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Diabetes-Dependent Association Between METS-VF and Chronic Kidney Disease: Findings from a Longitudinal Cohort Study

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Objectives : Metabolic dysfunction is a significant risk factor for chronic kidney disease (CKD). The visceral fat-based metabolic score (METS-VF) has been proposed as a novel marker for cardiometabolic health, but its association with CKD development remains unclear. Additionally, diabetes status plays a crucial role in CKD risk, and the relationship between METS-VF and CKD may differ depending on glucose metabolism. This study aimed to investigate the longitudinal relationship between METS-VF and CKD incidence and to determine whether this association varies according to diabetes status (normoglycemia, prediabetes, and diabetes).
Methods : We analyzed data from 8,092 participants in the Korean Genome and Epidemiology Study (KoGES-Ansung). Participants with CKD at baseline, those with missing covariates, or those who did not undergo follow-up were excluded. METS-VF quartiles were calculated, and hazard ratios (HRs) for CKD development were estimated using Cox proportional hazards models adjusted for age, sex, smoking, alcohol consumption, physical activity, hypertension, dyslipidemia, and inflammatory markers such as CRP. Subgroup analyses were conducted based on diabetes status.
Results : During the follow-up period, 2,202 participants developed CKD. Higher METS-VF quartiles were significantly associated with an increased risk of CKD in the unadjusted model (HR for Q4 vs. Q1: 2.941, 95% CI: 2.591–3.339, $p<0.001$). After adjusting for confounders, the association remained significant (adjusted HR for Q4 vs. Q1: 1.223, 95% CI: 1.061–1.409, $p=0.005$). Subgroup analysis indicated that the association was more pronounced in individuals with normoglycemia and prediabetes, but not in those with diabetes.
Conclusions : Higher METS-VF is associated with an increased risk of CKD development, particularly in individuals without diabetes. These findings suggest that METS-VF may be a useful predictor of CKD risk and emphasize the need for early metabolic intervention to prevent CKD progression, especially in individuals with normal glucose metabolism or prediabetes.

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Table 1. Baseline characteristics of the population with or without CKD at the baseline survey

Variable	Total	Not development CKD	Development CKD	P-value
N	8,092	5,890	2,202	
Age (years)	51.83 ± 8.75	49.92 ± 8.09	56.93 ± 8.40	<0.001
Gender				<0.001
Men	3,873 (47.9%)	2,946 (50.0%)	927 (42.1%)	
Women	4,219 (52.1%)	2,944 (50.0%)	1,275 (57.9%)	
Body mass index (kg/m²)	24.58 ± 3.14	24.45 ± 3.10	24.91 ± 3.23	<0.001
Waist circumference (cm)	82.53 ± 8.76	81.83 ± 8.64	84.42 ± 8.79	<0.001
SBP (mmHg)	120.91 ± 18.22	118.82 ± 17.20	126.51 ± 19.65	<0.001
DBP (mmHg)	80.15 ± 11.41	79.26 ± 11.20	82.54 ± 11.61	<0.001
FPG (mg/dL)	86.86 ± 20.16	86.03 ± 18.12	89.07 ± 24.67	<0.001
Total cholesterol (mg/dL)	191.27 ± 34.91	189.92 ± 34.54	194.90 ± 35.61	<0.001
Triglyceride (mg/dL)	159.92 ± 101.53	154.56 ± 96.95	174.26 ± 111.62	<0.001
HDL-cholesterol (mg/dL)	44.74 ± 10.01	45.10 ± 10.07	43.77 ± 9.80	<0.001
Non-HDL cholesterol	146.53 ± 34.23	144.82 ± 33.86	151.13 ± 34.79	<0.001
CRP	0.22 ± 0.41	0.21 ± 0.40	0.25 ± 0.43	<0.001
eGFR (CKD-EPI)	92.90 ± 13.11	95.36 ± 12.38	86.32 ± 12.74	<0.001
HOMA-IR	1.65 ± 1.15	1.60 ± 1.05	1.80 ± 1.37	<0.001
Smoking status†				<0.001
Never smoker	4,772 (59.0%)	3,390 (57.6%)	1,382 (62.8%)	
Former smoker	1,269 (15.7%)	935 (15.9%)	334 (15.2%)	
Someday smoker	240 (3.0%)	179 (3.0%)	61 (2.8%)	
Everyday smoker	1,811 (22.4%)	1,386 (23.5%)	425 (19.3%)	
Alcohol drinking				<0.001
Non-drinker	3,696 (45.7%)	2,533 (43.0%)	1,163 (52.8%)	
Former drinker	502 (6.2%)	347 (5.9%)	155 (7.0%)	
Current drinker	3,894 (48.1%)	3,010 (51.1%)	884 (40.1%)	
METs (hour/day)	24.07 ± 14.85	23.85 ± 14.73	24.66 ± 15.15	<0.001
Diabetes mellitus	927 (11.5%)	544 (9.2%)	383 (17.4%)	<0.001
Hypertension	2,499 (30.9%)	1,546 (26.2%)	953 (43.3%)	<0.001
Dyslipidemia	3,708 (45.8%)	2,583 (43.9%)	1,125 (51.1%)	<0.001

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