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Cardiometabolic multimorbidity in relation to the metabolic score for insulin resistance and creatinine-to-cystatin C ratio in a middle-aged and aged population

Objective

With the aging population, cardiometabolic multimorbidity (CMM) has become a major public health concern, increasing disease burden and impairing quality of life. The metabolic score for insulin resistance (METS-IR) and creatinine-to-cystatin C (CCR) are promising biomarkers linked to metabolic dysfunction and muscle-renal status, respectively. However, their combined effects on cardiometabolic multimorbidity (CMM), especially in both community and hospitalized populations, remain unclear. This study aims to explore the associations of METS-IR, CCR, and $1/CCR \times METS-IR$ (MRII) with CMM using data from the China Health and Retirement Longitudinal Study (CHARLS) and clinical sources.

Research design and methods

This cross-sectional study included 10,811 participants from the 2014–2015 CHARLS follow-up and 437 elderly inpatients from the Second Affiliated Hospital of Chongqing Medical University. CMM was defined as the coexistence of two or more of heart disease, diabetes, and stroke. METS-IR and CCR were calculated using standard formulas.

Logistic regression analyses with multi-model adjustment, restricted cubic spline (RCS) curves, receiver operating characteristic (ROC) curves, and subgroup analyses were performed to assess associations, nonlinear relationships, predictive value, and effect modification.

Results

In both datasets, participants with CMM had higher METS-IR, older age, and higher prevalence of metabolic risk factors. METS-IR was independently and dose-dependently associated with increased CMM risk. CCR showed context-dependent associations, with inverse links in partially adjusted CHARLS models but no significance in clinical data. The “Low CCR and High METS-IR” combination and highest quartile of MRII were consistently linked to elevated CMM risk. METS-IR had moderate predictive value (AUC = 0.712 in CHARLS, 0.618 in clinical data), outperforming CCR. RCS curves revealed linear associations for METS-IR and U-shaped patterns for CCR in CHARLS. Subgroup analyses showed heterogeneity by age, comorbidities, and hypertension.

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Conclusion

METS-IR is a robust independent predictor of CMM in both community and hospitalized populations, while CCR's role is context-dependent. The MRII enhances CMM risk stratification, highlighting the value of concurrent assessment of metabolic and muscle-renal status for CMM prevention and personalized risk management.