Abdominal Obesity Is More Closely Associated With Diabetic Kidney Disease Than General Obesity

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Jinbo Hu, Shumin Yang, Aipin Zhang, Ping Yang, Xueting Cao, Xiyue Li, Richa Goswami, Yue Wang, Ting Luo, Kun Liao, Qingfeng Cheng, Xiaoqiu Xiao, and Qifu Li

General and abdominal obesity are the major subtypes of obesity. Compared with general obesity, abdominal obesity was considered to be more closely associated with chronic diabetes complications, such as cardiovascular diseases and diabetic retinopathy (1,2). Although the association between abdominal obesity and urinary albumin was reported in previous studies (3–5), whether abdominal obesity is more closely associated with diabetic kidney disease (DKD) than general obesity has not been reported yet.

Two studies were carried out to investigate the association of general and abdominal obesity with DKD. Study A was a cross-sectional study. Body composition was assessed using DXA among 1,016 patients with type 2 diabetes (T2D). General obesity parameters, including BMI, total body fat percentage (TBF), and fat mass index (FMI), and abdominal obesity parameters, including waist circumference (WC), waist-to-height ratio (WHtR), and visceral adipose tissue (VAT), were measured. DKD is defined as chronic kidney disease (CKD) stage 3–5 (estimated glomerular filtration rate [eGFR] $<$60 mL/min/1.73 m^2). Study B was a 5-year prospective study in which 279 T2D patients without DKD at baseline were followed up. BMI, WC, and WHtR were used as indicators of obesity in study B. Obesity-related parameters were split into tertiles and subjects were stratified into those with low, median, and high values accordingly.

In study A, there were 470, 374, and 172 patients in CKD stage 1, stage 2, and stage 3–5, respectively. Participants with higher values of BMI, TBF, FMI, WC, WHtR, and VAT were more likely to have a lower eGFR, as compared with those with lower values. Logistic regression analyses showed that parameters of general obesity (BMI, TBF, or FMI) were associated with risk of DKD; however, the correlation disappeared when VAT was adjusted. Compared with subjects with low values of WC, WHtR, or VAT, those with median and high values had increased risk of DKD after adjusting BMI (low values were the references, odds ratio [OR] 0.92 [95% CI 0.57, 1.48] for median values, 1.56[1.11, 2.77] for high values, *P* for trend = 0.044 for WC; 1.40 [0.86, 2.27], 2.61 [1.47, 4.63], *P* for trend = 0.003 for WHtR; 1.53 [0.95, 2.46], 2.84 [1.66, 4.84], *P* for trend $<$0.001 for VAT). The associations between the risk of DKD and WC, WHtR, or VAT remained the same after multivariate adjustment (Fig. 1). In study B, 41 subjects had eGFR $\leq$60 mL/min/1.73 m^2 after 6 years of follow-up. No relationship of BMI and risk of DKD was found in crude, WHtR-adjusted, or multivariate-adjusted models. Abdominal obesity parameters were significantly associated with risk of DKD after adjustment for BMI (low values were the references, OR 1.91 [95% CI 0.73, 5.03] for median values, 3.26 [1.16, 9.12] for high values, *P* for trend = 0.025 for WC; 1.72 [0.66, 4.45], 2.85 [1.14, 7.10], *P* for trend = 0.025 for WHR; 3.11 [1.08, 8.98], 5.85 [1.89, 12.17], *P* for trend = 0.009 for WHtR). The associations between the risk of DKD and WC, WHR, or WHtR remained the same when other confounders were adjusted.

Our studies indicate that abdominal obesity is more closely associated with DKD than general obesity. Of note, the relationships between abdominal obesity and DKD were independent of BMI and other known risk factors such as age, duration of diabetes, blood pressure, blood glucose, and medication use. BMI, a widely used parameter of general obesity, was not significantly associated with the risk of DKD after adjusting for abdominal obesity parameters such as VAT or WHtR. The current study expands the current body of knowledge on the association of obesity with DKD and highlights abdominal obesity as a more important risk factor for DKD in T2D patients than general obesity.

First Affiliated Hospital of Chongqing Medical University, Chongqing, China

Corresponding author: Qifu Li, liqifu@yeah.net.

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J.H. and S.Y. are co-first authors.

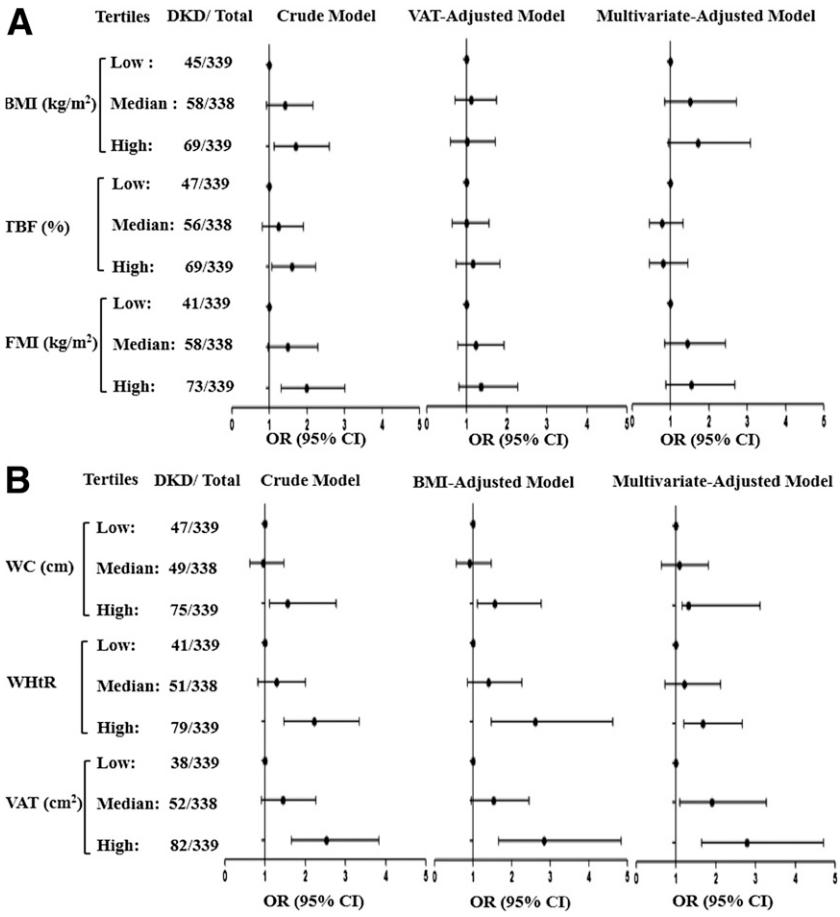

Figure 1—Univariate (crude model) and multivariate analyses (VAT-, BMI-, and multivariate-adjusted models) of general obesity (*A*) and abdominal obesity (*B*) for logistic regression of DKD risk in the cross-sectional study (study A). VAT adjusted: the model that adjusted VAT for general obesity parameters. BMI adjusted: the model that adjusted BMI for abdominal obesity parameters. Multivariate adjusted: the model that adjusted age, history of hypertension, duration of diabetes, smokers, hemoglobin, and medication use (including metformin, sulfonylureas, α-glucosidase inhibitor, insulin, angiotensin-converting enzyme inhibitor/angiotensin receptor blocker, calcium channel blocker, diuretic, β-blocker, statins, and aspirin).

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References

1. Balkau B, Deanfield JE, Després JP, et al. International Day for the Evaluation of Abdominal Obesity (IDEA): a study of waist circumference, cardiovascular disease, and diabetes mellitus in 168,000 primary care patients in 63 countries. Circulation 2007; 116:1942–1951

2. Man RE, Sabanayagam C, Chiang PP, et al. Differential association of generalized and abdominal obesity with diabetic retinopathy in Asian patients with type 2 diabetes. JAMA Ophthalmol 2016;134:251–257

3. Blaslov K, Bulum T, Duvnjak L. Waist-to-height ratio is independently associated with chronic kidney disease in overweight type 2 diabetic patients. Endocr Res 2015;40: 194–198

4. Tseng CH. Waist-to-height ratio is independently and better associated with urinary albumin excretion rate than waist circumference or waist-to-hip ratio in chinese adult type 2 diabetic women but not men. Diabetes Care 2005;28:2249–2251

5. de Boer IH, Sibley SD, Kestenbaum B, et al.; Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications Study Research Group. Central obesity, incident microalbuminuria, and change in creatinine clearance in the epidemiology of diabetes interventions and complications study. J Am Soc Nephrol 2007; 18:235–243