The Relationship Between Nephrolithiasis Risk with Body Fat Measured by Body Composition Analyzer in Obese People

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ABSTRACT

Background: Nephrolithiasis (kidney stones) continues to be a major cause of morbidity and healthcare spending that visceral and subcutaneous adipose tissue may associate with kidney stone formation. This study aimed to investigate the relationship between nephrolithiasis with visceral fat scale in obese people in Western Iran for the first time. **Materials and Methods**: In 2017, 103 participants with BMI≥30 kg/m^2 were selected for the present study. The participants were divided into two groups, 52 as case group (having the kidney stone) and 58 as healthy control group (no kidney stone or history of the kidney stone or any other disease). The levels of body composition were checked by body composition analyzer (BoCA x1) based on Bio Impedance mechanism. **Results**: Two groups were matched in terms of sex and BMI. There was a significant difference between two groups for the visceral fat to subcutaneous fat ratio (VSR) that accordingly, the mean VSR in the case group was higher than the control group. The difference for other variables between two groups was not significant. **Conclusions**: The results showed that visceral and subcutaneous fat and VSR were important risk factors for kidney stone formation (nephrolithiasis). Evaluating these fats in stone formers may facilitate a tailored metabolic evaluation and treatment plan.

Keywords: Kidney stone, visceral fat, VSR, obesity.

1. INTRODUCTION

Obesity (body mass index (BMI) of >30 kg/m^2) has reached an epidemic stage and represents a challenge for health authorities across the globe (1, 2). Obesity has become an epidemic condition around the world, and affects 10-27% of men and up to 38% of women in European countries (3, 4). Epidemiological studies suggest that a greater BMI (5, 6), greater body weight (5-7), larger waist circumference and major weight gain are independently associated with a greater risk of renal stone formation (5). Recent reports suggested that kidney stone disease carries a risk of myocardial infarction, the progression of chronic kidney disease (CKD), and diabetes (2). Along with an increase in obesity, we have also experienced an increase in the incidence of associated urolithiasis (5). The following factors are considered in urolithiasis: age, gender, heredity, body composition, geographic localization, climate, diet, fluid intake, and use of drugs (8). Nephrolithiasis continues to be a major cause of morbidity and healthcare spending (5). It has been recognized that abdominal adipose tissue is distributed into two main compartments with different anatomical and functional features: visceral abdominal adipose tissue and subcutaneous abdominal adipose tissue (9). Visceral and subcutaneous adipose tissue may confer differential metabolic risk profiles (10) and associate with kidney stones (7). Herein, the aim of this study was investigation of the relationship between nephrolithiasis with visceral fat scale in obese people in Western Iran for the first time.

2. MATERIALS AND METHODS

In 2017 and a case-control study that approved by the Ethics Committee of Kermanshah University of Medical Sciences, Kermanshah, Iran, out of participants referred to Mahdieh Clinic, Kermanshah, Iran, 103 participants were selected based on criteria. Inclusion criteria: the participants with BMI≥30 kg/m^2; the participants didn't have kidney diseases and other diseases (cancer, cardiovascular disease, hyperparathyroidism, hyperthyroidism, liver

Figure 1. Body composition analyzer

diseases, cystinuria, and diabetes), except for kidney stone and in the control group didn't have kidney diseases. The participants were divided into two groups, 52 as case group (having the kidney stone) and 58 as the healthy control group (no kidney stone or history of the kidney stone or any other disease). The diagnosis of kidney stone was based on the radiology report. All participants for measurement of visceral fat and other body composition were checked by body composition analyzer version 1.4.3.17 (Medigate Inc., BoCA x1, USA) (Figure 1). This device works based on Bio Impedance mechanism (transmitted wave resistance through the tissue) and based on Bio Impedance has the ability to detect the type of tissue in the total body. Patients were analyzed for age, gender, BMI, the amount of visceral and subcutaneous adipose tissue and other body composition. The data were analyzed with IBM SPSS version 22 (IBM Corp., *Armonk, NY*, USA) that T-test was used for the comparison of means and Chi-square test for the comparison of sex between two groups.

3. RESULTS

The demographic characteristics of participants in two groups have been shown in Table 1. Two groups were matched in terms of sex and BMI (P>0.05), but age was different in two groups (P=0.023).

Table 2 shows the comparison of body composition between two groups. There was a significant difference between two groups for the visceral fat to subcutaneous fat ratio (VSR) (P=0.012). Accordingly, the mean VSR in the case group was higher than the control group. The difference for other variables between two groups was not significant (P>0.05).

3. DISCUSSION

This study evaluated body composition in obese participants that the results showed that the mean VSR in the kidney stone or case group was higher than the healthy control group.

Obesity, diet, lifestyle factors and diabetes associate strongly with a history of kidney stones. (11) Sorensen et al. (12) reported that higher BMI and higher caloric intake was associated with increased risk of incident stones, but physical activity may reduce the risk of incident kidney stones in postmenopausal women independent of caloric intake and BMI. Two studies (13, 14) showed that greater BMI was associated with higher urinary oxalate excretion among females but not among males in two studies, whereas one report noted a correlation between body weight and urinary oxalate in males but not in females (15). Pigna et al. (16) suggested that total body fat and trunk fat are more strongly associated with risk factors for uric acid stone formation than are total body weight and lean body mass. Under a controlled metabolic diet, adiposity is not associated with risk factors for calcium oxalate stones. Tiwari et al. (17) reported that decreased urinary pH and increased relative saturation ratio of calcium oxalate are associated with risk factors for metabolic syndrome in obese adolescents. The metabolic syndrome is associated with a urinary acidification defect leading to the formation of uric acid kidney stones (18). Visceral adipose tissue is considered as an important and independent predictor of risk for metabolic syndrome (19) that a review study (20) showed that there is a link between uric acid nephrolithiasis with the metabolic syndrome. Triglycerides and insulin resistance appear to be associated with visceral and subcutaneous fat depots at even lower thresholds of abdominal adiposity (20-22). Obesity constitutes a strong risk factor for the development of CKD and nephrolithiasis as it relates to obesity (23). Recent studies confirmed that in addition to risk associated with diabetes; increased BMI is independently linked to increased risk for various kidney disorders, prominently CKD, but also renal cell carcinoma and nephrolithiasis (24).

Variables	Case (n=52)	Control (n=58)	P-value
Age, years			
Mean±SD	43.1±12.2	38.1±10.7	0.023
Range	20-71	18-63	
Sex, n(%)			0.208
Male	17(29.3)	20(38.5)	
Female	41(70.7)	32(61.5)	
BMI, kg/m2			
Mean±SD	35.4±4.2	35.1±4.0	0.710
Range	30-45	30-49	

Table 1. The comparison of demographic characteristics of participants in two groups. Abbreviations: BMI, body mass index; SD, standard deviation.

Variables	Case (n=52)	Control (n=58)	P-value
TBW, %			
Mean	41.8±8.6	39.6±7.4	0.154
Range	25-65	28-56	
Protein, %			
Mean	13.3±3.5	12.1±3.6	0.065
Range	6.4-20.1	7.3-20.3	
Mineral, %			
Mean	3.68±0.88	3.71±0.68	0.829
Range	2.5-5.6	2.3-5.5	
Fat mass, kg			
Mean	37.6±8.2	37.6±6.6	0.961
Range	24.2-60.3	23.5-59.5	
Muscle mass, kg			
Mean	55.2±11.6	51.7±10.6	0.105
Range	31.8-83.4	36.8±76.4	
Body fat, %			
Mean	39.1±5.9	40.6±5.4	0.178
Range	26.4-49.3	25.5±49.9	
Truncal fat mass, kg			
Mean	25.8±5.8	25.3±4.6	0.624
Range	17.2-42.8	17.3±39.9	
Limb fat mass, kg			
Mean	11.79±2.74	12.27±2.36	0.324
Range	6.3-18.7	6.3-20.6	
Abdominal fat, cm2			
Mean	0.98±0.04	0.97±0.03	0.296
Range	0.92-1.07	0.89-1.07	
Subcutaneous fat area, cm2			
Mean	320.1±80.1	325.1±68.0	0.761
Range	190.6-522.7	180.9-560.2	
Visceral fat area, cm2			
Mean	145.7±36.7	137.6±33.2	0.227
Range	85.7-256.3	63.5-230.1	
Abdominal fat area, cm2			
Mean	465.9±112.4	461.7±96.9	0.833
Range	284.4-779.1	244.4-790.3	
VSR			
Mean	0.458±0.074	0.423±0.069	0.012
Range	0.31-0.64	0.28-0.61	
BMR			
Mean	1800±327.9	1767.6±285.9	0.581
Range	1238.8-2702.8	1395.2-2464.0	

Table 2. The comparison of body composition between two groups. Abbreviations: TBW, total body water; VSR, the visceral fat to subcutaneous fat ratio; BMR, basal metabolic rate.

Low urinary pH abnormally is the major determinant in the increasing idiopathic uric acid stones (20). Elevated visceral fat is associated with increased probability of uric acid stone composition (6, 25) and has better predictive value than BMI or urinary pH to classify the types of stone (6). There is also an evidence to suggest that higher adiposity, especially subcutaneous (non-visceral) fat, may also be associated with better outcomes in the end-stage renal disease patients (26). A case-control study with sex- and age-matched between two groups that measurements for the stone and control groups for BMI were 29.1 and 27.6 kg/m^2 (2), indicated that VSR, in addition to obesity, hyperlipidemia, and hypertension were emerging factors in the formation of kidney stones. As a marker of visceral obesity, visceral fat area contributes to the risk of metabolic syndrome and urolithiasis. Uric acid stone formers showed a significantly higher hypertension rate and the mean visceral fat area, which were independent risk factors for uric acid urolithiasis (27). There is even a novel association between an elevated percent visceral adipose tissue and stone recurrence (28). Visceral tissue area was significantly larger in patients with kidney stones compared to those in controls (7).

4. CONCLUSIONS

The results showed that visceral and subcutaneous fat and VSR were important risk factors for kidney stone formation (nephrolithiasis). Evaluating these fats in stone formers may facilitate a tailored metabolic evaluation and treatment plan. Therefore, understanding and quantifying the effects of different fat compartments are probably important to understanding the metabolism of nephrolithiasis. Future studies with a larger number of patients are needed to confirm these results.

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