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Urban-Rural Comparison of Obesity and Related Metabolic Disorders in Southern Turkey

Güney Türkiye'de Obezite ve İlişkili Metabolik Bozuklukların Kentsel-Kırsal Karşılaştırması

Coşkun Özer Demirtaş[1 *]

ABSTRACT
Introduction: Once considered a high-income country problem, obesity is now on the rise in low and middle-income countries, particularly in urban settings. The aim of this study is to estimate the distribution of obesity and related metabolic morbidities between rural and urban regions of Adana. Materials and Methods: 545 consecutive patients, applied to Pozantı State Hospital Internal Medicine outpatient clinic between June-September 2017 were enrolled. Diabetes mellitus and/or hypertension and/or hyperlipidemia are defined as metabolic comorbid condition (MCC). Participants living at Pozantı were named locals, and those living in Adana city center were named springers. Results: 351 (64.4%) participants were from Pozantı and 194 (35.6%) were from Adana city center. The median Body-mass index (BMI) of the study population was 29.1 (17.5-48.8) kg/m2. Springers had slightly higher, but statistically insignificant BMI compared to locals (28.7 kg/m2 vs. 29.6 kg/m2 respectively, p=0.078). MCC was more frequent in springers (64.4% vs 54.1%, p= 0.02). Univariate analysis revealed that; springers (p=0.02), age>65 (p=0.00), patients with BMI>25 kg/m2 (p=0.001) and uric acid>7 mg/dl (p=0.001) is associated with MCC. Multivariate analysis displayed the association of BMI>25 kg/m2, age between 65-79 and uric acid >7 mg/dl with MCC independently. Conclusion: Obesity exists approximately one in every three cases and metabolic morbidities are observed in nearly half of the patients who applied to internal medicine outpatient clinic. The growing burden of obesity and related metabolic disorders in our region points to urgent preventive strategies on a national scale.

Key words: Obesity, Diabetes mellitus, Urban health, Rural health

ÖZET

Giriş: Bir zamanlar yüksek gelirli ülkelerin sorunu olarak görülen obezitenin, özellikle kent yaşamının yoğun olduğu düşük ve orta gelirli ülkelerde sıklığı giderek artmaktadır. Bu çalışmanın amacı, Adana'nın kırsal ve kentsel bölgeleri arasında obezite ve buna bağlı metabolik hastalıkların dağılımını belirlemektir. Materyal ve Metod: Haziran-Eylül 2017 tarihleri arasında Pozantı Devlet Hastanesi İç Hastalıkları polikliniğine başvuran 545 ardışık hasta dahil edildi. Diyabet, hipertansiyon ve/veya hiperlipidemi tanılarının varlığı metabolik komorbid durum (MKD) olarak tanımlandı. Pozantı ilçesinde yaşayan bireyler yerli, Adana şehir merkezinde yaşayan bireyler ise yaylacı olarak tanımlandı. Bulgular: Katılımcıların 351 (%64,4)'i Pozantı, 194 (%35,6)'ü Adana kent merkezinden idi. Çalışma popülasyonunun ortanca vücut-kitle indeksi (VKİ) 29,1 (17,5-48,8) kg/m2 saptandı. Yaylacılarda, yerlilere göre istatistiksel olarak anlamlı olmayan VKİ yüksekliği saptandı (sırasıyla 28,7 kg/m2 vs. 29,6 kg/m2, p=0,078). MKD, yaylacılarda daha sık görülmüştür (%64,4 vs. %54,1, p=0,02). Tek değişkenli analizler sonucunda; yaylacılarda (p=0,02), yaş>65 (p=0,00), VKİ>25 kg/m2 (p=0,001), ürik asit > 7 mg/dl (p=0,001) olanlarda MKD daha sık görülmüştür. Çok değişkenli analizler sonucunda ise; VKİ>25 kg/m2, 65-79 yaş arasında olmak ve ürik asit düzeyi > 7 mg/dl bağımsız olarak MKD varlığı ile ilişkili saptandı. Sonuç: İç Hastalıkları polikliniğine başvuran hastalardan her üç kişiden birinde obezite, ve her iki kişiden birinde de metabolik komorbiditeler bulunmaktadır. Bölgemizdeki artan obezite ve ilişkili metabolik problemler, ulusal ölçekte acil önleyici müdahale gerekliliğini ortaya koymuştur.

Anahtar kelimeler: Obezite, Şeker hastalığı, Kentsel sağlık, Kırsal sağlık

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*[1] Fevzi Cakmak Mahallesi, Pendik. Marmara Universitesi, Pendik Eğitim ve Araştırma Hastanesi, 2. kat, Endoskopi Unitesi
Address for Correspondence / Yazışma Adresi: Coskun Ozer Demirtas, Fevzi Cakmak Mahallesi, Pendik. Marmara Universitesi, Pendik Eğitim ve Araştırma Hastanesi, -2. kat, Endoskopi Unitesi
E-mail: coskun_demirtas10@hotmail.com

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INTRODUCTİON

Obesity is a global public health problem, which has nearly tripled from 1975 to 2016.1 This indicates that obesity is becoming a more important problem every day. It is associated with some serious health problems; such as type 2 diabetes mellitus (DM), hypertension (HT), hyperlipidemia (HL), cardiovascular and cerebrovascular diseases and various types of cancer.2,3 Besides obesity, many different cardio-metabolic factors can be blamed to lead DM and cardiovascular disease.

Once considered a high-income country problem, obesity is now on the rise in low- and middle-income countries, particularly in urban settings. The dietary habits, lack of physical activity as well as some other socioeconomic factors are reported to cause obesity. These socioeconomic factors are often the result of environmental and societal changes associated with the development and lack of supportive policies in sectors such as health, education, urban planning, agriculture, marketing, and food processing. Psychosocial stress factors, which are common in modern society, have been hypothesized to contribute to the increased prevalence of obesity.4,5 On the other hand, the place of residence is considered a risk factor for obesity and related metabolic comorbidities due to aforementioned reasons. However, there are conflicting results in the literature about this topic. Both living in rural and urban areas were revealed as a risk factor for obesity in previous studies.6,7,8

Pozantı district of Adana province is located approximately 100 km away from the city center and at middle altitude (800 -1300 meters), whereas Adana city center, a modern metropolitan, is nearly at sea level located in the Mediterranean Region-southern part of Turkey. Although on the same provincial boundaries, there is a big cultural difference between these districts. Pozantı region is known with its nature, fresh air and natural eating habits while Adana city center life is literally representative of city chaos. Pozantı district attracts tourists from Adana city center, especially at the hottest summer season. Therefore, summer season is the perfect time to compare these two near but substantially different regions.

The aim of the present study is to estimate the distribution of obesity and metabolic comorbid conditions (MCC) between rural and urban regions of Adana and determine other related factors.

MATERİALS AND METHODS

Patient selection

Five hundred and forty-five consecutive patients who applied to Pozantı State Hospital internal medicine outpatient clinic between June 2017 and September 2017 were enrolled. The reasons for outpatient clinic applications were mostly; acute conditions such as upper respiratory infections, acute gastroenteritis or chronic conditions such as diabetes mellitus, hypertension, hyperlipidemia, thyroid diseases, chronic renal failure and cardiovascular disease which requires periodic follow-up. Patients applied to prescribe medicine were also included in the study. Pregnancy, patients from other cities and <18 years of age were excluded.

Definitions

State of residence was obtained form the patient's history. Patients who lived at least the last 5 years and/or born and grew up in Pozantı were defined as locals. Those who came to Pozantı for holiday and actually lives in Adana city was accepted as springers. Age stratification was classified according to WHO as; 18-64: young, 65-79: middle-aged, >80: elderly.9 Antihypertensive drug use, systolic blood pressure ≥140 mm Hg and/or diastolic blood pressure ≥90 were defined as HT according to JNC 8 guideline.10 Anti-hyperlipidemic drug use or low-density lipoprotein (LDL) ≥ 160 mg/dl and/or triglycerides (TG) ≥ 200 mg/dl were defined as HL.11 Fasting blood glucose (FBG) > 126 mg/dl and/or postprandial blood glucose > 200 mg/dl, oral anti-diabetic or insulin use and those who were previously diagnosed with DM and followed up by diet were defined as diabetic.12 Coronary heart disease (CHD) was defined as myocardial infarction or by-pass history, drug use related to CHD and those who applied to outpatient clinic with angina pectoris and diagnosed CHD after further investigation. Creatinine clearance (CrCl) < 60 was defined as chronic renal failure (CRF). All other comorbidities and diseases were obtained from patient's story. MCC was defined as having at least one of the following comorbidities; DM, HT and/or HL.

Venous blood samples were taken after a fasting period of at least 8 hours and hemogram, FBG, HbA1c, LDL, TG, blood urea nitrogen (BUN), creatinine, aspartate aminotransferase (AST), alanine aminotransferase (ALT), TSH, uric acid, vitamin B12 were studied for each case. CrCl was calculated using Cockroft-Gault formula. Blood pressure measurement of each case was performed from the left arm while the patient was rested for at least 10 minutes in the sitting position. The height and weight of each case were measured using standard measuring instruments. Weights were measured when patients had their clothes on and without shoes. The body mass index (BMI) of each patient was calculated. BMI was classified according to WHO classification as; <18,5: low weight, 18,5-24,99 : normal, 25-29,99 : overweight, 30-39,99 : obese, ≥40 : morbidly obese.1 For logistic regression analysis; BMI was grouped as; normal weight: <25 kg/m2, overweight: 25-29,99 kg/m2, obese: ≥30 kg/m2

Statistical analysis

Statistical analysis package program SPSS (Statistical Package for Social Sciences) version 24.0 was used for statistical analysis. Whether the data have normal distribution was tested by the Shapiro-Wilk test. Frequency distributions were made and descriptive statistics were defined as mean ± standard deviation. The chi-square test was used to compare the categorized variables and the independent sample t-test was used to compare the averages of the continuous variables. Descriptive statistics for categorical variables are given in terms of frequency and n (%). Non-categorical data was indicated by med (min-max) and mean ± standard deviation. Logistic regression analysis was used as a multivariate analysis in evaluating the factors related to metabolic comorbid conditions. In logistic regression analysis, dependent variables were added according to significance in the univariate analysis ($p<0.05$). The results were examined at 95% confidence level and $p = 0.05$ significance level.

Ethics approval

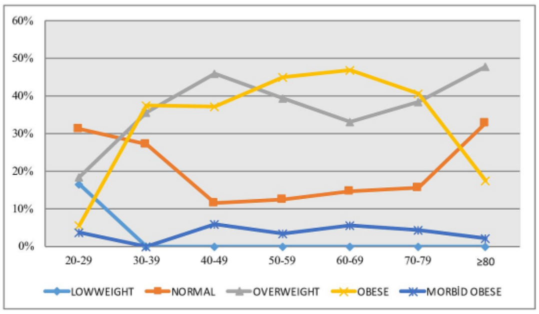
The study protocol was approved by Cukurova University School of Medicine Ethics Committee (Approval date 28.12.2017, number of approval: 72/17) and all the individuals who participated in the study were informed. The study was conducted consistent with the principles of the Declaration of Helsinki. All participants were enrolled if they were able and willing to provide informed consent.

RESULTS

Five hundred and forty-five consecutive patients were 32.2% (175) were male and 67.8% (370) were female. The mean age was 56 (18 - 95). The median BMI of the study population was 29.1 (17.5-48.8). 351 (64.4%) were from Pozantı and 194 (35.6%) were from Adana. Of the 545 175 (32.1%) had DM, 184 (33.8%) had HT, 194 (35.6%) had HL, 45 (8.3%) had thyroid disease, 66 (12.1%) had CHD, 84 (15.4%) had CRF, 29 (5.3%) had pulmonary disease, 7 (1.3%) had gout disease, 9 (1.7%) had CVD, 3 (0.6%) had any neurologic disease, 3 (0.6%) had any malignancy and 315 (57.8%) had a metabolic comorbid condition. Overall, 220 (40.4%) cases were obese and 202 (37%) were overweight.

Table 1. Distribution of Body-mass index according to state of residence

	POZANTI		ADANA	
	MALE	FEMALE	MALE	FEMALE
Low weight	-	6 (2.4%)	-	4 (3.2%)
Normal weight	13 (18.6%)	56 (22.8%)	13 (18.6)	24 (19.4)
Overweight	31 (44.3%)	78 (31.7%)	31 (44.3%)	39 (31.5)
Obese	24 (34.3%)	93 (37.8%)	24 (34.3%)	51 (41.1%)
Morbid obese	2 (2.9%)	13 (5.3%)	2 (2.9%)	6 (4.8)



	20-29	30-39	40-49	50-59	60-69	70-79	>80
LOWWEİGHT	9(16.4%)	-	-	-	-	-	-
NORMAL	31(56.4%)	16(27.1%)	8(11.4%)	11(12.4%)	19(14.6%)	15(15.6%)	15(32.6%)
OVERWEİGHT	10(18.2%)	21(35.6%)	32(45.7)	35(39.3%)	43(33.1%)	37(38.5%)	22(47.8%)
OBESE	3(5.5%)	22(37.3%)	26(37.1%)	40(44.9%)	61(46.9%)	39(40.6%)	8(17.4%)
MORBİD OBESE	2(3.6%)	-	4(5.7%)	3(3.4%)	7(5.4%)	4(4.2%)	1(2.2%)

Figure 1. Distribution of Body-mass index among decades

Springers were older than locals (59.99±16.300 vs 54.35±18.627, p=0.00), but the elderly percentage was not different in both groups (Locals; 18-64 years: 236 (67.2%), 65-79 years: 86 (24.5%), ≥80 years: 29 (8.3%), Springers; 18-64 years: 108 (55.7%), 65-79 years: 69 (35.6%), ≥80 years: 17 (8.8%)). Distribution of BMI between locals and springers was similar; although there was a slight increase in mean BMI of springers (28.7 vs. 29.6 respectively, p=0.078). Female gender had a tendency to obesity for both springers and locals

(Table 1), but there was no statistically significant difference in both groups (Female (local vs springer): p=0.92, Male (local vs springer): p=0.30, Whole population (local vs springer): p=0.89). When the obesity distribution for every decade was evaluated (Figure 1); there was a rising curve until 80 years as ages between 50-80 was the dominant years for obesity. There was a significant decrease in obesity after age 80 (17.4%). Elderly cases had more tendency to being overweight and normal weight (47.8% and 32.6%, respectively). 10 cases were detected as low weight and 9 (90%) of them were 20-30 years old.

Approximately one in every 3 patients had DM and HT; but they were more common at springers (Springers: 75 (38.7%) DM and 78 (40.2%) HT, Locals: 100 (28.5%) DM and 106 (30.2%) HT, p=0.015 and p=0.018 respectively). Mean TG and LDL levels were higher in springers (181.73 ± 180.564 vs 153.14 ± 103.513 and 113.05 ± 28.736 vs 105.83 ± 30.70, p=0.028 and p=0.012, respectively). MCC was observed in 54.1% in locals and 64.4% in springers. Springers were more metabolically ill and there was a statistically significant difference between them (p=0.023). Hyperuricemia was also more common in springers in accordance with the metabolic comorbid conditions (5.26 ± 1.46892 vs 5.01 ± 1.35911, p=0.04). Mean CrCl was found to be lower in springers (92.81 ± 30.57910 vs 100.04 ± 100.04 ± 40.44412, p=0.03). Besides those, mean B12 vitamin levels were lower in locals (321.22 ± 126.969 vs 350.38 ± 127.055, p=0.014) (Table 2).

Table 2. General characteristics of the subjects based on their state of residence

	POZANTI	ADANA	p score
Age	54.35 ± 18.62	59.99±16.3	0.000*
Female	246 (70.1%)	124 (63.9%)	0.151
Male	105 (29.9%)	70 (36.1)	0.151
BMI	28.75 ± 5.48	29.62±5.59	0.078
DM	100 (28,5%)	75 (38.7%)	0.015
HT	106 (30.2%)	78 (40.2%)	0.018*
HL	113 (37.3%)	81 (44.8%)	0.125
TD	34 (9.7%)	11 (5.7%)	0.108
Gout	4 (1.1%)	3 (1.5%)	0.704
CHD	45 (12.8%)	21 (10.8%)	0.584
PD	22 (6.3%)	7 (3.6%)	0.233
CRF	57 (16.2%)	27 (13.9%)	0.536
CVD	7 (1.3%)	2 (1%)	0.502
MCC	190 (54.1%)	125 (64.4%)	0.023*
HbA1C	55.76 ± 17.51	59.78 ± 23.83	0.133
LDL	105.83 ± 30.70	113.05 ± 28.73	0.012*
TG	153.14 ± 103.51	181.73 ± 180.56	0.028*
Uric acid	5.0119 ± 1.35	5.2649 ± 1.46	0.044
Hb	12.088 ± 1.81	12.350 ± 1.69	0.099
Htc	34.8296 ± 5.62	35.4294 ± 6.26	0.252
PLT	309,039 ± 82.92	300.221 ± 76.55	0.223
TSH	2.6343 ± 9.16	2.1289 ± 1.69	0.456
Vitamin B12	321.22 ± 126.96	350.38 ± 127.05	0.014*
CrCl	100.04 ± 40.44	92.81 ±30.57	0.03*

BMI: body-mass index, DM: diabetes mellitus, HT: hypertension, HL: hyperlipidemia, TD: thyroid disease, PD: pulmonary Disease, CRF: chronic renal failure, CVD: cardiovascular disease, MCC: metabolic comorbid condition, LDL:Low-density lipoprotein, TG:Triglycerides, Hb:haemoglobin, Htc: haematocrit, MPV: mean platelet volume, TSH: Thyroid-stimulating hormone, PLT: platelet

*p<0.05

¶ All results were compared using independent sample t-test.

Table 3. Significant parameters related with metabolic comorbid conditions in univariate analysis

	MCC(-)	MCC(+)	P score
State of residance;			
Pozantı (Locals)	161 (45.9%)	190 (54.1%)	0.023[a]
Adana (Springers)	69 (35.6%)	125 (64.4%)	
Uric acid			
<7 mg/dl	218 (44.5%)	272 (55.5%)	0.003[b]
≥7 mg/dl	12 (21.8%)	43 (78.2%)	
Age			
18-64	164 (47.7%)	180 (52.3%)	
65-79	49 (31.6%)	106 (68.4%)	0.003[b]
≥80	17 (37%)	29 (63%)	
BMI			
Normal	80 (64%)	45 (14.3%)	
Overweight	76 (33%)	124 (39.4%)	0.000[a]
Obese	74 (32.2%)	146 (46.3%)	

BMI: Body-mass index, MCC: Metabolic comorbid conditions

a. Chi-square test was used to compare the categorized variables, *b.* Independent sample t-test was used to compare the averages of the continuous variables.

Univariate analysis revealed that; urbanization, older age (middle age and elderly), overweight and obese and hyperuricemia have a relationship with metabolic comorbid conditions (Table 3). As a result of logistic regression analysis; overweight and obese, middle age and hyperuricemia are related to metabolic comorbid conditions independent of other factors. It is found that urbanization has an effect on metabolic comorbid conditions, but there was no statistically significant difference (Table 4).

Table 4. Relation of significant parameters in univariate analysis with metabolic comorbid conditions

		OR	95% CI	P score
State of residence				
	Pozantı (Locals)			
	Adana (springers)	1.420	0.351-3.274	0.07*
Uric acid				
	<7 mg/dl	2.414	0.881-6.227	0.013*
	≥7 mg/dl			
Age				
	18-64			
	65-79	1.739	0.553-6.752	0.009*
	≥80	1.686	0.522-2.277	0.131
BMI	*Normal*			
	Overweight	2.850	1.047-18.883	0.001*
	Obese	3.373	1.216-25.368	0.001*

BMI: Body-mass index

¶ Logistic regression analysis was used for multivariate analysis to evaluate the factors related with metabolic comorbid conditions.

DISCUSSION

This study was conducted with the aim of investigating the differences of the metabolic situation among rural and urban areas of Adana. The main result of our study was the marked high rates of overweight and obesity (77.4% and 40.4% respectively). Globally; %39 of adults (39% of men and 40% of women) were overweight and 13% (11% of men and 15% of women) were obese according to WHO.1 National and local studies conducted in our country also revealed that; 18.8% of the adult population was obese (9% of men and 28.5% of women) in 1990 and the prevalence increased to 36% in 2010 (27% in men and 44% in women).13 In our study; obesity rates were higher in female gender in both locals and springers in accordance with the literature. In TEKHARF study conducted in our country; obesity rates were 18.7% for male and 38.8% for female gender.14

Geographical distribution of obesity has also taken interest of our researchers. In a national study conducted in 7 regions of Turkey; the highest prevalence of obesity among women was observed in the Aegean region with 42% while lowest rate was observed in the Eastern region with 21%. Mediterranean region, which Adana is located in, had an obesity prevalence of 39% among women in the same study.15 Another study conducted in the northern part of Turkey, the prevalence of obesity was 23.5% (16.5% in men and 29.4% in women) and overweight was 60.3%.16 The main reason for the difference of obesity and overweight prevalence in our region seems like that our population usually consists of older-aged patients who applied to internal medicine polyclinic while others reflect the randomized patients. Besides that, it is well known that our region has bad dietary habits as fatty foods, lack of fiber and major part of daily energy is sourced through bread.

Obesity has increased until the age of 70 in our study and most of them were observed in the age group 60-69. 20-29 years was the fittest years and 50 to 79 years of life was the dominant years for obesity. After age 80, obesity was markedly decreased. In another study in our country; obesity rates were increased after 40s, dominant at 50s and decreased after the age of 60.17 Mean BMI of springers was slightly higher than the locals in our study, but obesity ratios were similar. Reports about the prevalence of obesity in rural and urban areas give conflicting results. In the Czech Republic; the prevalence of obesity in rural areas was found to be higher than urban areas (18.58% vs 12.84%). On the other hand; other developing countries like China, Saudi Arabia, South Africa, and Bahrain had higher obesity rates in urban areas (4% vs %2.4%, 39.7% vs 27%, 24% vs 17.5% and 30.99 vs. 18.24%).18 Obesity and related disease rates among woman in Solaklı and Karatas district of Adana province, which can be considered as rural area, has been investigated before.19 According to that report, 28.3% of the woman in that area were obese. In our study, woman from rural had 37.8% and urban had 41.1% rates of obesity. The explanation of the higher rates from Solaklı and Karatas district is that they randomized patients while our results are based on consecutive patients attending our outpatient clinic.

Our study clearly revealed the relationship between urbanization, aging, hyperuricemia, being overweight and obesity with metabolic disorders such as diabetes mellitus, hypertension and hyperlipidemia. MCC ratios were significantly more common at participants from urban areas in our study. Obesity, hypertension and diabetes mellitus were found to be higher in subjects from urban areas in a previous report in our country.20 In the same study metabolic syndrome rate was also higher in individuals living in city centres compared to those living in villages. The old population in Adana and Southern Turkey usually choose Pozantı for vacations; because they believe that the fresh air and natural atmosphere in Pozantı would be good for their medical conditions. That explains the difference between comorbidity rates between locals and springers. Previous reports have shown that; high uric acid levels are associated with obesity, dyslipidemia, hypertension and diabetes mellitus.21,22 Besides that, uric acid is also directly related to cardiovascular diseases.23 In our study, hyperuricemia was more common in springers. In a prospective study in Turkey; metabolically healthy and metabolically unhealthy 193 obese women were compared, and high uric acid levels have been shown as a metabolic illness parameter in obese patients.24 Being overweight and obese has been proven to have an effect on metabolic disorders, as a previous report has revealed that even a BMI cut-off of 23 may be appropriate for use in the identification of high risk for diabetes, hypertension, and hyperlipidemia.25 Increasing age is also a well-known risk factor for metabolic morbidities in accordance with our study.26

Previous reports showed that standardized hypertension prevalence rate was 49-51.3% in urban areas and 55.3-59.6% in rural areas in Turkey; but the ratios changed according to obesity, sedentary lifestyle, bad dietary habit and smoking habit in the same report.27 Prevalence of hyperlipidemia in Trabzon, a northern city in Turkey, was reported as 30.4-44.5%.28 Joshi SR et al. has also shown that hyperlipidemia prevalence is prominently higher in urban areas comparing to rural areas.29 In a large population study; obesity rate of 35.08%, hypertension rate of 13.66% and diabetes rate of 4.16% was observed from main 7 regions of Turkey.30 In The Turkish Diabetes Epidemiology Study (TURDEP), the prevalence of diabetes was 7.4%.31 Diabetes prevalence in Adana was reported as 11.6%.32 Ramachandran A et al. has observed that prevalence of diabetes was similar in the city and town, but it was significantly lower in periurban villages.33 Although there are conflicting results, the prevalence of hypertension, diabetes and hyperlipidemia in our population was relatively higher than those previous studies (33.8%, 32.1% and 35.6%, respectively) and all of them were more common in springers who live in an urban area. This can firstly be explained by older age of springers. Locals are a mixture of people living in town and villages who are mostly farmers and shepherds. It can be assumed that locals are more in physical activity. The second explanation may be the incomparable availability to medical facilities and difference of awareness among these two populations. Fresh and natural nutrition habits, comparing with easier access to fast food in urban areas, may also be another key point for the lower rate of metabolic morbidity in rural areas. Educational, cultural and psychosocial differences in rural-urban areas may also be relevant with this difference.

There were several limitations in the study. Firstly; the patient selection was not randomized, as consecutive 545 patients applying to our outpatient clinic were included in the study. Therefore, our results may not completely reflect the metabolic picture of our region. Probable risk factors for obesity, and metabolic morbidities such as smoking situation, alcohol consumption, occupation, education levels, physical activity levels and nutrition habits would have strengthened our results. Despite these limitations, we reached a sufficient number of patients to compare the urban-rural differences. Randomized cohort studies with large populations from our region are required for more accurate results.

In conclusion; obesity exists approximately one in every 3 cases and metabolic morbidities are observed in nearly half of the patients applying to internal medicine outpatient clinic in our region. Living in urban areas can be related to these metabolic morbidities, but it was not a direct risk factor for obesity. With the continuation and acceleration of urbanization, the prevalence of these metabolic morbidities will likely escalate. Therefore, urgent preventive interventions on a national scale should target these highly prevalent metabolic abnormalities (e.g. obesity, diabetes, hypertension, and dyslipidaemia). Based on our results, women and urban residents need to be the focus of more intensive attention.

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