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Identifying Key Predictors of Cardiovascular Outcomes in CKD Patients

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Objectives : Cardiovascular (CV) disease remains the leading cause of mortality in patients with chronic kidney disease (CKD). Growing recognition of the cardio-renal-metabolic axis highlights how metabolic derangements in accelerate CV risk in this population. We aimed to develop a CV event prediction model incorporating metabolic, anthropometric, and CKD-specific variables.

Methods : We included 1,434 nondialysis patients with CKD stages 2–5 from a nationwide prospective cohort in Korea. CV events were defined as fatal or non-fatal events, including acute myocardial infarction (MI), hospitalization for unstable angina or heart failure, coronary revascularization, stroke, coronary artery disease (CAD), peripheral artery disease, and symptomatic arrhythmia. Candidate variables were selected using Cox multivariable and restricted cubic spline analyses. Pooled logistic regression with recursive feature elimination (RFE) was applied for variable selection based on the training area under the receiver operating characteristic curve (AUC). Using 5-fold cross-validation, variables selected in ≥ 3 folds under the 1-standard error rule were retained. Model performance was evaluated using time-dependent ROC curves, mean AUC, C-index, and Brier score.

Results : During a median follow-up of 9.95 (Interquartile range [IQR]: 7.95–11.3) months, 203 patients (14.2%) CV events occurred. Patients with CV events were older and had a higher prevalence of comorbidities including CAD, DM, and arrhythmia (all $p < 0.05$). Waist-to-hip ratio (WHR) was significantly higher in the CV event group, while body mass index (BMI) did not differ. Through 5-fold cross-validation with RFE, 21 variables were retained as final predictors, including age,



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education, DM, uric acid, and lipid-lowering agents. The final model demonstrated a C-index of 0.750, mean AUC of 0.781, and a Brier score of 0.215.

Conclusions : Our pooled logistic regression model incorporating 21 predictors demonstrated good discrimination (C-index: 0.750, mean AUC: 0.781) for predicting CV events in nondialysis CKD patients. This model may facilitate early identification of high-risk patients for targeted CV risk management.