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The relationship between microalbuminuria, overweight and obesity

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ABSTRACT

Introduction: Diabetes, hypertension and obesity are associated with endothelial dysfunction. The first sign of endothelial dysfunction is microalbuminuria.

Objectives: The aim of this study was to measure urine albumin to creatinine ratio in obese patients without diabetes and with normal blood pressure.

Patients and Methods: In this cross-sectional study, 200 adults were chosen with body mass index (BMI) ≥25 kg/m^2. Anthropometry measurements [BMI and waist to hip ratio (WHR)] and biochemical tests were performed. Data were analyzed using chi-square test, analysis of variance (ANOVA), and Pearson's correlation coefficient.

Results: Among 200 obese people, microalbuminuria was seen in 22 individuals (11%). The prevalence of microalbuminuria was positively increased with increasing of BMI (P=0.04). Moreover, microalbuminuria was significantly higher in people with WHR >1 (P=0.02).

Conclusion: Through this study, we detected the association of microalbuminuria with BMI and WHR. Therefore, efforts must be conducted to reduce obesity through lifestyle changes and regular exercise.

Implication for health policy/practice/research/medical education:
In a cross-sectional study, on 200 adults with body mass index ≥ 25 kg/m^2, microalbuminuria in 11% of individuals was seen.

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Introduction

Advances in medical sciences as well as economic and urbanization improvement have increased longevity and quality of life. However, these improvements lead to increased exposure to risk factors for chronic diseases, including unhealthy diet and decreased physical activity (1). Iran is in the trend of nutritional and epidemiological changes, since there is still the problem of undernutrition, overweight and obesity is increasing (2,3). Obesity especially abdominal obesity measured by waist circumference is associated with chronic micro-inflammation. It is detected by cytokine production and an increase in acute phase reactant. Several inflammatory mediators that are released from adipose tissue have an important role in endothelial dysfunction and can lead to excretion of albumin in the urine (4,5). One of the basic indicators of nephropathy is microalbuminuria detected by the presence of small amounts of albumin in the urine (between 30–300 mg/24 h). It shows abnormally increased permeability for albumin in renal glomerular structure indicated morphological and structural changes. Micro-albuminuria is not only a sign of increased risk of kidney disease however it is also a sign of cardiovascular disease risk in patients with diabetes and high blood pressure (6-10)

Most studies have focused on body mass index (BMI) for identification of obesity, but some studies suggested waist as an appropriate indicator to predict kidney disease (11,12). However further research is essential to evaluate the relationship between obesity and albuminuria

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especially in non-diabetics without high blood pressure to prevent more serious diseases by screening obese patients for microalbuminuria.

Objectives

The aim of this study was to evaluate the prevalence of microalbuminuria in obese and overweight by BMI and waist to hip ratio (WHR) indices.

Patients and Methods

Study protocol

In this descriptive cross-sectional study, 200 volunteers aged 18-60 years with BMI ≥25 kg/m^2 were recruited. The participants referred to obesity clinic of Shahid Sadoughi hospital from March to October 2012. Those with a history of diabetes mellitus, hypertension, heart and kidney diseases, stroke, urinary tract infection, hypothyroidism, smoking, and pregnancy were excluded from the study. All qualified individuals were enrolled in the study. They were given a form to fill out their personal information. Then, BMI and WHR were measured for each person. BMI was calculated by ratio of weight (kg) to square of one's height (m). Participants with a BMI between 25-29.9 kg/m^2 were considered overweight and those with a BMI >30 kg/m^2 were considered obese. WHR was calculated by ratio of waist circumference (cm) (at the navel) to hip circumference (cm) (in the most prominent part of the pelvis) (13). Blood pressure was measured by mercury manometer and participants with blood pressure >140/90 mm Hg were excluded.

Biochemical tests such as urine albumin, creatinine, blood glucose, glucose tolerance test, blood lipids, and urinary leukocytes were administered in a central laboratory. Measurement of urine micro-albumin was conducted using binding site kit with immunofluorometric method.

Serum glucose was measured by glucose oxidase kit (Pars Azmoon, Iran) and serum creatinine was evaluated by automated enzymatic assay. Serum cholesterol (Chol) and serum triglyceride (TG) were measured by GPO-PAP method (Pars Azmoon kit).

Using modification of diet in renal disease (MDRD) formula, participants who had glomerular filtration rate (GFR) <60 mL/min/1.73 m^2 were excluded from the study. Heart disease was confined by patient's previous history. Those who had active urinalysis indicative of urinary tract infection, fasting blood sugar ≥110 mg/dL, and glucose tolerance test ≥140 mg/dL, TG ≥200 mg/dL, cholesterol ≥250 mg/dL, and LDL-C ≥130 mg/dL were excluded from the study. Albuminuria was obtained by ratio of albumin to creatinine. Microalbuminuria was defined as at least two times urinary albumin creatinine ratio between 30-300 mg/d (14).

Ethical issues

Human rights were respected in accordance with the Helsinki Declaration 1975, as revised in 1983. The ethical committee of Shahid Sadoughi University of Medical Sciences (Ethical Code; IR.ssu.FMD.REC.1396.14) approved the study. Informed consent was taken from the participants. This study was derived from the M.D, thesis of Fatemeh Yosefi at this university.

Statistical analysis

Statistical analysis was performed using SPSS (version 16). The obtained data were analyzed using chi-square, ANOVA, and Pearson's correlation coefficient tests. The *P* value less than 0.05 was considered significant.

Results

Out of 200 participants, 47 (23.5%) were male and 153 (76.5%) were female. The mean age of men was 33.8 ± 10.8 years and of women was 34 ± 9.3 years old. Moreover, 68% were obese (BMI above 30 kg/m^2) and 32% were overweight (29.9> BMI ≥25 kg/m^2). In this study, the prevalence of microalbuminuria was 11% (n = 22) while the prevalence of micro-albuminuria was significantly higher in men than women (P = 0.01; Table 1). Moreover, the prevalence of microalbuminuria was not significant across different age groups (18-29, 30-39, 40-49, 50-60, 60> years) (P = 0.80). Distribution of microalbuminuria in different BMI groups was summarized in Figure1. As shown in Figure 1, the prevalence of microalbuminuria increased with increasing BMI (P = 0.04). Distribution of micro-albuminuria in different WHR groups was also summarized in Figure 2. Based on this figure, the highest prevalence of microalbuminuria was 37.5% in patients with WHR>1.

Discussion

The results of this study showed high prevalence of microalbuminuria in obese people. Moreover, a significant association was found between BMI and microalbuminuria. Furthermore, a significant association was seen between WHR and microalbuminuria.

It is noteworthy to mention that the role of obesity in increasing microalbuminuria was very impressive in groups with higher BMI and WHR, since microalbuminuria was seen in 25% of the group with BMI >40 kg/m^2 and was

Table 1. The frequency of microalbuminuria based on gender

Index	Sex, No. (%)		Total, No. (%)
	Female	Male	
Albumiuria <30 (mg/g)	141 (92.2)	37 (7.78)	178 (89)
Albumiuria >30 (mg/g)	12 (7.8)	10 (21.3)	22(11)

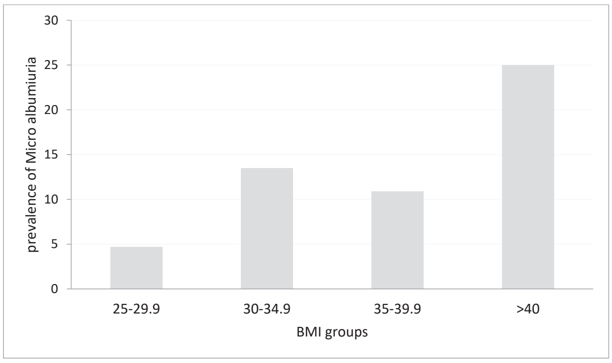

Figure 1. Distribution of microalbuminuria in different BMI groups.

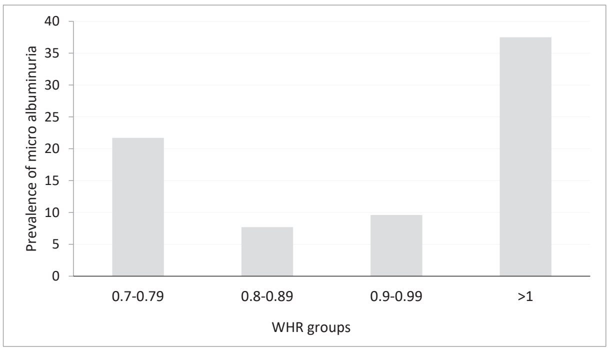

Figure 2. Distribution of micralbuminuria in different WHR groups.

37.5% in the group with WHR >1.

In the current study, the prevalence of microalbuminuria in obese people was 11%. However, the prevalence of microalbuminuria in different populations was 4% -16% (15-19).

This variation in the prevalence of microalbuminuria is attributed to several factors such as differences in the studied populations, in the description of microalbuminuria, in the method of measuring albumin, and the urine sample collection.

In the current study, the prevalence of microalbuminuria was 25% in patients with BMI >40 kg/m^2 which is similar to findings of the studies which investigated diabetic patients. The national health and nutrition examination survey (NHANES III) reported that the prevalence of microalbuminuria in patients with diabetes (type 1 and 2) was 28.8%. United Kingdom Prospective Diabetes Study (UKPDS) reported that the prevalence of microalbuminuria was 9.24% after 10 years of developing type 2 diabetes. Moreover, renal biopsy in obese people showed that histological lesions were similar to diabetic nephropathy (20).

It seems that obesity-related glomerulopathy occurs through a combination of hyper-filtration, increase in the absorption of protein and salt, high blood pressure, high urinary insulin level, and high tubuloglomerular feedback which resulted in increased salt reabsorption, dyslipidemia, inflammation, and increased levels of leptin (21-23). Moreover, a frequent complication of obesity-related glomerulopathy is secondary focal segmental glomerulosclerosis (FSGS) (22).

Obesity-related glomerulopathy presented clinically by microalbuminuria and may increase tenfold over 15 years. In comparison to primary FSGS, this trend is more prevalent in men than women (23). These results are compatible with our findings regarding level of albuminuria in men (Table 1). There are several anthropometric criteria to assess overweight and obesity; however, there is no consensus concerning the superiority of criteria (24,25). BMI and waist circumference are useful ways to assess obesity while epidemiologic studies have used these indicators (11). Our results concerning the relationship between BMI and chronic kidney disease (CKD) and BMI and albuminuria are in line with other studies (26-30). Recently, Munkhaugen et al (31) evaluated 75 000 of Norwegian's volunteers in a cohort study during 20 years and reported a strong correlation between BMI and the risk of kidney disease. This relationship showed that the optimal threshold of BMI was 25 kg/m^2 and people with BMI ≥ 30 kg/m^2 were more prone to being afflicted.

Data from the UK screening program in 2009 showed that with the increase of BMI, the incidence of microalbuminuria also increases. Moreover, they revealed that this association is even more significant in higher BMI groups (16). However, in a study conducted on young people in the United States, an association was found between BMI and microalbuminuria only in groups with BMI ≥35 kg/m^2; whereas, no association was observed in groups with lower BMI (15).

Despite the fact that most studies focused on BMI for identifying obesity, they also mentioned several limitations for this parameter. Since, BMI can be affected by muscle mass, fat mass, and bone and has little ability to recognize the subcutaneous fat from the visceral, and peripheral fat from central fat. While the waist circumstance can demonstrate information about shape and form of the body as well as it can demonstrate the fat distribution of the body, hence it is a better predictor to show abdominal fat mass (32).

Several studies have also shown that waist circumference is a better indicator than BMI to predict kidney disease (12,32,33). Recently, Evangelista et al showed that increasing waist circumference increases hazard ratio and CKD (34). Moreover, abdominal obesity calculated by waist circumference is more precise criterion for CKD risk assessment than WHR and BMI (35). Accordingly, Oh et al showed that measurement of central fat deposition instead of BMI can be a better predictor for revealing reduction of kidney function (12).

However, contradictory results have been reported about the relationship between age and the prevalence of microalbuminuria (34-36). In our study, there was no significant difference with respect to prevalence of microalbuminuria in age groups. Therefore, it is essential to establish a program to prevent obesity (2). One of the limitations of this study is its design which was cross-sectional. Moreover, our participants cannot be representative of the general population. Thus, further prospective studies are recommended to examine the relationship between obesity indexes (WHR, BMI, and waist) and microalbuminuria.

Conclusion

The result of this study showed high prevalence of microalbuminuria in obese participants. Therefore, efforts must be conducted to reduce obesity through lifestyle changes and regular exercise. Moreover, screening is recommended to be considered in the public health program to recognize and take appropriate steps to prevent subsequent complications.

Limitations of the study

In this study, the diet pattern was not evaluated. This pattern can affect the relationship between obesity/overweight and microalbuminuria.

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Authors' contribution

All authors contributed to design, management and review of the manuscript. FY and FK proposed the idea and conducted the clinical study. AG edited the paper. RH managed and supervised the method, checked experiments and morphology of the tests. All authors read and approved the final manuscript.

Conflicts of interest

There are no competing interests to declare.

Ethical considerations

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

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References

1. Guilbert JJ. The world health report 2002 - reducing risks, promoting healthy life. Educ Health (Abingdon). 2003;16(2):230.
2. Chooi YC, Ding C, Magkos F. The epidemiology of obesity. Metabolism. 2019;92:6-10.
3. Hummer RA, Hernandez EM. The Effect of Educational Attainment on Adult Mortality in the United States. Popul Bull. 2013;68(1):1-16.
4. Chudek J, Adamczak M, Nieszporek T, Wiecek A. The adipose tissue as an endocrine organ--a nephrologists' perspective. Contrib Nephrol. 2006;151:70-90.
5. McGown C, Birerdinc A, Younossi ZM. Adipose tissue as an endocrine organ. Clin Liver Dis. 2014;18(1):41-58.
6. Singh A, Satchell SC. Microalbuminuria: causes and implications. Pediatr Nephrol. 2011;26(11):1957–1965. doi:10.1007/s00467-011-1777-1
7. Yuyun MF, Khaw KT, Luben R, Welch A, Bingham S, Day NE, et al. A prospective study of microalbuminuria and incident coronary heart disease and its prognostic significance in a British population: the EPIC-Norfolk study. Am J Epidemiol. 2004;159(3):284-93.
8. Teta D. Weight loss in obese patients with chronic kidney disease: who and how? J Ren Care. 2010;36 Suppl 1:163-71.
9. Herrera R, Almaguer M, Chipi J, Martinez O, Bacallao J, Rodriguez N, et al. Albuminuria as a marker of kidney and cardio-cerebral vascular damage. Isle of Youth Study (ISYS), Cuba. MEDICC Rev. 2010;12(4):20-6.
10. Laville M. [Renal consequences of obesity]. Nephrol Ther. 2011;7(2):80-5.
11. Elsayed EF, Sarnak MJ, Tighiouart H, Griffith JL, Kurth T, Salem DN, et al. Waist-to-hip ratio, body mass index, and subsequent kidney disease and death. Am J Kidney Dis. 2008;52(1):29-38.
12. Oh H, Quan SA, Jeong JY, Jang SN, Lee JE, Kim DH. Waist circumference, not body mass index, is associated with renal function decline in korean population: hallym aging study. PLoS One. 2013;8(3):e59071. doi:10.1371/journal.pone.0059071.
13. Dupuy AM, Jaussent I, Lacroux A, Durant R, Cristol JP, Delcourt C. Waist circumference adds to the variance in plasma C-reactive protein levels in elderly patients with metabolic syndrome. Gerontology. 2007;53(6):329-39.
14. Karar T, Alniwaider RAR, Fattah MA, Al Tamimi W, Alanazi A, Qureshi S. Assessment of microalbuminuria and albumin creatinine ratio in patients with type 2 diabetes mellitus. J Nat Sci Biol Med. 2015;6(Suppl 1):S89-S92. doi: 10.4103/0976-9668.166095.
15. Ferris M, Hogan SL, Chin H, Shoham DA, Gipson DS, Gibson K, et al. Obesity, albuminuria, and urinalysis findings in US young adults from the Add Health Wave III study. Clin J Am Soc Nephrol. 2007;2(6):1207-14.
16. Kawar B, Bello A, Nahas A. High Prevalence of Microalbuminuria in the Overweight and Obese Population: Data from a UK Population Screening Programme. Nephron Clin Pract. 2009;112(3):c205-12. doi: 10.1159/000218365.
17. Coresh J, Selvin E, Stevens LA, Manzi J, Kusek JW, Eggers

P, et al. Prevalence of chronic kidney disease in the United States. JAMA. 2007;298(17):2038-47.
18. Abd ElHafeez S, Bolignano D, D'Arrigo G, Dounousi E, Tripepi G, Zoccali C. Prevalence and burden of chronic kidney disease among the general population and high-risk groups in Africa: a systematic review. BMJ Open. 2018;8(1):e015069.
19. Musah S, Mammoto A, Ferrante TC, Jeanty SSF, Hirano-Kobayashi M, Mammoto T, et al. Mature induced-pluripotent-stem-cell-derived human podocytes reconstitute kidney glomerular-capillary-wall function on a chip. Nat Biomed Eng. 2017;1(5):0069.
20. Goumenos DS, Kawar B, El Nahas M, Conti S, Wagner B, Spyropoulos C, et al. Early histological changes in the kidney of people with morbid obesity. Nephrol Dial Transplant. 2009;24(12):3732-8.
21. Gelber RP, Kurth T, Kausz AT, Manson JE, Buring JE, Levey AS, et al. Association between body mass index and CKD in apparently healthy men. Am J Kidney Dis. 2005;46(5):871-80.
22. Stengel B, Tarver-Carr ME, Powe NR, Eberhardt MS, Brancati FL. Lifestyle factors, obesity and the risk of chronic kidney disease. Epidemiology. 2003;14(4):479-87.
23. Rutkowski P, Klassen A, Sebekova K, Bahner U, Heidland A. Renal disease in obesity: the need for greater attention. J Ren Nutr. 2006;16(3):216-23.
24. Liu Y, Tong G, Tong W, Lu L, Qin X. Can body mass index, waist circumference, waist-hip ratio and waist-height ratio predict the presence of multiple metabolic risk factors in Chinese subjects? BMC Public Health. 2011;11:35.
25. Gallagher D, Visser M, Sepulveda D, Pierson RN, Harris T, Heymsfield SB. How useful is body mass index for comparison of body fatness across age, sex, and ethnic groups? Am J Epidemiol. 1996;143(3):228-39.
26. Kramer H, Luke A, Bidani A, Cao G, Cooper R, McGee D. Obesity and prevalent and incident CKD: the Hypertension Detection and Follow-Up Program. Am J Kidney Dis. 2005;46(4):587-94.
27. Ejerblad E, Fored CM, Lindblad P, Fryzek J, McLaughlin JK, Nyren O. Obesity and risk for chronic renal failure. J Am Soc Nephrol.2006;17(6):1695-702.
28. Fox CS, Larson MG, Leip EP, Culleton B, Wilson PW, Levy D. Predictors of new-onset kidney disease in a community-based population. JAMA. 2004;291(7):844-50.
29. Kramer H, Jacobs DR Jr, Bild D, Post W, Saad MF, Detrano R, et al. Urine albumin excretion and subclinical cardiovascular disease. The Multi-Ethnic Study of Atherosclerosis. Hypertension. 2005;46(1):38-43.
30. Murtaugh MA, Jacobs DR Jr, Yu X, Gross MD, Steffes M. Correlates of urinary albumin excretion in young adult blacks and whites: the Coronary Artery Risk Development in Young Adults Study. Am J Epidemiol. 2003;158(7):676-86.
31. Munkhaugen J, Lydersen S, Wideroe TE, Hallan S. Prehypertension, obesity, and risk of kidney disease: 20-year follow-up of the HUNT I study in Norway. Am J Kidney Dis. 2009;54(4):638-46.
32. Levey AS, Coresh J, Balk E, Kausz AT, Levin A, Steffes MW, et al. National Kidney Foundation practice guidelines for chronic kidney disease: evaluation, classification, and stratification. Ann Intern Med. 2003;139(2):137-47.
33. Honda H, Ono K, Akizawa T, Nitta K, Hishida A. Association of adiposity with hemoglobin levels in patients with chronic kidney disease not on dialysis. Clin Exp Nephrol. 2018;22(3):638-46. doi: 10.1007/s10157-017-1501-y.
34. Evangelista LS, Cho WK, Kim Y. Obesity and chronic kidney disease: A population-based study among South Koreans. PLoS One. 2018;13(2):e0193559. doi:10.1371/journal.pone.0193559.
35. Unuigbe E, Ighorojeb A, Imariagbe F, Aloziea O. Screening for microalbuminuria amongst medical students in University of Benin, Nigeria: a pilot study. JMBR. 2002;1:29 –33.
36. Miltenyi M. Urinary protein excretion in healthy children. Clin Nephrol. 1979;12(5):216-21.