

## PREVALENCE OF OBESITY AND NEWLY DIAGNOSED DIABETES IN THE ROMA POPULATION FROM A COUNTY IN THE SOUTH PART OF ROMANIA (CĂLĂRAȘI COUNTY) -PRELIMINARY RESULTS

Georgiana Enache<sup>1,2</sup>, Emilia Rusu<sup>1,✉</sup>, Alexandra Ilinca<sup>3</sup>, Florin Rusu<sup>4</sup>,  
Adrian Costache<sup>1</sup>, Gabriela Radulian<sup>1,3</sup>

<sup>1</sup> “Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania

<sup>2</sup> Călărași County Emergency Hospital

<sup>3</sup> “Prof. N.C. Paulescu” National Institute of Diabetes, Nutrition and Metabolic Diseases, Bucharest, Romania

<sup>4</sup> “Carol Davila” Clinical Emergency Military Hospital, Bucharest, Romania

received: December 02, 2015

accepted: February 27, 2016

available online: March 15, 2016

### Abstract

*Background and Aims: This study's aim was to evaluate the prevalence of obesity and new cases of diabetes in Roma population compared to ethnic Romanian Caucasians from Călărași County in the south part of Romania. Material and Methods: The population included in this study is part of a larger project that aims to evaluate the prevalence of obesity, prediabetes and diabetes in the Roma population from Călărași County. So far we have included 344 people: 180 Roma (119 female/61 male), and 164 non-Roma (108 female/56 male) aged between 18 and 85. Results: In Roma population, the prevalence of underweight, normal weight, overweight and obesity was 4.4% (n=8), 37.2% (n=67), 26.7% (n=48) and 31.7% (n=57) respectively. In Romanian Caucasians, the prevalence of overweight and obesity was 37.2% (n=61) and 32.3% (n=53) respectively. Diabetes was diagnosed in 14.6% (n=24) of Romanian Caucasians and in 11.7% (n=21) of Roma population. Risk factors for obesity in Roma population were: lower socio-educational level, smoking, physical inactivity (active less than 30 min/day). Conclusions: High prevalence of overweight (26.7%), obesity (31.7%) and new cases of diabetes (11.7%) among the Roma population in the south part of Romania, Calarasi County was an important finding of our study. We observed a negative effect of lifestyle behaviours on health-related outcomes: smoking, sedentariness, lower socio-educational level.*

**key words:** Roma people, obesity, diabetes, epidemiology

### Background and Aims

There are 8-12 million of Roma ethnics (also known as Gypsies, Roma people) living in Europe, with approximately 4.2 million living in Central and Eastern Europe [1,2]. By the second

half of the twentieth century, the population of Roma in Romania registered a continuous growth. In Romania there are 621.573 Roma ethnics - 3.29%, representing the second largest ethnic minority [3,4].

✉ Dionisie Lupu Street, No. 37, District 2, Bucharest, Romania; Phone: +40-742.959.946  
corresponding author e-mail: emiliarusumd@yahoo.com

In many countries, Roma populations have higher levels of childhood and adult obesity than non-Roma population [5,6]. In addition, previous studies have found higher mortality rates and lower life expectancy in Roma than non-Roma population [7].

This study's aim was to evaluate the prevalence of obesity and newly diagnosed diabetes in Roma population compared to ethnic Romanian Caucasians from Călărași County in the south part of Romania. The population of this study is part of a larger project that aims to evaluate the prevalence of obesity, prediabetes and diabetes in Roma people from Călărași County.

## Material and Methods

### *Description of the study design and population*

This cross-sectional, epidemiologic, non-interventional study was conducted from March 2014 until November 2015 in several localities in Călărași County. Screening action was promoted by the local media (newspaper and television) in Călărași and throughout the local general practitioners. The screening procedures carried out for all participants included interviews about *personal and family medical history*, anthropometric and clinical measurements and fasting capillary glucose (FCG) as well as questions related to physical activity, food consumption, smoking, educational and occupational level. All participants completed the Finnish Diabetes Risk Score questionnaire.

A total of 453 participants aged 6–84 years took part in the screening. For the present study we excluded subjects who refused to sign the informed consent (n=3), patients with already diagnosed type 1 or type 2 diabetes mellitus (DM) (n=2, respectively n=58) and participants <18 years (n=47). So far we have included 344

subjects: 180 Roma (119 female/61 male) and 164 non-Roma (108 female and 56 male) aged between 18 and 84 years.

*Inclusion criteria:* women and men aged between 18 and 85 years, without previously diagnosed type 1 or type 2 diabetes mellitus; born and residing in Romania; individuals that are able to understand the informed consent.

*Anthropometric parameters:* Weight, height, waist, hip and neck circumferences (WC, HipC, NC) were measured with a standard clinical scale and a centimeter according to standard procedures. Body mass index (BMI=weight (kg)/square height (m<sup>2</sup>), waist to hip ratio (WHR=WC/HipC) and waist to height ratio (WHtR=WC/Height) [8] were calculated.

For this study we calculated “body adiposity index” (BAI) as a new method to estimate the percentage of body fat (%BF); BAI is based on hip circumference and height without requiring a measure of body weight (BAI=[Hip circumference (cm)/height (m)<sup>1.5</sup>]-18) [9]. Percentage body fat (BF%) was predicted using an equation developed in Dutch Caucasians which include BMI, age, and sex [10]: BF% = 1.2xBMI + 0.23xage - 10.8xsex - 5.4, where age is in years and sex is 0 in females and 1 in males. BAI and BF% have been previously validated with measurements using Dual Energy X-ray Absorptiometry (DXA) [11], magnetic resonance [12], or computed tomography [13].

*Physical activity, food consumption, smoking and educational level:* Data related to physical activity, food consumption and smoking were obtained using the Finnish Diabetes Risk Score (FINDRISC) questionnaire completed by the research team. Those reporting less than 30 minutes of physical activity per day were classified as inactive. In order to assess education levels we referenced the last institution attended out of three categories: primary (<8 years of education),

secondary (8–12 years of education), and university (>12 years of education). The classification used for smoking was non-smoker (has never smoked), ex-smoker and smokers (current smokers).

**Definitions:** For BMI classification we used the definitions of World Health Organization [14]: underweight was defined as BMI <18.5 kg/m<sup>2</sup>, normal weight as 18.5-24.9 kg/m<sup>2</sup>, overweight as 25-29.9 kg/m<sup>2</sup>, and obesity as a BMI over 30 kg/m<sup>2</sup>. %BF ≥ 20% (males) and %F ≥ 33% (females) were the cut-points adopted to define excessive body fat [15]. Metabolic waist or central obesity was defined as WC ≥94 cm for men and ≥80 cm for women according to the IDF recommendations [16]. WHtR over 0.5 for both males and females defined central fat distribution [17].

Diabetes was defined using the American Diabetes Associations 2010 criteria [18].

Resting blood pressure was measured by trained technicians using auscultatory methods with patient in a seated position. Patients were considered to have hypertension if they had systolic blood pressure (SBP) ≥140 mmHg, or diastolic blood pressure (DBP) ≥90 mmHg, or currently receiving antihypertensive treatment, or medical history of physician-diagnosed hypertension.

Laboratory assays: Fasting capillary glucose (FCG) was measured using the Accu-Chek® Active (Roche Diagnostics GmbH, Mannheim, Germany) glucose meter after an overnight fast. Patients with FCG > 100 mg/dl were recalled for biochemical analyses including fasting plasma glucose and HbA1c. For fasting plasma glucose measurement we used spectrophotometry (colorimetric enzyme assay method GOD / PAP, using the hexokinase enzymatic method). For HbA1C measurement we used spectrophotometry / amperometric method.

### *Statistical Analyses*

Comparisons among groups were made by use of ANOVA for quantitative variables and the  $\chi^2$  test for categorical variables. All reported p-values were based on two-sided tests. The level of statistical significance was set at  $p < 0.05$ . Continuous variables that were normally distributed were presented as mean±standard deviation (SD), those with abnormal distribution as median and categorical variables as percentages. Kolmogorov-Smirnov test was used for testing the normality of data.

For statistical analyses we used Statistical Package for Social Sciences (SPSS) version 19.

### **Results**

The socio-economic and demographic characteristics of the study participants are presented in [Table 1](#). Educational level was significantly different between groups ( $p < 0.001$ ); 81.6% (n=155) from Roma population were assigned in category less than 8 classes versus 44.5% (n=73) of Romanian Caucasians. In both populations women had a lower educational level (Table 1). Prevalence of cigarette smoking was higher in Roma population (45.6% (n=82) vs. 23.1% (n=37),  $p < 0.001$ ). In Roma population, the prevalence of underweight, normal weight, overweight and obesity was 4.4% (n=8), 37.2% (n=67), 26.7% (n=48) and 31.7% (n=57) respectively. In Romanian Caucasians, the prevalence of underweight, normal weight, overweight and obesity was 5.5% (n=9), 25% (n=41), 37.2% (n=61) and 32.3% (n=53) respectively. Moreover 72.8% (n=131) from Roma and 80.5% (n=132) from Romanian Caucasians presented central obesity using waist circumference. Hypertension had a higher prevalence in Romanian Caucasians (64% (n=105) vs. 48.9% (n=88),  $p = 0.005$ ). Diabetes was diagnosed in 14.6% (n=24) of Romanian Caucasians and in 11.7% (n=21) of Roma population ( $p = 0.099$  between populations).

**Table 1.** Socio-economic and demographic characteristics of the study participants.

Variables	Romanian (n=164)	Caucasians	p*	Roma population (n=180)		p*	p#
	Female	Male		Female	Male		
Sex distribution	108	56		119	61		0.96
Environment (urban / rural) (n, %)							
Urban	10 (8.4%)	8 (13.1%)	0.038	51 (47.2%)	36 (65.3%)	0.319	<0.001
Rural	109 (91.6%)	53 (86.9%)		57 (52.8%)	20 (35.7%)		
Educational level (n, %)							
< 8 classes	56 (51.9%)	17 (30.4%)	0.004	111 (93.3%)	44 (72.1%)	0.001	<0.001
8-12 classes	32 (29.6%)	16 (28.6%)		8 (6.7%)	10 (16.4%)		
>12 classes	20 (18.5%)	23 (41.4%)		0	7 (11.5%)		
Current smoking (n, %)							
	28 (26.2%)	9 (17%)	0.002	45 (37.8)	37 (60.7)	0.012	<0.001
BMI (kg/m <sup>2</sup> ) (n, %)							
<18.5	7 (6.5%)	2 (3.6%)	0.233	5 (4.2%)	3 (4.9%)	0.512	0.027
18.5-24.9	30 (27.8%)	11 (19.6%)		46 (38.7%)	21 (34.4%)		
25-29.9	33 (30.6%)	28 (50%)		34 (28.6%)	14 (23%)		
>30	38 (35.2%)	15 (26.8%)		34 (28.6%)	23 (37.7%)		
Metabolic waist (>80 cm in female, >94 cm in male) (n, %)							
	87 (80.6%)	45 (80.4%)	0.976	95 (79.8%)	36 (59%)	0.003	0.092
WHR (>0.85 in female, >0.95 in men) (n, %)							
	79 (73.1%)	37 (66.1%)	0.345	87 (73.1%)	33 (54.1%)	0.001	0.417
WhtR >0.5							
	90 (83.3%)	50 (89.3%)	0.306	95 (81.9%)	42 (68.9%)	0.049	0.03
Sedentary lifestyle in min/week (<30 min/day) (n, %)							
	41 (38%)	18 (32.1%)	0.461	50 (42%)	21 (34.4%)	0.324	0.507
Hypertension (n, %)							
	64 (59.3%)	41 (25%)	0.077	59 (49.6%)	29 (47.5%)	0.796	0.005
Diabetes (n, %)							
	15 (13.9%)	9 (16.1%)	0.625	9 (7.6%)	12 (19.7%)	0.046	0.099

p\* between female and male in the same group; p# between Romanian Caucasians and Roma population

**Table 2.** Health-related anthropometric characteristics in Romanian Caucasians.

	Female (n=108)		Male (n=56)		Total (n=164)		p*
	Mean	SD	Mean	SD	Mean	SD	
Age (years)	53.81	14.45	55.91	12.74	54.52	13.89	NS
Height (cm)	159.18	7.49	172.68	14.02	163.79	12.02	<0.001
Weight (cm)	70.07	15.67	84.86	18.78	75.12	18.15	<0.001
BMI (kg/mp)	27.63	5.81	28.03	4.79	27.77	5.47	NS
WC (cm)	94.13	14.25	103.39	15.09	97.29	15.15	<0.001
HipC (cm)	105.88	12.71	106.07	14.14	105.94	13.18	NS
NC (cm)	35.14	4.36	41.33	4.78	37.24	5.37	<0.001
WHR	0.89	0.07	0.98	0.07	0.92	0.08	<0.001
WhtR	0.59	0.09	0.60	0.07	0.59	0.08	NS
BAI	34.25	7.95	28.50	5.81	32.39	7.54	<0.001
BF (%)	40.08	8.32	30.18	6.77	36.70	9.12	<0.001
SBP (mmHg)	137.76	26.25	151.44	26.05	142.27	26.89	<0.001
CPG (mg/dl)	111.94	29.66	116.73	36.45	113.57	32.11	NS
FPG (mg/dl)**	163.4	44.67	179.33	48.24	169.37	45.68	NS
HbA1c (%)**	7.05	1.2	7.09	0.96	7.07	1.1	NS

p\* between female and male in the same group; \*\*, only in patients with diabetes.

**Table 3.** Health-related anthropometric characteristics in Roma population.

	Female (n=119)		Male (n=61)		Total		p*	p#
	Mean	SD	Mean	SD	Mean	SD		
Age (years)	48.93	16.02	42.40	15.72	46.65	16.17	0.01	<0.001
Height (cm)	156.52	5.91	170.36	8.34	161.21	9.46	<0.001	0.03
Weight (cm)	67.13	17.13	81.56	21.40	72.02	19.84	<0.001	NS
BMI (kg/mp)	27.30	6.21	28.01	6.73	27.54	6.38	NS	NS
WC (cm)	94.13	15.64	98.67	19.15	95.70	17.02	NS	NS
HipC (cm)	104.59	14.25	103.15	12.34	104.09	13.60	NS	NS
NC (cm)	33.30	3.35	39.36	5.38	35.39	5.05	<0.001	<0.001
WHR	0.90	0.08	0.95	0.10	0.92	0.09	<0.001	NS
WHtR	0.60	0.10	0.58	0.11	0.59	0.10	NS	NS
BAI	34.13	10.96	28.50	5.81	32.23	9.89	<0.001	NS
BF (%)	38.61	8.77	27.11	9.65	34.72	10.57	<0.001	NS
SBP (mmHg)	129.58	27.64	136.02	25.48	131.77	27.03	NS	NS
CPG (mg/dl)	102.06	36.84	118.80	53.91	107.73	43.96	0.02	0.05
FPG (mg/dl)**	192.5	90.51	213.75	76.17	204.66	81.14	NS	NS
HbA1c (%)**	7.44	1.59	7.73	1.24	7.44	1.36	NS	NS

p\* between female and male in the same group; p# between Romanian Caucasians and Roma population; \*\*, only in patients with diabetes.

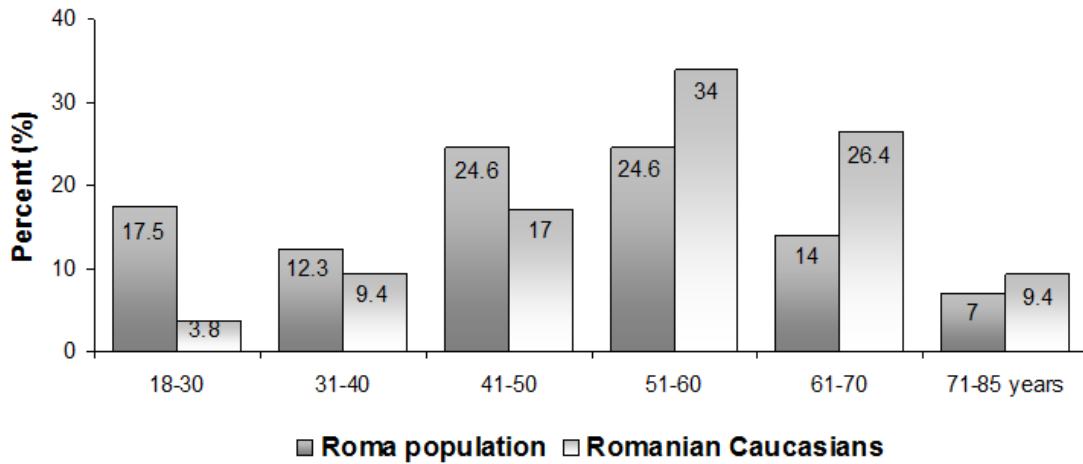
Roma people were younger (aged 46.65±16.17 vs. 54.52±13.89 years, p <0.001), had lower height (161.2 ± 9.46 vs. 163.79 ± 12.02 cm, p=0.03) and lower neck circumference (35.39 ± 5.05 vs. 37.24 ± 5.37 cm), as detailed in [Tables 2](#) and [3](#). In Roma population there were significant differences for height, weight, neck circumferences, WHR, BAI and BF (%) between genders but no significant differences for BMI, WC, and HipC ([Table 3](#)). In Romanian Caucasians, males were on average heavier, taller, with higher waist and neck circumferences, and higher WHR than females ([Table 2](#)). BAI and BF (%) were lower in Romanian Caucasian men ([Table 2](#)). We found significant differences for age (p<0.001), neck circumference (p=0.04), and BF % (p=0.05) between men (Romanian Caucasian vs. Roma). There were significant differences for age (p=0.023), height (p=0.003), neck circumference (p<0.001) and SBP (p=0.024) between women (Romanian Caucasian vs. Roma).

### Obesity and age in Roma and general population

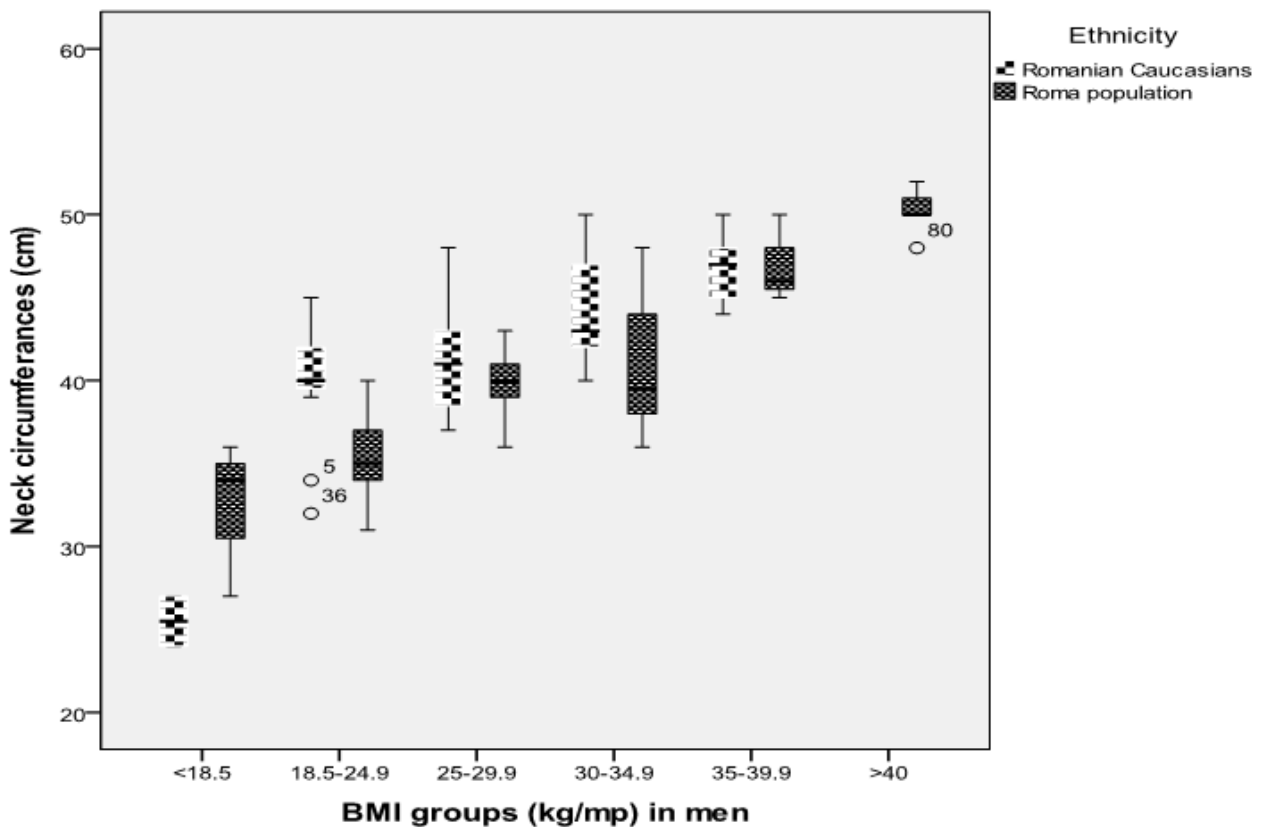
The highest prevalence of obesity in Roma population was found in the 41-50 and 51-60 years age groups (n=14, 24,6% respectively n=14, 24,6%); in Romanian Caucasians the peak was in the 51–60 years age group (n=18, 34%). There was a lower prevalence of obesity in persons over 71 years (7%, n=4) in Roma population, and in the 18-30 age group (n=2, 3,8%) for Romanian Caucasians (all p>0.05).

### Sex and racial differences in neck fat accumulation

Data for neck circumference stratified by sex and ethnicity are presented in [Figure 2](#) and [3](#). All men had a significantly higher NC than women (p<0.001). Romanian Caucasian men had higher neck circumference (44.33±4.78 cm vs. 39.36±5.37 cm (p= 0.04)). In all groups, neck circumference was higher with increasing BMI ([Figure 2](#) and [3](#)).



**Figure 1.** Prevalence of obesity in Roma population and Romanian Caucasians.



**Figure 2.** Neck circumference in men stratified by ethnicity

### Risk factors for obesity

Obesity was present in 32.3% (n=53) of Romanian Caucasian and 31.7% (n=57) of Roma population (p=0.897). Risk factors for obesity in the Roma population were: lower socio-educational level (less than 8 years) (OR=1.3,

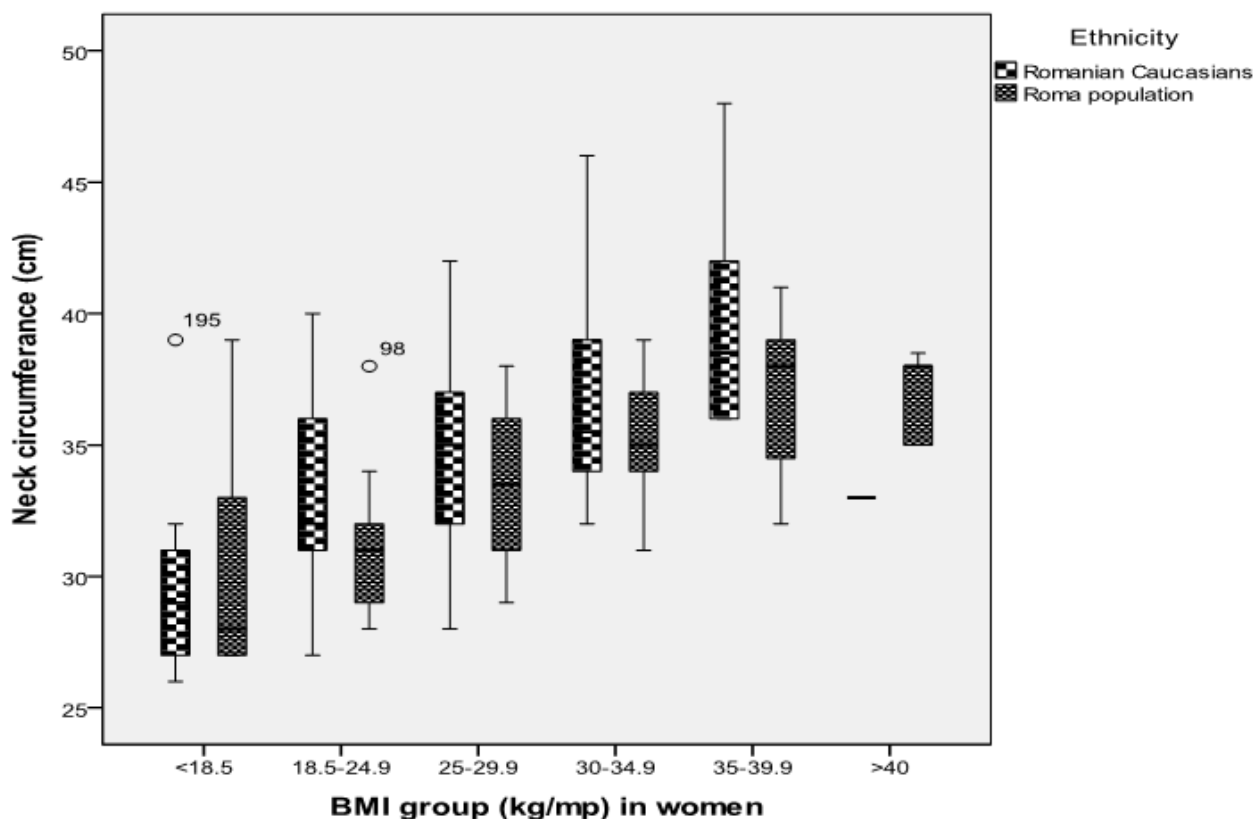
95% CI 1.1-3.45), smoking (OR=1.4 (95% CI 1.04-4.21) and physical activity less than 30 min/day (OR=1.4 95% CI 1.2-5.23).

### Discussion

Our study revealed that the prevalence of overweight and obesity in Roma population was

26.7% and 31.7% respectively and for Romanian Caucasians 37.2% and 32.3% respectively. These results are similar to those published by Bartos and Badila, where the prevalence of obesity was 34.4% in Roma people [19]. Recently the ORO study, which included 2128 persons, found a prevalence of 31.1% for

overweight and 21.3% for obesity in Romania [20]. Global prevalence of adult (>18 years) obesity and overweight reported by WHO in 2014 was 13% (11% for men and 15% for women) and 39% (38% of men and 40% of women) respectively [21].



**Figure 3.** Neck circumference in women stratified by ethnicity

In Slovakia, de Courten B et al. [22] found a prevalence of 30% (95% CI 26-34) for obesity. In another study, the Roma population in the eastern Croatian region of Baranya had a prevalence for overweight and obesity of 30% and 23% respectively [23]. Prevalence of obesity in the Roma population residing in the Greater Bilbao region (Basque Country, Spain) was 51.7% [24]. In a study that included 70 adult Roma immigrants in Italy, the prevalence of obesity was 32.2% in males and 12.8% in females [25].

In Croatia, the rate of obesity was higher among Roma women than in Roma men among the general population [26]. A higher prevalence of obesity in Roma women was reported also in other countries [27,28].

In our study, the analysed Roma population presented a higher prevalence of visceral obesity (72.8%) compared to the results of Bartoş and Bădilă (50.8%), but the cut-off values for waist circumferences used by the last were 88 cm for women and 102 cm for men [19]. In a study conducted in Hungary (including 646 Roma adults) the prevalence of central obesity was

60.68% (66.16% in women and 52.17% in men) [29].

In our study, the preliminary data revealed a high prevalence of diabetes in the Roma population living in Călărași Contry. In 2011, Bartoș and Bădilă found a prevalence of 10.3% for diabetes [19]. The PREDATORR (PREvalence of DiAbeTes mellitus, prediabetes, overweight, Obesity, dyslipidemia, hyperuricemia and chronic kidney disease in Romania) study has shown an overall age- and sex-adjusted prevalence of diabetes in the general adult Romanian population of 11.6% (95%CI 9.6%-13.6%) [30]. In a study conducted in Slovakia, the prevalence of type 2 diabetes in Roma population was 30% versus 10% in the control population, obesity 65% (vs. 30% in controls) and metabolic syndrome 20% versus 4% in controls [22] .

In our study the prevalence of hypertension was 30.3%, similar with that reported in the study conducted by Bartoș and Bădilă [19].

Similar to other studies of the Roma population, we found that lower educational level is a risk factor for obesity [31].

Denutrition was present in 4.9% of participants (4.4% in Roma population and 5.5% in Romanian Caucasians). However, in Croatia, 8% of the Bayash were underweight in contrast to 1% of the majority of the population in the region, and underweight rates were especially high in women (11%) compared to men (4%). We did not find differences in gender distribution for malnutrition.

Regarding height, only Roma women had shorter stature. In Serbia, a study revealed that Roma males and females had significantly shorter stature [32]. Recent studies [33] revealed

that shorter people have a higher risk of metabolic syndrome and other related diseases with a similar WC. These findings indicated that height modification of WC is reasonable and it should be taken into account in obesity evaluation.

The prevalence of current smoking in the Roma population was significantly higher compared to that recorded Romanian Caucasians and that reported in other studies [19].

Our study has several limitations. Thus, the cross-sectional design of the study is a limiting factor with regard to the risk factor for obesity and diabetes. Another limitation is represented by the fact that Roma population in Calarasi is not representative for the overall Romanian Roma population.

### Conclusions

High prevalence of overweight (26.7%), obesity (31.7%) and diabetes (11.7%) among the Roma population in the south part of Romania, Calarasi County was an important finding of our study.

We observed a negative effect of lifestyle on health-related outcomes. Thus, smoking, sedentariness and lower socio-educational level were risk factors for obesity in the Roma population. All these could represent a starting point for the development and implementation of prevention programs for this population.

**Acknowledgement.** This paper is supported by The Sectoral Operational Programme Human Resources Development (SOP HRD), financed from the European Social Fund and by the Romanian Government under the contract number POSDRU/187/1.5/S/155631.

## REFERENCES

---

1. **Hajioff S, McKee M.** The health of the Roma people: a review of the published literature. *J Epidemiol Community Health* 54: 864-869, 2000.
2. **Dobranici M, Buzea A, Popescu R.** The cardiovascular risk factors of the Roma (Gypsies) people in Central-Eastern Europe: a review of the published literature. *J Med Life* 5: 382-389, 2012.
3. **McKee M, Adany R, MacLehose L.** Health status and trends in candidate countries. In: McKee M, MacLehose L, Nolte E (eds). *Health Policy and European Union Enlargement*. Open University Press, Buckingham, pp. 24-42, 2004.
4. **Center for Documentation and Information on Minorities in Europe-Southeast Europe (CEDIME-SE).** Minorities in Southeast Europe. Roma of Romania. 2001. Available at [http://www.edrc.ro/resurse/rapoarte/Roma\\_of\\_Romania.pdf](http://www.edrc.ro/resurse/rapoarte/Roma_of_Romania.pdf)
5. **Robertson A, Lobstein T, Knai C.** Obesity and socio-economic groups in Europe: Evidence review and implications for action. 2007. Available at [http://ec.europa.eu/health/ph\\_determinants/life\\_style/nutrition/documents/ev20081028\\_rep\\_en.pdf](http://ec.europa.eu/health/ph_determinants/life_style/nutrition/documents/ev20081028_rep_en.pdf), accessed 4 December 2013.
6. **Babinska I, Veselska ZD, Bobakova D et al.** Is the cardiovascular risk profile of people living in Roma settlements worse in comparison with the majority population in Slovakia? *Int J Public Health* 58: 417-425, 2013.
7. **Koupilová I, Epstein H, Holčík J, Hajioff S, McKee M.** Health needs of the Roma population in the Czech and Slovak Republics. *Soc Sci Med* 53: 1191-1204, 2001.
8. **Hsieh SD, Yoshinaga H.** Abdominal fat distribution and coronary heart disease risk factors in men-waist/height ratio as a simple and useful predictor. *Int J Obes Relat Metab Disord* 19: 585-589, 1995.
9. **Bergman RN, Stefanovski D, Buchanan TA et al.** A better index of body adiposity. *Obesity (Silver Spring)* 19: 1083-1089, 2011.
10. **Deurenberg P, Weststrate JA, Seidell JC.** Body mass index as a measure of body fatness: age and sex specific prediction formulas. *Br J Nutr* 65: 105-114, 1991.
11. **Geliebter A, Atalayer D, Flanchbaum L, Gibson CD.** Comparison of body adiposity index (BAI) and body mass index (BMI) with estimations of % body fat in clinically severe obese women. *Obesity (Silver Spring)* 21: 493-498, 2013.
12. **Schulze MB, Thorand B, Fritsche A et al.** Body adiposity index, body fat content and incidence of type 2 diabetes. *Diabetologia* 55:1660-1667, 2012.
13. **Barreira TV, Staiano AE, Harrington DM et al.** Anthropometric correlates of total body fat, abdominal adiposity, and cardiovascular disease risk factors in a biracial sample of men and women. *Mayo Clin Proc* 87: 452-460, 2012.
14. **World Health Organization.** Obesity: preventing and managing the global epidemic. WHO Technical Report Series. 1-252, 2000.
15. **Gallagher D, Heymsfield SB, Heo M, Jebb SA, Murgatroyd PR, Sakamoto Y.** Healthy percentage body fat ranges: an approach for developing guidelines based on body mass index. *Am J Clin Nutr* 72: 694-701, 2000.
16. **Alberti KG, Zimmet P, Shaw J.** Metabolic syndrome - a new world-wide definition. A Consensus Statement from the International Diabetes Federation. *Diabet Med* 23: 469-480, 2006.
17. **Ashwell M, Hsieh SD.** Six reasons why the waist-to-height ratio is a rapid and effective global indicator for health risks of obesity and how its use could simplify the international public health message on obesity. *Int J Food Sci Nutr* 56: 303-307, 2005.
18. **American Diabetes Association.** Diagnosis and classification of diabetes mellitus. *Diabetes Care* 33[Suppl 1]: S62-S69, 2010.
19. **Bartos D, Badila E.** Prevalence of arterial hypertension and other cardiovascular risk factors in an adult gypsy population from Romania. *Romanian Journal of Cardiology* 21, 2011.
20. **Roman G, Bala C, Crețeanu G et al.** Obesity and health-related lifestyle factors in the general population in Romania: a cross sectional study. *Acta Endocrinologica* 11: 64-72, 2015.
21. **World Health Organizaton.** Obesity and overweight. Fact Sheet No. 311, 2015. Available: <http://www.who.int/mediacentre/factsheets/fs311/en/>.
22. **de Courten BV, de Courten M, Hanson RL et al.** Higher prevalence of type 2 diabetes, metabolic

syndrome and cardiovascular diseases in gypsies than in non-gypsies in Slovakia. *Diabetes Res Clin Pract* 62: 95–103, 2003.

**23. Zajc M, Smolej Narančić NS, Škarić-Jurić T et al.** Body mass index and nutritional status of the Bayash Roma from Eastern Croatia. *Coll Antropol* 30: 783–787, 2006.

**24. Poveda A, Ibáñez ME, Rebato E.** Obesity and body size perceptions in a Spanish Roma population. *Ann Hum Biol* 41: 428-435, 2014.

**25. Gualdi-Russo E, Zironi A, Dallari GV, Toselli S.** Migration and health in Italy: a multiethnic adult sample. *J Travel Med* 16: 88-95, 2009.

**26. Zeljko HM, Skarić-Jurić T, Narančić NS et al.** Age trends in prevalence of cardiovascular risk factors in Roma minority population of Croatia. *Econ Hum Biol* 11: 326-336, 2012.

**27. Carrasco-Garrido P, López de Andrés A, Hernández Barrera V, Jiménez-Trujillo I, Jiménez-García R.** Health status of Roma women in Spain. *Eur J Public Health*. 21: 793-798, 2011.

**28. Dolinska S, Kudlackova M, Ginter E.** The prevalence of female obesity in the world and in the

Slovak Gypsy women. *Bratisl Lek Listy* 108: 207-211, 2007.

**29. Kosa Z, Moravcsik-Kornyicki Á, Diószegi J et al.** Prevalence of metabolic syndrome among Roma: a comparative health examination survey in Hungary. *Eur J Public Health* 25: 299-304, 2015.

**30. Moța M, Popa SG, Moța E et al.** Prevalence of diabetes mellitus and prediabetes in the adult Romanian population: PREDATORR study. *J Diabetes* 2015. doi: 10.1111/1753-0407.12297.

**31. Krajcovicova-Kudlackova M, Blaziceck P, Spustova V, Valachovicova M, Ginter E.** Cardiovascular risk factors in young Gypsy population. *Bratisl Lek Listy* 105: 256-259, 2004.

**32. Gallagher A, Cvorović J, Strkalj G.** Body mass index in Serbian Roma. *Homo* 60: 567-578, 2009.

**33. Schneider HJ, Klotsche J, Silber S, Stalla GK, Wittchen HU.** Measuring abdominal obesity: effects of height on distribution of cardiometabolic risk factors risk using waist circumference and waist-to-height ratio. *Diabetes Care* 34: e7, 2011.