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Visceral Fat increased the Risk of Progression to Chronic Kidney Disease in Non-Obese Korean Adults.

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Objectives: Increase in visceral abdominal adipose tissue is highly related to the subsequent development of chronic kidney disease. We conducted a longitudinal health examination follow-up cohort study to evaluate the impact of visceral abdominal adipose tissue (VAT) and subcutaneous abdominal adipose tissue (SAT) measured by computed tomography(CT) on the risk of CKD development according to BMI, and the impact of central obesity measured by VAT according to BMI status.

Methods: The study included 11,050 adults who underwent abdominal CT as part of a health check-up and re-evaluated the follow-up medical examination at a university-affiliated healthcare center. Levels of VAT and SAT were divided into quartiles, and the highest quartile for VAT was set as the cut-off for central obesity. Impact of abdominal adipose tissue and central obesity on CKD development was analyzed separately in the non-obese group (BMI<25) and obese group (BMI≥25).

Results: During the mean of 5.6 follow-up years, 104 incident CKD cases were identified. In multivariable Cox analysis, hazard ratio for CKD progression was significantly increased in 3rd and 4th quartile ranges of VAT (HR 4.84 [1.57-14.98] and 8.49 [2.68-26.93], respectively). In the analysis stratified by BMI, the risk for CKD was increased in the highest quartile range of VAT compared to the lowest in the normal weight group: 7.20 (1.56-33.17). However, there was no significant relationship between VAT and CKD development in the obese group. Compared to normal weight and no central obesity, the HR for CKD was 2.71(1.48-4.96) for normal weight and central obesity and 2.94(1.34-6.46) for obesity and central obesity.

Conclusions: Visceral adipose tissue measured by CT proved to be a significant risk factor for subsequent CKD only in the normal-weight group. Normal-weight central obesity had an excessive risk of CKD compared to normal-weight without central obesity, even similar to the risk of obesity and central obesity.

Table 3. The risk of CKD in relation to VAT according to BMI

Table 3. The risk of chronic kidney disease in relation to the visceral adipose tissue area according to body mass index.

	Univariable			Multivariable Model 1			Multivariable Model 2		
	N	HR (95% CI)	P-value	N	HR (95% CI)	P-value	N	HR (95% CI)	P-value
BMI < 25									
Visceral abdominal fat area (cm²)			<0.001			0.096			0.015
Q1, reference	1873	1		1873	1		1872	1	
Q2	1874	2.53 (0.65-9.77)	0.179	1874	2.28 (0.54-9.74)	0.264	1866	2.44 (0.55-10.78)	0.24
Q3	1874	3.32 (0.91-12.05)	0.069	1874	2.31 (0.55-9.73)	0.254	1873	2.98 (0.67-13.35)	0.153
Q4	1874	11.01 (3.37-35.95)	<0.001	1874	4.71 (1.08-20.46)	0.039	1873	7.20 (1.56-33.17)	0.011
BMI ≥ 25									
Visceral abdominal fat area (cm²)	0.065		0.079			0.249			0.128
Q1, reference	888	1		888	1		887	1	
Q2	889	1.75 (0.68-4.53)	0.246	889	1.16 (0.44-3.03)	0.765	887	1.21 (0.45-3.26)	0.709
Q3	889	2.71 (1.13-6.48)	0.026	889	2.17 (0.89-5.28)	0.089	884	2.63 (1.03-6.72)	0.043
Q4	889	2.88 (1.18-7.02)	0.02	889	1.61 (0.62-4.17)	0.325	888	2.06 (0.78-5.42)	0.145

N, number of participants; HR, hazard ratio; CI, confidence interval

Q1~Q4, quartile group of each visceral adipose tissue area

Multivariable Model 1 was adjusted for age, sex, diabetes mellitus, hypertension, body mass index, and baseline eGFR

Multivariable Model 2 was adjusted for covariates in model 1 and alcohol consumption, regular exercise, and smoking

Hazard ratio for CKD based of obesity categorization by BMI and Visceral adipose tissue

Table 4. Hazard ratio for chronic kidney disease based of obesity categorization by body mass index and visceral adipose tissue.

	Central obesity =VAT above 75%	HR (95% CI), P-value		P-value
		BMI < 25	BMI ≥ 25	
Unadjusted model	No central obesity	1 (reference)	2.1 (1.16-3.79), 0.014	<0.001
	central obesity	5.34 (3.07-9.30), <0.001	4.23 (2.61-6.86), <0.001	
Adjusted model 1	No central obesity	1 (reference)	2.02 (0.92-4.44), 0.08	0.013
	central obesity	2.31 (1.27-4.20), 0.006	3.05 (1.41-6.57), 0.005	
Adjusted model 2	No central obesity	1 (reference)	1.66 (0.73-3.76), 0.224	0.004
	central obesity	2.71 (1.48-4.96), 0.001	2.94 (1.34-6.46), 0.007	

BMI, body mass index; VAT, visceraladipose tissue

Central obesity was defined as the visceral adipose tissue above 75 percentiles (154.3 cm²).

Model 1 was adjusted for age, sex, diabetes mellitus, hypertension, body mass index, and baseline eGFR

Model 2 was adjusted for covariates in model 1 and alcohol consumption, regular exercise, and smoking