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ORIGINAL ARTICLE

Identifying the determinants of microalbuminuria in obese patients in primary care units: the effects of blood pressure, random plasma glucose and other risk factors

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Abstract
Objective The objective of this study is to evaluate the demographic characteristics, blood pressure and blood glucose and the other related factors that affect the microalbuminuria levels in the obese patients aged 40 and above who applied to the primary care for medical evaluation.
Materials and methods The population of the research, which was a cross-sectional type, comprised obese patients aged 40 and above who had applied to the community health centers in the center of Malatya. A total of 422 obese patients consisting of 116 males and 306 females were included in the research. The anthropometric measurements of the participants were determined, their blood pressures and their random blood glucoses were evaluated, as well. A microalbuminuria measurement was performed in the urine samples taken from the patients using "Nycocard Reader II" device.
Findings The incidence of microalbuminuria in patients was found as 31.5 %, whereas the incidence of macroalbuminuria was 6.6 %. The incidence of microalbuminuria in female patients was 32.7 %, while it was 28.4 % in male patients; on the other hand, the incidence of macroalbuminuria in female patients was found as 6.8 %, whereas this percentage was determined as 7.8 in male patients ($p > 0.05$). The probability of the incidence of microalbuminuria increased 2.8 times more in those with the diastolic blood pressure of 90 mmHg and above when compared to those without it (GA: 1.79–4.56), whereas the incidence increased 3.2 times more in those with the random blood glucose of 200 mg/l and above (GA: 1.32–7.84) ($p < 0.001$). In our study, among the variables predicting the microalbuminuria in obese patients; the cutoff values of the diastolic and systolic blood pressures, the waist circumference were found as >85 mmHg; >130 mmHg; >141 mg/dl, respectively, in male patients and found as >85 mmHg, >114 cm, and 109 cm, respectively, in female patients. The sensitivity and specificity of the tests indicating the cutoff values showed significance ($p < 0.05$). There was no statistically significant relevance between the microalbumin levels of the obese patients via the anthropometric criteria, except for their waist circumference ($p > 0.05$).
Result In this study, the blood pressure and blood glucose levels of the patients along with their waist circumference that indicated a central obesity were specified as the determinants of microalbuminuria. While the obese patients are being evaluated in terms of proteinuria, the cutoff values of these variables can be taken into consideration.

Keywords Obesity · Hypertension · Diabetes · Primary care · Microalbuminuria

Introduction

Obesity throughout the world has become a common public health issue. In the USA, while the prevalence of obesity improved according to age was 22.9 % between the years 1988–1994, it reached up to 30.5 % between 1999 and 2000. Within the same period of time, the prevalence of obesity rose from 55.9 to 64.5 % [1]. In Turkey, the prevalence of obesity has showed a great deal of increase in recent years. While obesity was 12.9 % in males and

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29.9 % in females in 1988, it reached up to 18.7 % in males and 38.8 % in females 10 years later [2, 3].

The major indicator of organ damages that develop due to obesity, type II diabetes and hypertension is microalbuminuria. Microalbuminuria is defined as the early-stage marker regarded as the risk for cardiovascular diseases, indicating a damage in the kidneys as the target organs [4, 5]. On the other hand, type II diabetes alarms as an important public health issue. According to the World Health Organization (WHO), this disease is seen in more than 170 million people throughout the world. This figure will have reached up to 370 million by 2030. One-third of those affected by this disease are confronted with the progressive deterioration/demolition of renal functioning. Performing the routine check-up of the patients is of great importance in terms of minimizing the renal and microvascular complications [6]. Thus, determining and treating microalbuminuria in primary care are of most importance for public health in bringing chronic diseases under control and preventing the development of complications [7]. This study was conducted to determine the incidence of microalbuminuria in the obese patients aged 40 and above who applied to the health care centers in the city center of Malatya for diagnosis and treatment and also to analyze the relationship between the factors that affect this incidence.

Materials and methods

Research population and sampling

The population of the research comprised obese patients aged 40 and above who applied to the health care centers in the city center of Malatya. In the selection of sampling, the cluster sampling method was used. 21 out of 25 health care clusters located in the city center of Malatya were reached. A total of 422 obese patients consisting of 20 people from each cluster were included within the scope of the research.

Research population and variables

This is a cross-sectional type of research. The main variables of the research are the incidence of microalbuminuria, hypertension and random blood glucose (blood sugar).

Data collection

This study consisted of obese patients aged 40 and above who applied to the health care centers of the city center of Malatya during the period, April 2010–July 2010. A total of 422 obese patients consisting of 306 females (72.5 %) and 116 males (27.5) aged between 40 and 91 who applied to health care centers during the day were selected by randomly visiting each cluster twice. The patients with the body mass index (BMI) of over 30 kg/m^2 were included in the study. Apart from being obese, those under the age of 40 and having menstruation along with the pregnant ones were excluded from the study.

First of all, a questionnaire form consisting of 30 questions including the socio-demographic characteristics was performed for the patients. The questionnaire form was answered with the help of their relatives in the elderly and illiterate patients. Afterwards, the blood pressure of the patients was measured one after the other, and glucose in capillary blood and microalbumin in urine were examined.

Measuring/testing blood pressure (mmHg)

Following a 10-min rest, the systolic and diastolic blood pressure (DBP) tests/measurements were performed from the right arm in the sitting position twice at 5-min intervals through the use of a mercury sphygmomanometer by supporting the arm in the way that it would be at the heart level. By taking the averages (mean) into consideration, those with the mean systolic blood pressure (SBP) of 140 mmHg and above and those with the mean DBP of 90 mmHg and above were regarded as hypertension.

Measuring/testing random blood glucose (mg/dl)

Taking blood sample from the tip of a finger, a blood glucose test in the capillary blood was performed via "Lever Check" device. Those with the random blood glucose of over 200 mg/l were regarded as the patients with diabetes mellitus.

Microalbumin measurement in SPOT urine

A microalbumin test in the spot urine sample was performed via "Nycocard Reader II" device in the obese patients included within the scope of the research. While the microalbumin testing was being performed, 50 µl of urine sample was first added into the test tube containing dilution fluid and was then pipetted to the testing card. The values lower than 30 mg/l were recorded as normal, while 30–200 mg/l was recorded as microalbuminuria and over 200 mg/l was recorded as macroalbuminuria.

Weight, body mass index (BMI, kg/m^2), body fat percentage and body fat mass

The BMIs of the patients were calculated through kg/m^2 formula. Body Composition Analyzer TBF 300 device was used on the patients for the analysis of bioelectric impedance meter. The metals and ornaments and the big metallic clothing (e.g., belt) were removed off the patients.

The measurement/testing was performed by allowing the individual to stay in a vertical position by stepping on the aluminum sole plates (arch support) of the device in the way that s/he would be clothed but without shoes and socks.

Waist circumference (cm)

The waist circumference was measured by having a slight expiration performed and from the narrowest region of the waist, upon the plane passing between spina iliaca anterior superior and lower costa (rib) while the patient was standing.

Hip circumference (cm)

The waist circumference was measured from the most protruding point of gluteus maximus muscle and at the level of the line passing over pubis.

Waist/hip ratio (WHR) (%)

After the waist and hip circumferences had been measured, the waist/hip ratio (WHR) was calculated.

Data analysis

In data analysis, SPSS 15.0 statistical package program was used. The normality hypothesis of the data was examined through the Kolmogorov–Smirnov test. As the statistical analysis, Kruskal–Wallis test, Mann–Whitney *U* test, Chi-square test and logistic regression analysis and ROC analysis were performed. The optimum breakpoint for ROC analysis was determined via Youden index (Youden J). The p value was taken as <0.05. The maximum discrepancy of waist circumference between the groups was 5.7, the standard deviation was 10, and the emerging power according to the experimental power results (post hoc power analysis) was 100 % when type I error (alpha) proved to be 0.05 (Minitab 16.2 for Windows).

Test validity

The urine samples taken from a total of 20 patients consisting of 12 females and 8 males who were within the scope of the study were analyzed in the laboratory of biochemistry in Turgut Özal Medical Center. These results were regarded as a reference, and the results of the two tests were compared.

The reference test showed the microalbumin values of 16 out of 20 obese patients below 30 mg/l. In addition, the values of 15 of those patients were indicated as below 30 mg/l by the Nycocard Reader II device, as well. According to these results, the sensitivity of the new test was found as 93.75 %, whereas the selectivity proved to be 100 %.

Ethical approval

Ethical approval to this research was given by the ethics committee of Faculty of Medicine, Inonu University on 23 June 2009 with registration number 2009/88. Informed consent was obtained from all patients.

Findings

27.5 % of those who were included within the scope of the study were male patients and 72.5 % of them were female. Microalbuminuria was significantly more common in females (38.9 %) than in men (36.2 %) ($p < 0.001$). 46.4 % of the patients who applied to the health care center were aged between 40 and 49, whereas 9.2 % of them were aged 70 and above. The incidence of microalbuminuria beyond the normal limits differed according to age groups. While the incidence of microalbuminuria was 31.1 % in the age group of 40–49, it went up to 49.6 % in the age group of 60–69 ($p < 0.05$). 34.4 % of the patients were either literate or illiterate, while 41.7 % of them had primary and secondary education, and 23.9 % had high school and college education. The incidence of microalbuminuria showed no difference according to the educational level (Table 1; $p > 0.05$).

When the anthropometric measurements and the microalbumin levels of the obese patients who were within the scope of the research were compared, there was a statistically significant association between the waist circumference and the microalbumin levels ($p < 0.05$). In the ROC analysis performed between the waist circumference values of both male and female patients with the incidence of microalbumin (those above/not above 30 mg/ml), the cutoff value of the waist circumference of the male patients was found as >114 cm (101–117), whereas this value proved to be 109 cm (98–123) in the female patients.

The sensitivity of the test producing these cutoff (threshold) values was 50.0 % in males (95 % CI 34.2–65) and the specificity was 80.08 % (95 % CI 70.3–89.3; $p < 0.0015$), whereas the sensitivity in females was 41.53 % (95 % CI 32.5–51.0), and the specificity was found as 67.55 % (95 CI 60.4–74.2; $p < 0.0089$) (Fig. 1). The area that remained below the curve assessed through the ROC curve method was 0.67 (95 % CI 0.58–0.75), and the standard error was obtained as 0.05. There was no statistically significant difference determined between the microalbumin levels and height, weight, waist circumference, waist hip ratio, arm circumference, body fat rate and body fat mass (Table 2; $p > 0.05$).

The mean (average) microalbuminuria was determined as 44.8 ± 56.4 mg/l in male patients and 43.6 ± 54.06 mg/l in female patients, and there was no difference in terms of gender ($p > 0.05$). The mean SBP was 132.4 ± 20.4 mmHg

Table 1 The incidence of microalbuminuria and macroalbuminuria according to the socio-demographic features of those within the scope of the research

Features	Number	%	Microalbuminuria and macroalbuminuria frequency (>30 mg/l)		χ^2	*p*
			No	%		
Sex						
Male	116	27.5	42	36.2	0.116 $df = 1$	0.098
Female	306	72.5	119	38.9		
Age[b]						
40–49[b]	196	46.4	63 (7)[a]	32.1	14.323 3.662[c] $df = 6$	0.001
50–59	117	27.7	48 (10)[a]	41.0		
60–69	70	16.6	34 (6)[a]	48.6		
70 and over	39	9.2	16 (6)[a]	41.0		
Education						
Illiteracy/literacy	145	34.4	65	44.8	2.641 $df = 2$	0.076
Primary/secondary school[d]	176	41.7	66	37.5		
High school and over[d]	101	23.9	30	29.7		

df degree of freedom

[a] The number in parentheses show people who have macroalbuminuria

[b] When statistical analysis is made in terms of only microalbuminuria frequency it is observed that there is no difference in the distribution to ($\chi^2 = 6.766$; $df = 3$; $p > 0.05$) age groups

[c] When the first line was removed from the analysis

[d] The groups showing difference

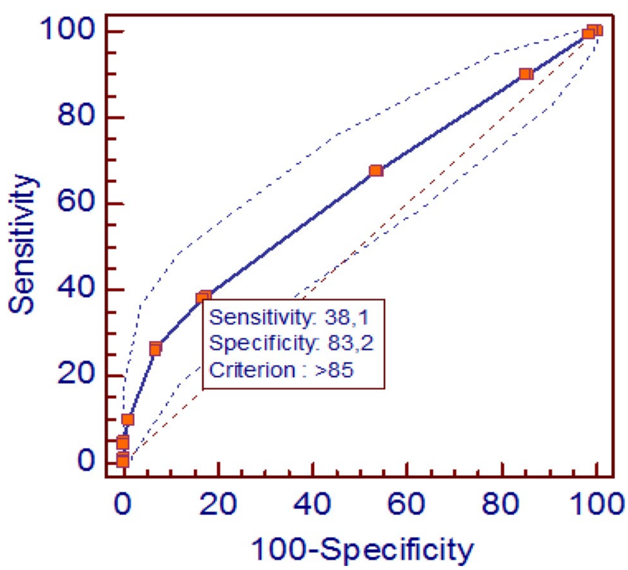

Fig. 1 The ROC analysis between the diastolic blood pressure (DBP) and the microalbuminuria levels in obese patients

in males and 133.8 ± 22.4 mmHg in females; whereas the mean DBP was 78.3 ± 14.03 mmHg in males and 79.4 ± 14.2 mmHg in females, and there was no statistically significant difference in terms of both mean values ($p > 0.05$). However, the mean random blood glucose was determined as 125.3 ± 37.2 in males and 120.9 ± 44.0 in females (Table 3), and a statistically significant difference was found between both mean values ($p < 0.05$).

The frequency/incidence of microalbuminuria in those included within the scope of the research with an SBP lower than 140 mmHg was 26.6 % and the incidence of macroalbuminuria was 3.7 %; on the other hand, the incidence of microalbuminuria in those whose SBP was between 160 and 179 mmHg was 40.0 %, whereas the incidence of macroalbuminuria was found as 6.7 % (Table 4). There is a statistically significant association between the SBP levels and the microalbumin level ($p < 0.05$).

The frequency/incidence of microalbuminuria in those included within the scope of the research with a DBP lower than 90 mmHg was 27.8 %, whereas the incidence of macroalbuminuria was 3.8; on the other hand, the incidence of microalbuminuria in those whose DBP was between 100 and 109 mmHg was 51.2 %, whereas the incidence of macroalbuminuria was found as 12.2 %. The incidence of microalbuminuria in those whose DBP level was 110 mmHg and above was 47.4 %, while the incidence of macroalbuminuria was found as 36.8 % (Table 4). There was a statistically significant difference found between the DBP levels and the microalbumin levels ($p < 0.05$). Microalbuminuria is seen in 30.1 % of those whose random blood glucose levels are lower than 150 mg/l, while macroalbuminuria is seen in 5.1 % of them; on the other hand, microalbuminuria is seen in 36.6 % of those with a random blood glucose level between 150 and 199 mg/l, whereas

Table 2 The distribution of the anthropometric measurements and the microalbuminuria and macroalbuminuria levels of those within the scope of the research

Measurements	Albuminuria				
	Normal	Microalbuminuria	Macroalbuminuria	KW	*p*
Height (cm)	160.3 ± 8.8	159.9 ± 9.5	161.0 ± 7.9	1.372	0.504
Weight (kg)	85.4 ± 13.6	86.0 ± 15.3	88.7 ± 16.2	1.093	0.579
Waist circumference (cm)*	106.8 ± 9.8	107.9 ± 10.2	112.5 ± 10.4	7.971	0.019
Hip circumference (cm)	116.5 ± 9.4	117.0 ± 9.4	117.8 ± 9.9	0.817	0.665
Waist hip ratio (%)	0.90 ± 0.09	0.91 ± 0.06	0.95 ± 0.07	4.956	0.084
Body fat rate (%)	38.5 ± 7.1	38.9 ± 6.5	39.1 ± 6.02	0.300	0.861
Body fat mass (kg)	34.2 ± 15.6	33.5 ± 9.1	34.8 ± 9.4	0.908	0.635
Arm circumference (cm)	32.6 ± 2.9	33.1 ± 3.07	34.2 ± 4.4	3.918	0.141

KW Kruskal–Wallis

* $p < 0.05$

Table 3 The mean measurements of the male and female patients included within the scope of the study regarding the research variables

Variables	Male (*n*: 116) $X \pm SD$	Female (*n*: 306) $X \pm SD$	MW-U	*p*
Microalbuminuria (mg/l)	44.8 ± 56.4	43.6 ± 54.06	17299.5	0.688
Systolic blood pressure (SBP)	132.4 ± 20.4	133.8 ± 22.4	17237.0	0.642
Diastolic blood pressure (DBP)	78.3 ± 14.03	79.4 ± 14.2	16810.0	0.387
Random blood glucose (mg/dl)*	125.3 ± 37.2	120.9 ± 44.0	15368.5	0.033

MW-U Mann–Whitney *U* test

* $p < 0.05$

macroalbuminuria is seen in 7.3 % of them; and microalbuminuria is seen in 42.3 % of those with a random blood glucose level of 200 mg/l and above, while macroalbuminuria is seen in 26.9 % of them. The incidence of microalbuminuria and macroalbuminuria in those whose random blood glucose levels are 200 mg/l and above is significantly high ($p < 05$).

The systolic and DBP levels and the random blood glucose levels of the obese patients included within the scope of the research were evaluated through the logistic regression analysis, and the values given in Table 5 were obtained. The probability of the incidence of microalbuminuria (Odds Ratio) in those included within the scope of the research with a DBP of 90 mmHg and above was 2.8 times (GA: 1.79–4.56) higher than those with a DBP lower than 90 mmHg ($p < 0.05$). The probability of the incidence of microalbuminuria (OR) in those with a random blood glucose level of 200 mg/dl and above was 3.2 times (GA: 1.32–7.84) higher than those whose random blood glucose level was below 200 mg/dl ($p < 0.05$). According to these results, the DBP and high blood glucose are included in this research as the effective factors in the final model.

In the pairwise comparison where there was a difference found, the age of the obese patients and the effect of the SBP on microalbuminuria were found to be statistically insignificant in the final model (Table 5) ($p > 0.05$).

The probability of the incidence of microalbuminuria (OR) in the male patients with a waist circumference of 102 cm and in the female ones with a waist circumference of 88 cm and above was 3.1 times (1.10–8.77) higher than those with a waist circumference below these values ($p < 0.05$). In the ROC analysis performed between the incidence of microalbuminuria (those above/not above 30 mg/ml) and the DBP values, the cutoff value of the patients' DBP was found as >85 mmHg. The sensitivity of the test giving this cutoff/threshold value was determined as 38.13 % (95 % CI 30.6–46.1), whereas the specificity was obtained as 83.21 % (95 % CI 78.1–87.5). Although the test sensitivity is low, the results show significance at the level of $p = 0.001$ (Fig. 1). The area that remained under the curve calculated through the ROC curve method was 0.73 (95 % CI 0.68–0.77), and the standard error was obtained as 0.03.

In the ROC analysis performed between the incidence of microalbuminuria (those above/not above 30 mg/ml) and the SBP values, the cutoff value of the patients' SBP was found to be >130 mmHg.

Accordingly, when the SBP proved to be >130 mmHg in obese patients, it was determined that performing an evaluation in terms of proteinuria showed significance ($p < 0.001$). The sensitivity of the test indicating this cutoff value was 49.38 % (95 % CI 41.4–57.4), whereas the specificity was found to be 72.14 % (95 % CI 66.3–77.5). Apart from the fact that the test sensitivity is low, the results show a significance at the level of $p = 0.0001$ (Fig. 2). The area that remained under the curve calculated through the ROC curve method was 0.33 (95 % CI 0.59–0.68), and the standard error was obtained as 0.03.

Table 4 The albuminuria levels of those within the scope of the research according to the variables

Variables	Albuminuria levels						Total		χ^2	p
	Normal (<30 mg/l)		Microalbuminuria (30–200 mg/l)		Macroalbuminuria (>200 mg/l)					
	No	%	No	%	No	%	No	%		
Systolic blood pressure (SBP)										
<140	189	69.7	72	26.6	10	3.7	271	64.2	73.935	0.001
140–159	52	52.0	42	42.0	6	6.0	100	23.7		
160–179[a]	16	53.3	12	40.0	2	6.7	30	7.1		
180–199[a]	4	19.0	7	33.3	10	47.7	21	5.0		
Diastolic blood pressure (DBP)										
<90	217	68.5	88	27.8	12	3.8	317	75.1	53.400	0.001
90–99	26	57.8	15	33.3	4	8.9	45	10.7		
100–109[a]	15	36.6	21	51.2	5	12.2	41	9.7		
110+[a]	3	15.8	9	47.4	7	36.8	19	4.5		
Random blood glucose										
>200	253	63.9	122	30.8	21	5.3	396	84.1	22.539	0.0001
200+[a]	8	30.8	11	42.3	7	26.9	26	6.2		

[a] The groups showing difference

Table 5 The results of logistic regression analysis in the affecting factors for proteinuria (including microalbuminuria and macroalbuminuria)

Parameters	Number (%)	OR (confidence interval)	p
Systolic blood pressure			
<140	271 (64.2)	Reference group	
≥140	151 (35.8)	1.55 (0.94–2.56)	0.083
Diastolic blood pressure			
<90	317 (75.1)	Reference group	
≥90	105 (24.9)	2.24 (1.29–3.88)	0.004*
Random blood glucose			
<200	396 (93.8)	Reference group	
≥200	26 (6.2)	3.17 (1.29–7.77)	0.011*
Age			
<65	354 (83.9)	Reference group	
≥65	68 (16.1)	1.47 (0.83–2.61)	0.179
Waist circumference (WC)			
WC male			
<102	15 (12.9)	Reference group	0.032*
≥102	101 (87.1)	3.11 (1.10–8.77)	
WC female			
<88	14 (4.6)		
≥88	292 (95.4)		

Microalbuminuria or macroalbuminuria = 1 and no proteinuria = 0

* $p < 0.05$

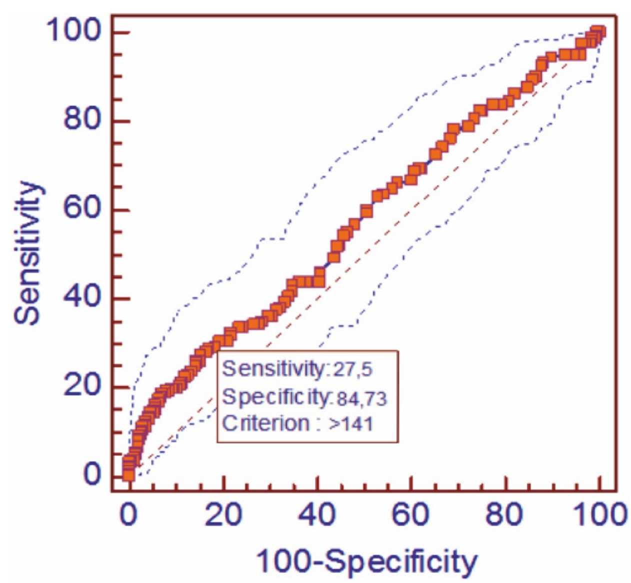

Fig. 2 The ROC analysis between the systolic blood pressure (SBP) and microalbuminuria levels in obese patients Fig. 3. The ROC analysis between the random blood glucose (RBG) and microalbuminuria levels in obese patients

When the data of the ROC analysis performed between the incidence of microalbuminuria in the urine of obese patients and the random blood glucose levels were evaluated, the cutoff value corresponding to the abnormal microalbumin value was found as >141 mg/dl. The sensitivity of the test giving this cutoff/threshold value was 27.50 % (95 % CI 20.7–35.1), whereas the specificity was obtained as 84.73 % (95 % CI 79.8–88.9). Although the power of the test that differentiated the patients was low, the results showed a significance at the level of $p = 0.0166$ (Fig. 3).

The area that remained under the curve calculated through the ROC curve method was 0.57 (95 % CI 0.52–0.62), and the standard error was 0.03.

Discussion

In our study, we determined that the microalbuminuria prevalence in the obese patients aged 40 and above (BMI ≥ 30 kg/m^2) was 31.5 %, while the macroalbuminuria prevalence was 6.6 %, which were higher than the prevalence of microalbuminuria reported for the general population. In a review performed in 22.224 adults in the USA, the prevalence of microalbuminuria was 7.8 %, and 28.8 % in diabetic patients, whereas in a review performed in 4100 people in Holland, this prevalence was reported to be 7.0 %, and 16 % in diabetic patients [8, 9].

In our study, microalbuminuria was seen in 32.7 % of the obese females, whereas macroalbuminuria was detected in 6.6 % of them; on the other hand, microalbuminuria is seen in 28.4 % of the males, while macroalbuminuria is seen in 7.8 % of them; yet, this situation is statistically insignificant ($p > 0.05$). Tazen et al. reported that female sex was independently associated with MA [10]. Yildirimturk et al. could not find any difference according to gender in microalbuminuria [11].

In a study conducted by Hitha et al. on 6801 people in ten different Asian countries in the Asian–Pacific Region, the prevalence of microalbuminuria in females (32.7 %) was found to be higher than that in males (23.7 %) ($p > 0.05$) [12].

Varghese et al. [13] also found that the prevalence of microalbuminuria in females (39.9 %) was higher than that in males (32.1 %), however, it was determined that the difference was insignificant ($p > 0.05$).

In our study, we could not determine a difference in the obese patients in terms of macroalbuminuria prevalence according to the gender. In our study, the mean age of our participants was 52.9 ± 10.9. The prevalence of microalbuminuria in the age group of 40–49 (including macroalbuminuria) was 32.1, whereas it was 48.6 % in the age group of 60–69 and 41.0 % in the group aged over 70. The fact that the prevalence of microalbuminuria in those aged 70 and above was seen to be lower than the other age groups suggests that the adults with microalbuminuria who were aged 70 and above might have been dead. There is a significant change in the microalbuminuria values along with the age ($p < 0.05$).

In a research conducted by Hitha et al. on the non-diabetic patients with hypertension who had applied to a medical center in Southern India, it was determined that the prevalence of microalbuminuria had increased along with the age ($p < 0.05$) [13].

In Valensi et al.'s study where the relationship between the albuminuria and obesity was investigated, it was determined that the albumin excretion in the urine of obese patients was higher than that in the control group ($p < 0.05$) [14].

Ahmadani et al. [15], on the other hand, in a study they conducted on type II diabetic and hypertensive patients, found no significant association between the body measurements and microalbuminuria ($p > 0.05$).

Yeung et al., in a research they carried out on 437 hypertensive and diabetic patients whose mean age was 61.7 and who had applied to six medical centers in Hong Kong, found the prevalence of microalbuminuria as 24.9 % and the prevalence of macroalbuminuria as 18.3 % [16]. In this study of Yeung et al., the fact that the prevalence of macroalbuminuria was found to be high could be due to the fact that the sampling consisted of older and more chronic patients.

In our study, a significant relationship was found between the waist circumference and the proteinuria levels ($p < 0.05$). In our study, the cutoff value of the waist circumference of male patients was found as >114 cm (101–117), whereas this value was 109 cm (98–123) in females. The test sensitivity in males was 50.0 % (95 % CI 34.2–65), whereas the specificity was 80.08 % (95 % CI 70.3–89.3; $p < 0.0015$); on the other hand, the test sensitivity in females was 41.53 % (95 % CI 32.5–51.0), whereas the specificity was obtained as 67.55 % (95 % CI 60.4–74.2; $p < 0.0089$). Both criteria showed significance.

In a study conducted by Liese et al. on 920 male and 879 female patients, it was determined, similar to our study, that there was no significant association between obesity and microalbuminuria, whereas the central obesity had 3.3 times and hypertension had 4.0 times more effect on microalbuminuria. While obesity was not associated with microalbuminuria once central adiposity was taken into account, elevated percent body fat remained associated with microalbuminuria [17]. On the contrary, in a study conducted by Ersoy et al. from Turkey on 29 microalbuminuric and 68 normoalbuminuric type II diabetic patients who did not need any insulin, there was no significant association found between waist circumference, waist–hip ratio and microalbuminuria ($p > 0.05$) [18]. A similar relationship was also obtained in the research that comprised 1187 non-diabetic patients, where Lieb et al. examined the relationship between the central obesity and microalbuminuria. However, Lieb et al. reported that there was a significant association between the body fat mass and microalbumin levels only in females ($p < 0.05$) [19].

Also in the study by Ersoy et al. from Turkey, there was no any relationship found between microalbuminuria and body fat rate [18]. which could be due to the fewer number of individuals within the sampling. The reason why the prevalence of microalbuminuria and macroalbuminuria proved to be different could be due to the fact that the duration and severity of the existing chronic diseases along

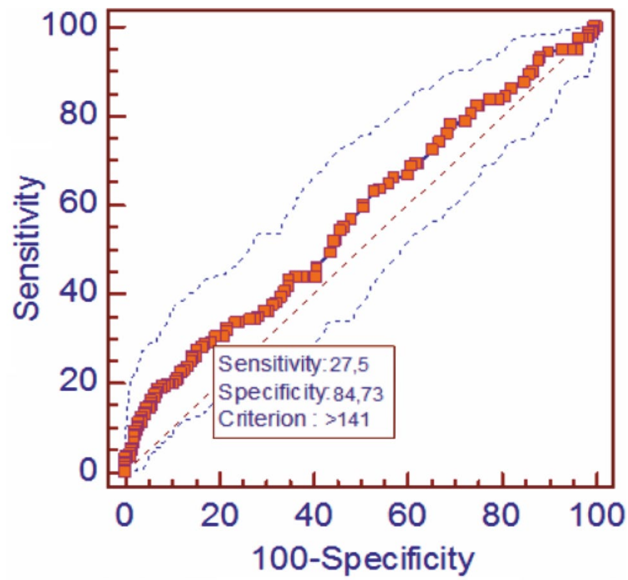

Fig. 3 The ROC analysis between the random blood glucose (RBG) and microalbuminuria levels in obese patients

with gender, race, obesity, diabetes mellitus, hypertension and the way of collecting urine were different from one another.

It is known that obesity and metabolic syndrome are the independent risk factors for chronic kidney disease. Obesity was reported to be responsible for the development of focal segmental glomerulosclerosis and glomerulonephropathy [20]. The visceral adipose tissue is known to cause glomerulopathy and metabolic syndrome associated with obesity by increasing the inflammatory cytokine release, such as interleukin-6 and tumor necrosis factor [21, 22]. However, the role of the central obesity in triggering the renal/kidney damage in obese patients is not well known.

The results of our study suggest that there was an increase in the proteinuria level along with the increase in the waist circumference that indicated a central obesity in obese patients.

Hypertension and microalbuminuria

Microalbuminuria may often co-exist with hypertension [15]. In our study, microalbuminuria is seen at a rate of 42 % in the obese patients with hypertension, while macroalbuminuria is seen at a rate of 4.9 %. There is a significant relevance between hypertension and microalbuminuria sa. Wu et al., in a research they performed in Singapore on 499 type II diabetic patients with hypertension, obtained the prevalence of microalbuminuria as 48.5 % and the prevalence of macroalbuminuria as 23.5 % [23]. Those who had no albuminuria in their urine are merely 28 %.

The research suggests that the weakness in controlling blood glucose and hypertension can be regarded as the most important indicator that could give rise to severe renal failures.

The reason why the prevalence of microalbuminuria seen in the patients with hypertension appears to be in different rates in the studies conducted could be due to the differences in the duration and severity of hypertension disease as well as age, race, obesity and the way of collecting urine. In our study, we determined that as the level of SBP and DBP increased, so did the prevalence of microalbuminuria in a significant way ($p < 0.05$). Ersoy et al. also found a significant relevance between the SBP and DBP levels and microalbuminuria [18]. A similar result was also obtained by Lieb et al. in a research they carried out [19]. However, in the research performed by Ahmadani et al., there was no significant difference found between the SBP and DBP levels and microalbuminuria [15].

In our study, when the variables affecting microalbuminuria in obese patients were tested through the logistic regression analysis, they were not included as effective factors in the SBP final model which had an impact on the dependent variable in pairwise comparison (OR 1.55 (0.94–2.56; $p > 0.083$). Whereas, microalbuminuria is seen 2.24 times more in the obese patients with the DBP of 90 and above compared to those with the DBP below 90 (CI 1.29–3.88; $p < 0.004$). The relationship between the prevalence of microalbuminuria and diastolic and SBP values was evaluated through the ROC analysis method. In the primary care obese patients, the microalbumin assay in the spot urine and the cutoff values of the effective variables were determined through a rapid technique. Accordingly, the break point of the DBP corresponding to the abnormal value of microalbuminuria in obese patients was found as >85 mmHg, and the break point of the SBP was determined to be >130 mmHg. Although the sensitivity of this value was determined to be at a lower level, such as 38.13 % for DBP (95 % CI 30.6–46.1), and 49.38 % for SBP (95 % CI 41.4–57.4), they were determined as significant.

The specificities of the tests determining the break points were found as 83.21 and 72.14 %, respectively. Apart from the fact that there was no significant correlation between the SBP values and microalbumin levels in the logistic regression analysis, the cutoff value was determined to have shown significance in the ROC analysis.

Even though the sensitivity values of the tests were low, it was determined that evaluating the patients in terms of proteinuria was significant when the DBP of the obese patients was over 85 mmHg and their SBP was over 130 mmHg ($p = 0.001$).

Diabetes mellitus and microalbuminuria

In our study, microalbuminuria is seen in 42.3 % of those with a random blood glucose of 200 mg/l and above, whereas macroalbuminuria is seen in 26.9 % of them. The microalbuminuria in those with a random blood glucose of 200 mg/l and above proved to be 3.17 times higher (OR) than those whose RBG was below that rate. In our study, similar to others [13, 24], as the blood glucose level increased, do did the microalbumin levels along with it.

Heart Outcome Prevention Evaluation study (HOPE) study suggested that the risk of a major cardiovascular event in the diabetic and non-diabetic people with microalbuminuria had increased by 1.83 %, while the mortality risk out of all the other causes had increased by 2.09 % [25]. In the researches carried out in the developed countries on the patients with diabetes mellitus, the prevalence of microalbuminuria varies between 17 and 21 % [16]. In our study, the prevalence of microalbuminuria in type II diabetic patients is seen as 40.6 % and the prevalence of macroalbuminuria is seen at a rate of 14.6 %.

Gerstein et al. [25] determined the prevalence of microalbuminuria in the patients with diabetes mellitus as 32.6 %, whereas Chrowta et al. [24] determined it as 37 %.

In the research conducted by Bessie et al. on 2969 diabetic patients who had applied to the primary care health institutions in the city of Seattle in the USA, the prevalence of microalbuminuria was determined as 24.6 %, while the prevalence of macroalbuminuria was found as 6.3 % [26].

The fact that the result of microalbuminuria differs from these research data is because of the sampling.

According to the result of the ROC analysis performed between the prevalence of microalbuminuria in the urine of obese patients and their random blood glucose levels, the cutoff value corresponding to the abnormal microalbumin value was found to be >141 mg/dl. The proteinuria in the patients with this value must be followed up with care.

Study limitation

The main analysis to evaluate microalbuminuria was performed in a single spot urine sample performed via "Nycocard Reader II'' device, where international guidelines recommend that microalbuminuria should be established by three separate tests out of which two measurements should be positive. However, microalbuminuria testing at one single occasion has been established as a useful screening test in epidemiological research.

Conclusion

In this study, the DBP and random blood glucose in obese patients and central obesity have been determined as the main variables that identify microalbuminuria.

Microalbuminuria is the first clinical sign of the deaths that occur due to progressive renal damage and cardiovascular system diseases in the diabetic and/or hypertensive patients.

In conclusion, the obesity table/picture in the patients aged over 40 in the primary care and the risk factors coexisting with this table/picture as well as the results of microalbuminuria must be carefully followed up, and a way of treatment must be performed.

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Conflict interest No conflict of interest.

Ethical approval Our study provides all mandatory compliance with ethical standards.

Informed consent Informed consent was taken from all participiants.

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