

# Kidney function and anemia as risk factors for coronary heart disease and mortality: the Atherosclerosis Risk in Communities (ARIC) Study



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**Background** Kidney failure causes anemia and is associated with a very high risk of coronary heart disease (CHD). Mildly to moderately decreased kidney function is far more common and also is associated with an elevated prevalence of anemia and CHD risk. Recent data suggest an even higher risk of CHD when both conditions are present.

**Methods** We investigated the association of kidney dysfunction and anemia with CHD events (fatal or nonfatal CHD or coronary revascularization procedures) and CHD and all-cause mortality over 12 years of follow-up in 14,971 adults aged 45 to 64 years in the ARIC Study. Glomerular filtration rate (GFR) was estimated from calibrated serum creatinine using the MDRD Study equation (<30 mL/min per 1.73 m<sup>2</sup> excluded, n = 32). Anemia was defined as hemoglobin level <13.5 g/dL in men (648/6746, 9.6%) and <12 g/dL in women (1049/8225, 12.8%).

**Results** The prevalence of anemia was progressively higher at lower estimated GFR <75 mL/min per 1.73 m<sup>2</sup> (both  $P < .001$ ) for both men and women. A total of 1635 (10.9%) participants had a CHD event, 360 (2.4%) died of CHD, and 1722 (11.5%) died of any cause during follow-up. After adjustment for known risk factors, including diabetes, lipid levels, blood pressure, and use of antihypertensive medication, decreased kidney function was associated with a higher risk of recurrent CHD events and mortality from CHD and all causes. These associations were significantly stronger among participants with anemia. The adjusted relative hazards of all-cause mortality associated with moderately decreased versus normal kidney function (GFR 30-59 vs  $\geq 90$  mL/min per 1.73 m<sup>2</sup>) were 1.7 (95% CI 1.3-2.2) in the absence of anemia and 3.5 (95% CI 2.4-5.1) in the presence of anemia ( $P$  interaction = .001).

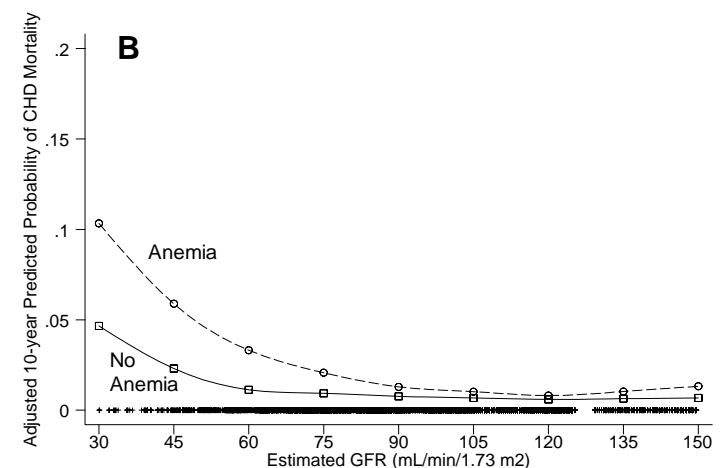
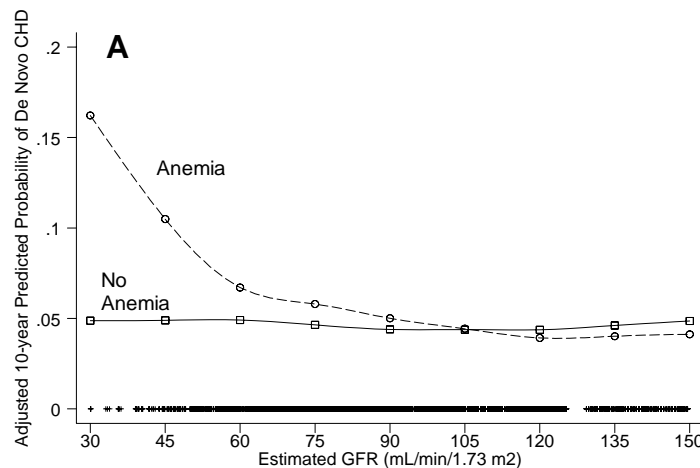
**Conclusions** The combination of moderately decreased kidney function and anemia is associated with an increased risk of CHD events and mortality, emphasizing the need to identify individuals with these conditions and evaluate interventions to treat anemia and slow the progression of chronic kidney disease. *Am Heart J* 2006 Feb; 151(2): 492-500



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Smoothed 10-year predicted probability of de novo CHD (A) and CHD mortality (B) among 14,971 ARIC Study participants, by anemia and estimated. Anemia defined as hemoglobin level <13.5 g/dL in men and <12 g/dL in women.