35 [1.23-1.48] in 75+ years); i.e. a substantial effect-modification by age (P-values for overall interaction <0.05 in every age category with 55-64 years as a referent). In contrast, attributable mortality risks were greater at older age (e.g., at eGFR 45, 2.8 extra deaths per 1,000 person-years in 18-54 years, 12.2 in 55-64 years, 26.6 in 65-74 years, and 74.9 in 75+ years). Similar patterns with mortality were observed for albuminuria. Relative and absolute ESRD risk were less influenced by age (P-values for interaction >0.1 for eGFR and albuminuria).

CONCLUSIONS: Low eGFR and high albuminuria are strongly associated with mortality and ESRD regardless of age.
Effect modification of age on adjusted HRs by eGFR
- on the line indicates $p<0.05$ vs. eGFR=80 in each age
group and $+$ on the bottom indicates $p<0.05$ for age-
interaction compared to age 55-64 years.