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AKADÉMIAI KIADÓ

A complex study of obesity and cardiometabolic risk factors in the Hungarian-speaking population of the Carpathian Basin, with a focus on the Roma minority

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ABSTRACT

Obesity and other unhealthy behaviors are behind cardiovascular morbidity and mortality, with the Roma population particularly at risk. The aim of our cross-sectional (questionnaire- and physical measurements-based) study was to compare the prevalence of obesity in Hungarian, Romanian, and Slovakian Hungarian-speaking Roma and non-Roma (N = 1893) in relation to lifestyle-related risk factors for cardiovascular diseases (CVD). In the total sample, the proportion of extreme obesity was higher in Roma ($P < 0.001$) than non-Roma. The mean waist circumference was the highest in Hungary ($P < 0.001$). Visceral fat was higher in the Hungarian Roma sample than in the Slovak ($P = 0.006$) or Romanian Roma samples ($P = 0.005$). Hungarian Roma total cholesterol levels were lower than in the Slovak ($P < 0.001$) or Romanian samples ($P < 0.001$). Hypertension and cholesterol levels were associated with a higher risk among non-Roma men ($P < 0.001$), and the presence of smoking increased CVD risk among both men ($P = 0.024$) and women ($P < 0.001$) in the Roma minority. The combined presence of several risk factors was found mainly in Roma. Overall, Roma scores were found to be worse, but ethnicity did not provide clear evidence for the questions examined, but rather the level of education, which is associated with socioeconomic status.

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KEYWORDS

Roma, obesity, cardiometabolic risk

1. INTRODUCTION

In our fast-paced world, we are exposed to many risks, and we cope with stresses differently. According to Poirier (2014), we are living in an era where our cardiovascular health is setting the upper limit of the human lifespan.

According to HCSO (Hungarian Central Statistical Office) (2021), although the cardiovascular disease (CVD) mortality rate has declined somewhat in our country since 2000 (35.9%), myocardial infarction, ischaemic heart disease, or cerebrovascular disease are still the leading causes of deaths, accounting for 33.3% of deaths in 2019. Hungary is followed by Romania and Slovakia in the list of the three countries that are the focus of the study (WHO 2022).

The lifestyle, obesity, stress, chronic diseases, or even comorbidities are associated with an increased risk of developing CVD. The main risk factors for developing the disease are high blood pressure, high total cholesterol and triglycerides, smoking, physical inactivity, and obesity (Wallisch et al., 2021; An et al., 2023). These are basically all modifiable factors. The strongest non-modifiable risk factor is age, followed by gender and race (Kotseva et al., 2019; Jilani et al., 2021; Jancsó et al., 2022).

In the world ranking of obesity, Hungary ranks 41st with 26.5% of the population being obese. Romania ranks 75th with 22.5% and Slovakia 98th with 20.5% obesity (Obesity Rates by Country, 2022).

In the context of ethnicity in Europe, the Roma minority is the focus of our study. Even today they tend to live in large, closed communities, often segregated, and under poor sanitary conditions. Low educational attainment, resulting unemployment, poor nutrition, high levels of smoking and alcohol consumption, and lack of physical activity may all contribute to higher morbidity and mortality rates among the Roma minority (FRA, 2018). Their number is estimated at 10–12 million, half of the Roma population live in EU countries, and the majority are citizens of these countries. The European Commission (2020) estimates that the majority of Roma live in four Member States (Bulgaria, Slovakia, Romania, and Hungary). Due to their socio-economic status, many of them are disadvantaged, have very poor health, and often have difficulty accessing health care. CVD is thought to be associated with higher mortality among Roma than among the general population (Piko et al., 2021; Zajc Petranović et al., 2021), and similar patterns have been reported in Slovakia and Romania (Babinská et al., 2014; Orav, 2016).

The target population of our comparative research was the Hungarian-speaking Roma and non-Roma population living in rural areas in Hungary, Romania, and Slovakia. The Roma minority is growing in all three countries (Orav, 2016; Atlas, 2019).

The objective of this publication was to compare the prevalence of risk factors underlying CVD in the three countries. It is important to investigate whether there are parameters that are typical for a sample of the countries we examine, irrespective of gender, age, ethnicity, and country. The pandemic caused by the SARS-CoV-2 broke out before the start of our research, so our work was carried out in this setting. The presence and impact of the virus therefore motivated our research even more. Obesity and the associated chronic cardiovascular disease

(CVD) are already a major concern in the population by default, whereas changing life circumstances in the context of the epidemiological response have further increased both the incidence and prevalence of obesity and CVD (Chocair et al., 2020; Stefan et al., 2021).

2. MATERIALS AND METHODS

Our study was conducted among Hungarian-speaking residents aged 18, living in rural areas of the Carpathian Basin, of Roma and non-Roma origin in three countries. The inclusion criteria for Roma and non-Roma sample were, in addition to age, to participate in the research voluntarily and to state clearly whether they considered themselves to be Roma or non-Roma. Those who did not agree to participate in both the questionnaire and the physical survey were excluded from the study.

The survey was conducted in 21 settlements in Hungary, 15 in Romania, and 6 in Slovakia. The survey was carried out in five regions of Hungary, whereas in Romania the majority of the survey was conducted in the counties of Bihor, Satu Mare, Harghita, Mures, and Covasna, and in Slovakia in the districts of Nitra, Kosice, and Banska Bystrica. The subjects of our research were reached through social networks and local Roma leaders.

We started our study with a self-made questionnaire including questions on socio-economic status, health status, and health behaviour. As a second part of the study, we conducted physical measurements at the locations in 2021 and 2022. Physical examinations were carried out on all participants who completed the questionnaire, according to the measurement protocol. Blood parameters were measured on an empty stomach, no food was consumed at least 6 h before the measurement as the organisers had informed everyone in advance. We used OMRON 511 Bioimpedance body composition monitors and OMRON M7 Intelli IT blood pressure monitors for the physical examinations, and MuliCare IN 3-in-1 kits to measure blood glucose, triglycerides, and cholesterol levels for blood samples.

In the questionnaire survey, we listed examples related to the issue of physical activity (hiking, cycling, sports, gardening, or if you walk a lot, e.g. going to work or shopping, or running errands in the village).

The questionnaire survey was performed under the ethical approval of the ETT TUKEB (ETT TUKEB IV/5210-2/2020/EKU), and the physical examinations were performed under an official ethical research approval of the head of the National Public Health Center (NPHC) (20102-8/2021/EÜIG).

SPSS Statistics 25 was used for statistical analysis. It was used to perform descriptive statistics. Khi2 test, *T*-test, and ANOVA were used to examine associations and differences between variables. Normality test was performed using Kolmogorov–Smirnov test with 95% confidence interval and $P < 0.05$ significance level.

3. RESULTS AND DISCUSSION

Our sample consisted of 1,893 participants from Hungary, Romania, and Slovakia, approximately half of whom were of Roma origin, with women over-represented in the subsamples. The average age was similar in all strata, but it is also clear that the educational attainment of Roma participants was lower in all strata (Table 1).

Table 1. Socio-demographic data of the sample

Variable		Hungary (n = 852) (45.47 ± 14.96 year)				Romania (n = 631) (40.12 ± 15.69 year)				Slovakia (n = 631) (40.12 ± 15.69 year)			
		Roma (n = 430) (44.61 ± 14.52 year)		Non-Roma (n = 422) (46.34 ± 15.38 year)		Roma (n = 330) (39.07 ± 14.48 year)		Non-Roma (n = 301) (41.27 ± 16.87 year)		Roma (n = 204) (39.42 ± 15.51 year)		Non-Roma (n = 206) (40.63 ± 14.55 year)	
Gender		Male (n = 108)	Female (n = 322)	Male (n = 128)	Female (n = 294)	Male (n = 72)	Female (n = 258)	Male (n = 118)	Female (n = 183)	Male (n = 58)	Female (n = 146)	Male (n = 43)	Female (n = 163)
Age (year)		44.35 ± 16.07	44.70 ± 13.98	46.45 ± 16.12	46.29 ± 15.07	38.00 ± 15.35	39.37 ± 14.25	42.31 ± 17.26	40.60 ± 16.63	39.66 ± 16.55	39.32 ± 15.13	44.26 ± 15.50	39.67 ± 14.19
Education	8 primary class or less	50.0%	60.2%	21.1%	15.0%	70.8%	84.5%	23.7%	29.0%	36.2%	61.0%	2.3%	5.5%
	Secondary vocational school	24.1%	19.9%	21.1%	11.2%	23.6%	12.8%	24.6%	9.8%	32.8%	21.2%	20.9%	13.5%
	Secondary school	19.4%	12.7%	28.9%	29.6%	4.2%	2.3%	32.2%	26.2%	24.1%	15.8%	25.6%	31.3%
	College/ University	6.5%	7.1%	28.9%	44.2%	1.4%	0.4%	19.5%	35.0%	6.9%	2.1%	51.2%	49.7%

At the time of the survey, Roma smoked at higher rates in all three countries. A notable finding was that in Slovakia, quit rates were higher among Roma than among non-Roma (Fig. 1).

Physical inactivity is predominantly particularly prevalent among Roma in Hungary and Romania. In Slovakia, however, Roma are reported to be more active (Fig. 2).

The results of the physical examinations are shown in Table 2.

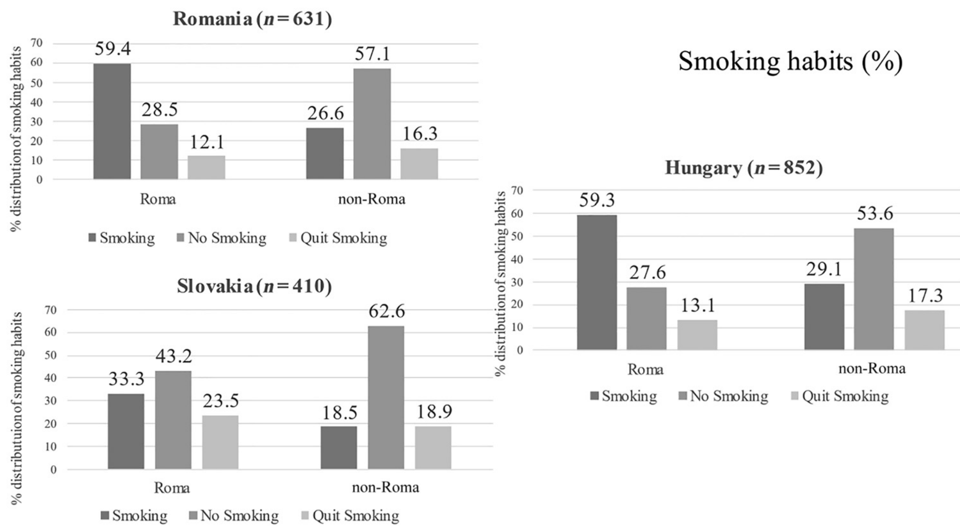

Fig. 1. Smoking habits in each sub-sample in % (N = 1893)

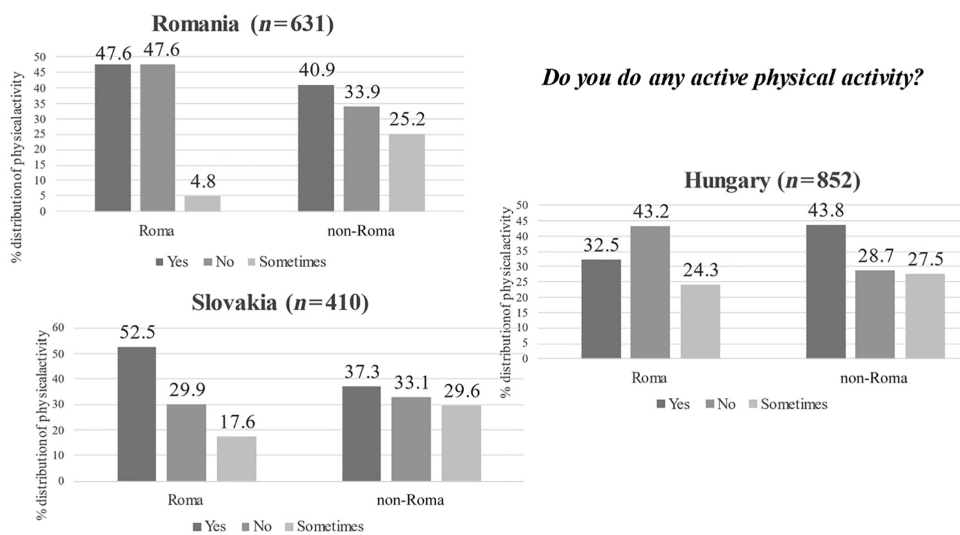

Fig. 2. Physical activity characteristics in % (N = 1893)

Table 2. Mean results of physical examinations in the study sample ($N = 1893$)

	Hungary ($n = 852$)				Romania ($n = 631$)				Slovakia ($n = 631$)			
Variable	Roma ($n = 430$)		Non-Roma ($n = 422$)		Roma ($n = 330$)		Non-Roma ($n = 301$)		Roma ($n = 204$)		Non-Roma ($n = 206$)	
BMI (kg m^{-2})	29.77 ± 7.43		28.43 ± 6.6		29.22 ± 7.47		28.19 ± 6.57		28.07 ± 7.92		27.25 ± 6.03	
Waist circumference (cm)	Male ($n = 108$)	Female ($n = 322$)	Male ($n = 128$)	Female ($n = 294$)	Male ($n = 72$)	Female ($n = 258$)	Male ($n = 118$)	Female ($n = 183$)	Male ($n = 58$)	Female ($n = 146$)	Male ($n = 43$)	Female ($n = 163$)
♂<102 cm ♀ <88 cm	100.74 ± 16.48	94.64 ± 18.34	99.80 ± 16.00	91.27 ± 15.02	101.23 ± 16.50	94.35 ± 17.50	97.51 ± 14.78	91.54 ± 18.06	96.41 ± 17.39	91.47 ± 15.30	95.46 ± 12.35	89.48 ± 15.90
Visceral fat (<9)	10.35 ± 5.82		9.40 ± 4.76		9.23 ± 4.89		9.14 ± 5.30		9.08 ± 4.96		8.43 ± 4.78	
Blood glucose (≤6.0 mmol L^{-1})	5.78 ± 2.67		5.59 ± 1.99		5.87 ± 2.67		6.07 ± 2.17		5.79 ± 2.10		5.72 ± 2.47	
Total cholesterol (≤5.2 mmol L^{-1})	4.84 ± 1.29		5.23 ± 1.34		5.44 ± 1.52		5.23 ± 1.53		5.38 ± 1.43		5.20 ± 1.50	
Triglyceride (≤1.7 mmol L^{-1})	2.12 ± 1.13		2.01 ± 1.12		2.06 ± 1.20		1.85 ± 1.08		2.16 ± 1.19		2.17 ± 1.23	
Blood pressure Systolic Diastolic (<140/90 Hgmm)	132.70 ± 21.98 83.59 ± 12.58		133.80 ± 20.53 83.74 ± 11.86		135.62 ± 23.38 86.30 ± 13.14		135.69 ± 20.23 85.29 ± 12.03		135.45 ± 26.51 85.95 ± 11.27		135.98 ± 28.50 85.88 ± 13.63	

When comparing the BMI values of the Roma respondents, we found that the mean BMI value of Roma in Hungary was significantly higher than that of Roma in Slovakia (F (963) = 5.311, P = 0.005). The mean BMI value of Roma in Hungary was higher than that of the majority sample (t (850) = 3.098, P = 0.002). Categorising BMI values according to WHO recommendation, we found that there were significantly more extremely obese Roma in the Roma population (P = 0.004) than in the overall sample (P < 0.001).

For waist circumference, based on the average of the three countries (Roma, and non-Roma), we found that Hungary presented significantly higher values (F (1892) = 5.730, P < 0.003) than Slovakia. In Hungary, the mean waist circumference was significantly (t (850) = 1.993, P = 0.047) higher for Roma compared to non-Roma.

When examining visceral fat, we found that the mean of Hungarian (Roma, and non-Roma) participants was significantly (F (1866) = 7.397, P < 0.001) higher than that of Slovak or Romanian participants. Within countries, comparing the mean visceral fat of Roma and non-Roma subjects, we found a significant difference only in the Hungarian sample, where the mean was significantly higher (t (835) = 2.571, P = 0.010) for Roma than for non-Roma. When comparing the Roma groups, we found that the mean visceral fat of Hungarian Roma was significantly higher than that of Roma from Slovakia (F (954) = 5.751, P = 0.003) or Romania.

Blood glucose levels showed similar average results for Roma in all three countries. However, among non-Roma, Hungarian participants had a lower value than the non-Roma in Romania (F (928) = 4.499, P = 0.011).

Serum total cholesterol levels were significantly lower in the Hungarian Roma samples (F (963) = 19.938, P < 0.001) than in the Roma samples from Slovakia or Romania.

Significant differences were observed for diastolic values, with the Hungarian Roma sample having a significantly lower value (F (963) = 5.102, P = 0.006) than the Slovak and Romanian Roma samples. We were not able to investigate the exact background of this further, but it is assumed that a higher proportion of Roma in Hungary were diagnosed with hypertension and been taking prescribed medication regularly, but it is also possible that the so-called „Roma paradox" is more apparent in Hungary (Hu et al., 2012; Kósa et al., 2015; Soltész et al., 2020; Zajc Petranović et al., 2021).

Waist circumference (t (962) = –4.003, P < 0.001), BMI (t (962) = –5.524, P < 0.001), and visceral fat (t (953) = –6.279, P < 0.001) values were lower in total Roma than in smokers, as were blood glucose levels (t (962) = –2.680, P = 0.007). Total non-Roma smokers also had lower BMI (t (927) = 2.913, P = 0.004) and visceral fat (t (910) = 2.124, P = 0.034) than total non-Roma non-smokers. In the native Roma sample, the mean waist circumference (t (428) = –2.679, P = 0.008), BMI (t (428) = –3.950, P < 0.001), visceral fat (t (423) = –5.024, P < 0.001) and blood glucose (t (428) = –3.005, P = 0.007) were higher in Hungarian Roma participants who did not smoke. The mean BMI (t (420) = –3.481, P < 0.001) and visceral fat (t (410) = –2.235, P = 0.026) were higher in the native majority participants than in Hungarian majority non-smokers.

The mean BMI (t (962) = 2.308, P = 0.021) and triglyceride levels (t (962) = 4.455, P < 0.001) of Roma who regularly exercised were lower than in those Roma who never exercised. Non-Roma had higher waist circumference (t (927) = 3.992, P < 0.001), BMI (t (927) = 4.061, P < 0.001), visceral fat (t (910) = 2.706, P = 0.007), cholesterol (t (927) = 2.329, P = 0.020), and triglyceride levels (t (927) = 2.445, P = 0.015) than those non-Roma who were never physically active. Among Hungarian Roma, cholesterol (t (428) = 3.208, P < 0.001) and triglyceride levels

(t (428) = 3.893, P < 0.001) of those who regularly exercised were also lower than in those who never exercised. In the majority sample, the mean waist circumference (t (420) = 3.453, P < 0.001) and BMI (t (420) = 3.096, P = 0.002) were higher in inactive participants.

We examined participants for CVD risk in relation to obesity.

The two main risk factors were high blood pressure and cholesterol levels. These were found to affect 23.3% of men and 20.5% of women in the total sample. When smoking was taken into account, 10.4% of men and 8.3% of women were affected by the risk. After adding gender and age, we found that 6.1% of men were affected by all five risk factors, while 5.6% of women were affected by four risk factors (female gender is not a risk factor here). Comparing Roma and non-Roma, smoking among the risk factors had a higher proportion for Roma, whereas majority participants were more affected by the two other factors (Table 3).

Summarising the prevalence of the five possible risk factors for men, we found that significantly (P = 0.002) more Roma men were affected by two of the risk factors for CVD than non-Roma men from the same country (Fig. 3). Among men for whom gender was the only risk factor, the majority (P = 0.007) had a tertiary education. For men, there was no risk factor 0, as being male alone is not a risk factor for CVD.

When looking at women in Hungary, we found that Roma women had a higher proportion of four risk factors (P = 0.032) (Fig. 4). We found a similar result for Roma women in Romania, where more of them had four risk factors (P < 0.001). For women, five risk factors are not possible, as one of the risk factors is being a male, so only four factors can be considered for women.

Table 3. Prevalence of risk factors in the sample (%)

			High blood pressure + Cholesterol	+ Smoking	+ Over the age of 40
Male	**Complete male sample (*n* = 527)**	**Roma (*n* = 238)**	21.8%	11.8%	7.1%
		non-Roma (*n* = 289)	24.8%	9.3% (**P = 0.024** vs. Roma)	5.2%
	Hungary (*n* = 236)	Roma (*n* = 108)	12.0%	6.5%	6.5%
		non-Roma (*n* = 128)	20.3%	9.4%	3.9%
	Romania (*n* = 190)	Roma (*n* = 72)	36.1% (***P*<0.001** vs. Roma Hungary)	20.8% (**P = 0.048** vs. Roma Hungary)	9.7%
		non-Roma (*n* = 118)	30.5%	11.0%	7.6%
	Slovakia (*n* = 101)	Roma (n=58)	22.4%	10.3%	5.2%
		non-Roma (*n* = 43)	20.9%	4.7%	2.3%
Female	**Complete female sample (*n* = 1366)**	**Roma (*n* = 726)**	21.5%	11.8%	8.1%
		non-Roma (*n* = 640)	19.4%	4.4% (***P*<0.001** vs. Roma)	2.8% (***P* =0.009** vs. Roma)
	Hungary (*n* = 616)	Roma (*n* = 322)	17.4%	9.6%	8.4%
		non-Roma (*n* = 294)	21.1%	5.1%	3.7%
	Romania (*n* = 441)	Roma (*n* = 258)	26.4%	16.3% (**P = 0.014** vs. Roma Hungary)	10.0%
		non-Roma (*n* = 183)	15.3%	2.7%	2.2%
	Slovakia (*n* = 309)	Roma (*n* = 146)	21.9%	8.9%	4.1%
		non-Roma (*n* = 163)	20.9%	4.9%	1.8%

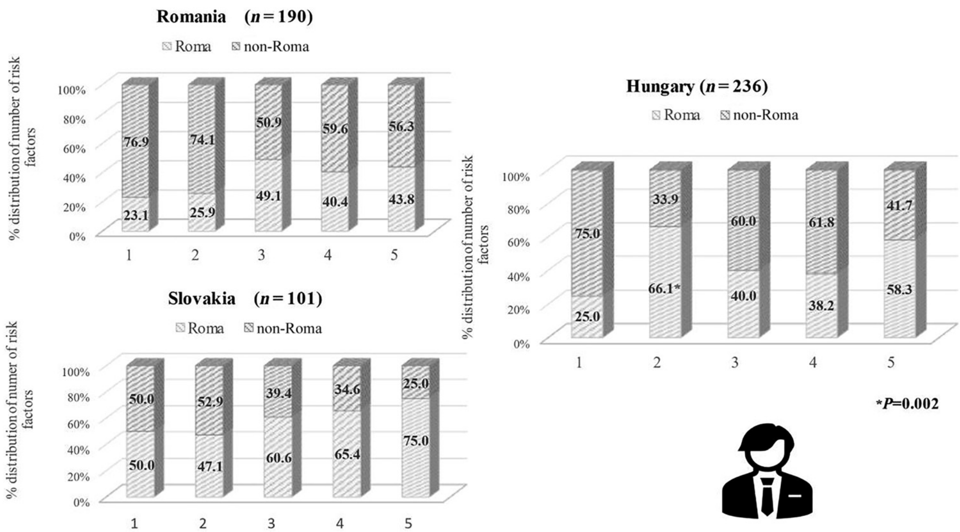

Fig. 3. Comparison of Roma and non-Roma men by number of risk factors by country ($n = 527$)

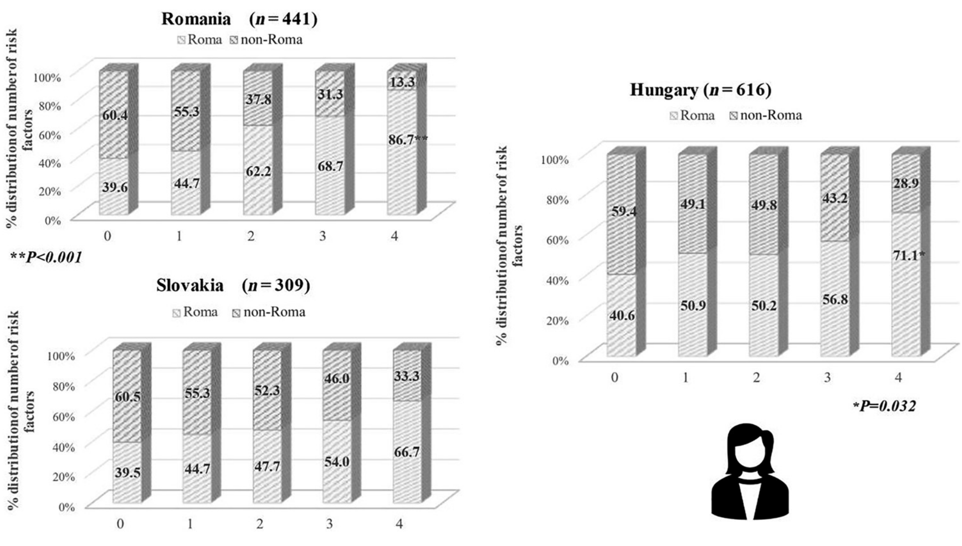

Fig. 4. Comparison of Roma and non-Roma women by number of risk factors by country ($n = 1{,}366$)

Among Hungarian women, we found that the majority ($P < 0.001$) of women without risk factors had a tertiary education. Among Hungarian Roma women, three risk factors were already present in the 18–24 age group ($P < 0.001$) compared to non-Roma women in this age group.

Among domestic non-Roma women in the 25–39 age category, only two risk factors appeared in a higher proportion, while in the case of Roma women of a similar age, more risk factors were observed, but here the difference was not significant.

Overall, we found that both men and women in our study during the pandemic had unfavourably high mean values for both body weight and waist circumference. The proportion of people with high blood pressure was common among the study participants, total cholesterol levels were also elevated, and triglycerides were clearly higher than the recommended levels in all three countries. The elevated parameters measured were in themselves a significant cardiovascular risk. The obesity rate was more pronounced in women than in men. We obtained similar results in a previous study in Hungary (Barna et al., 2020).

Cardiovascular risk factors were significantly present in both male and female samples, with a high number of those with two or three factors. When only hypertension and cholesterol were included as risk factors, the proportion of those affected was higher in the non-Roma sample in all three countries. Smoking as another risk factor reversed the prevalence rates in the sample, and Roma were at a higher risk.

Our data above provide clear evidence that obesity, increased visceral fat, waist circumference, cholesterol and blood glucose levels, higher smoking rate, and thus CVD risk rates were higher in Roma minorities in all three countries, and we have confirmed this in line with our previous research. Smoking was the risk factor responsible for the higher CVD risk rate for Roma. On the other hand, the "Roma paradox" was also well confirmed in the sample, as Roma had lower blood pressure, so when this was one of the risk factors, the non-Roma sample was more affected (Hu et al., 2012; Kósa et al., 2015; Soltész et al., 2020; Zajc Petranović et al., 2021).

One limitation of our research was that women were over-represented in the sample we studied. This was partly because men were working at the time of the screening and partly because they were much less willing to participate in the study than women. A further complicating factor for us was the COVID-19 pandemic, as restrictive measures prevented pre-arranged fieldwork in many cases. Another factor, particularly among Roma, was the needle marks for blood sampling being often used to cover up the COVID-19 vaccination. A further complicating factor was the phrase "what we do not know, we do not have". If they are not aware of their particular health problem, then it does not exist for them, and therefore does not need to be treated.

4. CONCLUSIONS

In conclusion, obesity and CVD risk measures were significantly present in the study sample in all three countries. However, as expected, the Hungarian sample came out on top among the three countries studied (WHO, 2022; Obesity, 2022). The Hungarian sample showed the highest proportion of obesity, as well as the highest proportion of risk factors.

We hypothesised that the Roma sample would have higher rates of obesity, but we found no significant difference between the Roma and non-Roma samples when comparing the total Roma sample with the total non-Roma sample, regardless of country. However, women, whether of Roma or non-Roma origin, were primarily at risk for abdominal obesity. In terms of CVD risk factors, smoking was found to be the most influential factor, and the combined presence of several risk factors was found to be more prevalent in Roma.

Our results also call for a reduction in smoking rates, especially in the Roma population, requiring a broader and more effective education programme (Stauder et al., 2010; Cselkó et al., 2018; Kékes et al., 2019; Eurostat, 2022a, 2022b). On the other hand, it can be seen that initiatives to reduce obesity rates are ineffective, although data suggest that CVD incidence is decreasing, it is still the leading cause of death (Rurik et al., 2021; HCSO, 2022; WHO, 2022).

Further detailed research is needed on the knowledge of the population of good lifestyle choices, including issues related to nutrition, physical activity, and smoking, which may be closely related to obesity.

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