

Cardiometabolic-Renal Syndrome in CHARLS

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Abstract

Evidence from the China Health and Retirement Longitudinal Study (CHARLS) highlights the intertwined roles of kidney decline and cardiometabolic-renal syndrome in shaping health risks among middle-aged and older adults in China. Reduced kidney function, defined by an estimated glomerular filtration rate below 60 ml/min/1.73m², is strongly associated with higher risks of cancer, hearing loss, and falls, emphasizing chronic kidney disease as a systemic driver of poor health rather than a condition limited to renal outcomes. CHARLS findings identify multiple risk factors for chronic kidney disease, including frailty, sarcopenia, circadian syndrome, social isolation, adverse early-life health and unfavorable social determinants, particularly in men. Conversely, regular physical activity of over 300 minutes per week consistently reduces chronic kidney disease risk by approximately 40%, underscoring its protective role. Cardiometabolic-renal syndrome, which integrates cardiovascular, metabolic, and renal dysfunction, is highly prevalent, with baseline rates ranging from 6.3% to 46.3% depending on classification. Disease progression is substantial, with nearly 30% worsening over four years. Chronic kidney disease incidence is particularly elevated in individuals with cardiovascular disease and metabolic syndrome. Determinants of cardiometabolic-renal progression include metabolic dysfunction, cardiovascular comorbidities, systemic inflammation (e.g., high C-reactive protein), visceral obesity, advanced age, male sex, and depression. Once again, physical activity emerges as a protective factor. Population disparities are evident: men tend to experience greater deterioration, lower socioeconomic groups face higher disability risks, and regional variations influence disease prevalence and staging. Overall, CHARLS studies reveal overlapping biological and social pathways linking kidney decline and cardiometabolic-renal syndrome, involving inflammation, frailty, and socioeconomic disadvantage. Physical activity consistently mitigates these risks, highlighting the importance of targeted interventions, particularly for older men, disadvantaged populations, and individuals with metabolic or cardiovascular vulnerabilities.

Keywords: CHARLS, Chronic Kidney Disease, Cardiometabolic-renal syndrome, Obesity, Physical Activity

Abbreviations

CHARLS: China Health and Retirement Longitudinal Study;

CKD: Chronic Kidney Disease; **CKM:** Cardiometabolic-Renal Syndrome

1. Introduction

Evidence from the China Health and Retirement Longitudinal Study (CHARLS) highlights how declining kidney function and cardiometabolic-renal (CKM) syndrome jointly contribute to health risks among middle-aged and older Chinese adults. Together, these studies reveal both the burden of disease and the

multifactorial nature of risk and protection.

Kidney function and adverse outcomes: reduced kidney function, often defined as an estimated glomerular filtration rate (eGFR) below 60 ml/min/1.73m², is consistently linked to negative outcomes. CHARLS-based studies report higher risks of incident cancer (HR 2.08, 95% CI 1.22-3.53), hearing loss (OR 1.25, 95% CI 1.04-1.49), and falls (OR 1.35, 95% CI 1.07-1.70) among participants with low estimated glomerular filtration rate [1-3]. These findings underscore chronic kidney disease (CKD) not only as a renal condition but as a driver of broader health decline.

Risk and protective factors for CKD: across CHARLS analyses, risk factors include frailty (HR 1.71), sarcopenia (HR 1.45), circadian syndrome (OR 3.05), high social isolation (OR 1.80), adverse social determinants of health (HR up to 2.85 in men), and poor childhood health (adjusted OR 1.24) [4-9]. In contrast, higher physical activity-over 300 minutes per week-was protective, lowering CKD risk by roughly 40% [10].

Cardiometabolic-renal syndrome burden: complementary CHARLS studies show that CKM syndrome is widespread, with baseline prevalence ranging from 6.3% to 46.3% depending on staging approach [11-13]. One longitudinal study found a 27.2% deterioration rate over four years [12]. CKD incidence also differed by cardiometabolic phenotype: 12.7% in those with cardiovascular disease, 9.4% in those with metabolic syndrome, and 5.9% in healthy controls [14].

Determinants of CKM progression: major drivers include metabolic dysfunction (OR 1.54), cardiovascular phenotypes (OR 2.04), systemic inflammation such as elevated C-reactive protein (OR 1.55), and visceral obesity (OR 1.81) [12, 14, 15]. Demographic factors play a role as well: being aged 60 or older (OR 5.93), male (OR 2.89), and experiencing depression increase progression risk [12]. As in CKD research, physical activity appears protective [12].

Population disparities: prevalence and progression vary by sex, region, and socioeconomic status. Men tend to show greater disease deterioration, while lower socioeconomic groups face higher disability risk [13]. Regional differences also emerge, with certain CKM stages more common in distinct geographic areas [11].

Overall picture: together, these findings show that kidney decline and CKM syndrome share overlapping pathways-linking metabolic dysfunction, inflammation, clinical frailty, and social disadvantage-while physical activity consistently provide a protective buffer. CHARLS studies stress the urgency of targeted prevention and intervention strategies, especially for older men, socioeconomically disadvantaged groups, and individuals with metabolic or cardiovascular comorbidities.

Acknowledgment

None.

Conflicts of Interest

No conflict of interest.

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