

OBESITY AND HEALTH-RELATED LIFESTYLE FACTORS IN THE GENERAL POPULATION IN ROMANIA: A CROSS SECTIONAL STUDY

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Abstract

Context. The socio-economic and medical burden of obesity represents a continuous challenge for both developing and developed countries. For Romania, the available data on the eating patterns, behavior and other components of lifestyle are scarce.

Objective. The objective of this study was to assess the prevalence of overweight and obesity in the Romanian general population and to identify lifestyle patterns characteristic for the Romanian population in terms of eating patterns and physical activity.

Design. Cross-sectional, epidemiologic, multicenter non-interventional study

Subjects and Methods. Between January 2014 and August 2014 were enrolled 2128 adults by 8 investigators spread in the main historical regions of Romania. The following data: demographic, anthropometric, employment status, education, family history, personal medical history, information on the lifestyle and eating habits.

Results. The final population included in the analysis presented here consisted of 2103 participants with no missing information on height and weight. The prevalence of overweight and obesity was 31.1% and 21.3%, respectively. The prevalence of obesity was 9.9% in the 18-39 years age group, 30.1% in the 40-59 years age group, 41.6% in the 60-79 years age group and 24.1% in the ≥ 80 years age group ($p < 0.001$). Irregular meals together with eating while watching TV were the most frequent unhealthy eating habits of the participants.

Conclusions. We found a high prevalence of overweight and obesity among the participants enrolled. Our study has important implications for increasing the knowledge on the prevalence of overweight and obesity in Romania and associated lifestyle habits.

Key words: overweight, obesity, prevalence, lifestyle.

INTRODUCTION

Obesity represents a major health issue worldwide, the World Health Organization estimating that 502 million persons over 20 years of age were obese in 2008 (1,2). Additionally, it was reported that the prevalence of obesity increased from 5% for men and 8% for women in 1980 to 10% for men and 14% for women in 2008 (1, 2). It was estimated that each year 2.8 million deaths are associated with overweight or obesity (2). The prevalence of overweight and obesity varies between world regions and countries, but also within the same country. For countries, the prevalence increases in parallel with income reaching the highest level in upper-middle-income ones. Within the same country, it has been shown that an inverse relationship exists between the socio-economic and educational levels on the one side and the prevalence of overweight and obesity on the other (2-8), while in medium- and low-income countries the relationship is positive, the body-mass index (BMI) increasing with the level of socio-economic status (2). The burden of obesity represents a continuous medical, financial, social and political challenge for both developing and developed countries. It has been long accepted that an increased weight is associated with an increased risk of coronary heart disease, ischemic stroke and type 2 diabetes mellitus, and that this risk increases in parallel with the BMI (9). Additionally, the presence

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of overweight and obesity has been associated with an increased risk for breast, colon/rectum, endometrium, kidney, oesophagus and pancreatic cancer (9, 10).

For Romania, the available epidemiological data estimate a prevalence of overweight to be 30 – 36% of the adult population and the prevalence of obesity to be of 20 – 25% (11, 12), but the available data on the eating patterns, behavior and other components of lifestyle are scarce and they have been analyzed only in populations limited to several areas and without a confirmation at the national level (13).

In this context, we designed the study presented here with the aim to evaluate the prevalence of overweight and obesity in Romanian adults and to identify the risk factors associated with an increased BMI in this population.

METHODS

Study design and population

This cross-sectional, epidemiologic, multicenter non-interventional study was conducted from January 2014 until August 2014 in 8 study centers spread in the main historical regions of Romania: Banat, Crisana and Transylvania (participating centers: Cluj-Napoca, Oradea and Timisoara), Moldavia (participating centers: Iasi, Suceava and Galati), and Muntenia and Oltenia (participating centers: Bucharest and Targu Jiu). Each participating investigator was to collaborate with their resident physicians and students who were asked to apply the questionnaires in their home towns or in different institutions. This approach was recommended in order avoid the inclusion of only those participants who address for a medical appointment in outpatient clinics. Additionally, this approach was chosen with the aim of also enrolling participants who do not have a family physician or do not have health insurance.

For eligible participants (Adults >18 years of age), the investigators were asked to collect the following data using a standardized working sheet: demographic, anthropometric, employment status, education, family history, personal medical history, information on the lifestyle and eating habits.

Anthropometric data and socio-economic status

Each participant's height and weight were measured by the investigators. Body weight was measured using a portable weighing scale. with participants lightly dressed and without shoes. The BMI was calculated with the formula $\text{weight (kg)}/[\text{height (m)}^2]$. Based on the BMI values, participants were classified as having a normal

weight if their BMI was $<25 \text{ kg/m}^2$, overweight if their BMI was between 25 and 29.99 kg/m^2 or obese if their BMI was $\geq 30 \text{ kg/m}^2$. Because underweight (BMI $<18.5 \text{ kg/m}^2$) participants represented a small proportion of the overall sample, they were combined with participants in the normal weight category.

Waist circumference was measured by the investigators using a non-stretchable tape at the midway between the tenth rib and the iliac crest at the end of a normal breath. Each person's education and employment status were collected and used as measures of socio-economic status. Data on birth weight, previous diets, overall health (self-rated), the weight of parents and siblings (self-rated as small, medium, high), and medical history were also collected.

Lifestyle

Lifestyle and food habit data were collected using a 24h food recall diary and a questionnaire designed to evaluate lifestyle risk factors for obesity. Physical activity was assessed using a part of the Global Physical Activity Questionnaire (World Health Organization) and the food frequency several questions from the Nurses Health Questionnaire (14, 15). Both were conceptually translated in the Romanian language, were adapted and were validated. Additionally we added questions aiming to better evaluate the lifestyle of the participants.

The Global Physical Activity questionnaire consists of 16 questions assessing the intensity, duration, and frequency of the physical activities in 3 domains in which it is performed (occupational physical activity, transport-related physical activity, and physical activity during discretionary or leisure time) (14). In our study we used only 9 questions evaluating the professional and leisure-time physical activities: "Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like for at least 10 minutes continuously?"; "In a typical week, on how many days do you do vigorous-intensity activities as part of your work?"; "Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking for at least 10 minutes continuously?"; "In a typical week, on how many days do you do moderate-intensity activities as part of your work?"; "Do you do any vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate like [running or football,] for at least 10 minutes continuously?"; "In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational activities?"; "Do you do any moderate-intensity sports, fitness

or recreational activities that cause a small increase in breathing or heart rate such as brisk walking, cycling, swimming, volleyball for at least 10 minutes continuously?"; "In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational activities?"; "How much time do you usually spend sitting or reclining on a typical day (sitting at a desk, reading, watching television, using a computer, travelling by car, train, or knitting, but do not include time spent sleeping)?"

For the evaluation of lifestyle habits we have also added the following questions: "How many hours do you sleep each night?"; "Do you smoke?"; "Have you ceased smoking in the past 2 years?"; "Do you consider that you are stressed?"

The dietary habits were assessed using 16 questions developed for this study: "Do you eat 3 meals/day?"; "Do you have snacks between meals?"; "Which is the most consistent meal you eat?"; "Do you eat breakfast every day?"; "Do you eat large meals after 21:00 pm?"; "Do you know the number of calories you eat/day?"; "What quantity of liquids do you drink/day?"; "What type of liquids do you prefer?"; "What type of liquids do you prefer when you are thirsty?"; "If you prefer sweetened carbonated drinks, what do you appreciate in these?"; "How many teaspoons of sugar do you add in drinks and food every day (for example in tea, coffee, milk, yogurt; fruit juices, lemonade)?"; "Do you wake up during nights for eating?"; "If YES, on how many nights per week?"; "Do you eat large quantities of food less than 2 hours following another consumption of large quantity of food and although you feel satiated?"; "If YES, do you feel guilty for eating large amounts of food?"; "Do you eat while watching TV, being on the computer or reading?". Additionally, for assessing the dietary intake we used a semi quantitative food frequency questionnaire (questions from the Nurses Health Study). These questions aimed to assess the consumption of beverages, bread, cereals, pasta, eggs, meat, fish, milk and dairy products; sweets, snacks, cooked food; vegetables; fruits, fried food, the type of fat used for cooking, as well as fast-food consumption. It covered the previous 12 months and comprised 87 food items and beverage categories. For each item, the questionnaire offered nine frequency response options, ranging from "never" to "6 or more times per day".

Written informed consent was obtained from all participants prior to conducting any study-related procedures. The study was conducted in accordance with the Good Clinical Practice guidelines, the Declaration of Helsinki and local laws and regulations. All study-related

documents were approved by the National Bioethics Committee for Medicine and Medical Devices.

Study Objectives

Primary objective

The primary objective of this study was to assess the prevalence of overweight and obesity in the Romanian general population.

Secondary objectives

The secondary objectives included: the identification of lifestyle patterns characteristic for the Romanian population in terms of eating patterns and physical activity; the identification of possible relationships between an unhealthy lifestyle (hypercaloric diet, excess intake of saturated and trans fats, excess intake of sugar, a sedentary lifestyle, smoking, stress) and obesity; the assessment of potential correlations between educational attainment, profession, income and obesity in the Romanian general population; the assessment of the differences between different regions of the country in terms of the prevalence of overweight and obesity and of lifestyle.

Statistical analysis

For the sample size calculation, based on previous studies, it was estimated that the prevalence of obesity in the Romanian general population is around 24%. Considering a 95% confidence interval and a 5% precision level, a sample size of 2100 participants would be needed. In order to ensure representativity of each historical region, each center was required to enroll a minimum of 262 participants. The sample size calculation was done using the formula where $\varepsilon\%$ represents the error and which was set to 5% for this study, and f represents the estimated frequency.

$$n = z^2 \frac{a}{2} \frac{(1-f)}{\varepsilon^2 f}$$

Quantitative variables were described using the mean and standard deviation. Frequency tables, contingency tables and graphics were used for the description of the qualitative variables. To compare the observed distribution of variables between different groups were applied the Chi² test, the Chi² test with the Yates correction, the Chi² test with the Mantel-Haenszel correction and the Fisher exact test.

Means were compared using the "t" test for independent samples or variance analysis ANOVA.

Table 1. The characteristics of the population included in the analysis

Variable	Banat, Crisana, Transylvania N=768	Moldavia N=791	Oltenia, Muntenia N=544	Total N = 2103
Age, years	39.6±16.1	42.9±15.7	42.3±14.7	41.5±15.7
Weight, kg	73.1±16.3	76.3±17.3	73.7±16.8	74.4±16.9
BMI, kg/m ²	25.4±5.2	26.4±5.4	25.9±5.4	25.9±5.3
Waist circumference, cm	87.6±17.9	88.1±18.2	86.1±16.6	87.4±17.7
Women, n (%)	288 (62.4%)	320 (59.5%)	193 (64.5%)	1301 (61.9%)
Distribution by age groups, n (%)				
18-39 years	445 (58.8%)	360 (45.6%)	249 (47.2%)	1054 (50.8%)
40-59 years	213 (28.1%)	297 (37.6%)	215 (40.7%)	725 (34.9%)
60-79 years	86 (11.4%)	125 (15.8%)	56 (10.6%)	267 (12.9%)
≥80 years	13 (1.7%)	8 (1.0%)	8 (1.5%)	29 (1.4%)
Living in urban area, n (%)	562 (73.2%)	548 (69.3%)	421 (77.4%)	1531 (72.8%)

The data are presented as mean ± standard deviation for continuous variables and as number (percentage) for categorical variables BMI, body mass index; N, number of participants enrolled; n (%), number (percentage).

RESULTS

We received 2128 completed questionnaires. Of these, 25 had missing data on weight or height and were removed from the analysis of the prevalence of obesity. The final population included in the analysis presented here consisted of 2103 participants with a mean age of 41.5 years and with a mean BMI of 29.9 kg/m² (range: 15.2 to 57.8 kg/m²). 61.9% of the participants were women and 72.8% were from an urban area (Table 1).

Prevalence of overweight and obesity

In our study sample, 1001 (47.6%) persons had a BMI <25kg/m². The prevalence of overweight and obesity was 31.1% (654 participants) and 21.3% (448 participants), respectively (Fig. 1). The prevalence of both overweight and obesity was significantly higher in Moldavia and Muntenia, Oltenia than in Banat, Crisana, Transylvania (p = 0.002, Fig. 1).

Upon stratification by age group, the prevalence

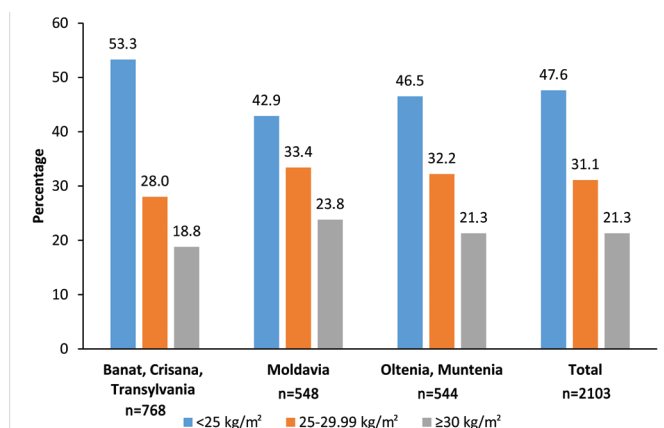


Figure 1. The prevalence of overweight and obesity per country regions and overall.

of overweight was 22.4% in the 18-39 year old age group, 40.1% in the 40-59-year age group, 40.8% in the 60-79-year age group and 41.4% in the ≥80 years age group (p <0.001). The prevalence of obesity was 9.9% in the 18-39 years age group, 30.1% in the 40-59 years age group, 41.6% in the 60-79 years age group and 24.1% in the ≥80 years age group (p <0.001).

The prevalence of both overweight and obesity by sex was higher in men than in women: 41.6% vs. 24.7% and 23.0% vs. 20.3%, respectively (p <0.001). After comparing by living residence, the prevalence of both overweight and obesity was higher among the persons living in rural areas compared to those living in urban areas: 33.0% vs. 30.3% and 25.7% vs. 19.7%, respectively (p = 0.004 for both comparisons).

When the professional situation was analyzed, the overweight and obese participants were more likely to declare themselves as not being capable of working or that they were retired than those with a normal weight (declaring that they are not capable to work: 1.1% and 1.8% vs. 0.2%; retired: 21.4% and 31.3% vs. 7.9%). Also, the overweight and obese participants were more likely to have been educated only up to secondary school, high school or had only received professional education (p <0.001; Table 2).

Health-related lifestyle factors

Intense professional-related physical activity was more frequently reported by the overweight and obese participants (22.1% and 19.2%) compared to the normal weight participants (16.8%), while moderate professional-related physical activity and intense and moderate leisure-time physical activity was more frequently reported by normal weight persons (Table

Table 2. Socio-economic status of participants by body mass index categories

		BMI			P
		<25 kg/m ²	25-29.99 kg/m ²	≥30 kg/m ²	
Employment status	Full time	63.1%	59.8%	47.7%	<0.001
	Partial time (<30 h/week)	5.9%	5.9%	6.5%	
	Unemployed	3.4%	3.1%	2.9%	
	Not capable of working	0.2%	1.1%	1.8%	
	Retired	7.9%	21.4%	31.3%	
	Student	13.2%	3.6%	2.0%	
	Homemakers	3.5%	3.7%	5.8%	
	Other	2.7%	1.5%	2.0%	
Education	1-4 classes	1.2%	0.9%	2.5%	<0.001
	≤8 classes	3.1%	8.5%	12.8%	
	High school	23.0%	23.7%	26.1%	
	Professional education	9.3%	22.1%	24.9%	
	University	63.3%	44.6%	33.5%	

BMI, body mass index; %, percentage of participants within a given category.

3). The number of days/week with intense professional-related physical activity and moderate leisure time physical activity was significantly higher for obese participants compared to the overweight and normal weight ones (intense professional-related physical activity: 4.26 vs. 3.9 vs. 3.4; moderate leisure time physical activity: 4.2 vs. 3.9 vs. 3.8).

A significantly higher percentage of overweight and obese participants declared that they consume 3 meals/day every day compared to normal weight participants (36.0% and 38.8% vs. 29.8%; $p=0.002$). In terms of having breakfast every day or snacks between meals, no difference was observed between groups ($p > 0.05$ for both). The most consistent meal was eaten after 21:00 more frequently by a higher percentage of obese participants than the normal weight ones (22.8% vs. 15.4%). Also, these participants declared that they used to eat during night more frequently than the normal weight participants (10.6% for overweight, 13.2% for obese vs. 7.2% for normal weight) and that they eat large quantities of food less than 2 hours following another consumption of a large quantity of food and although feeling satiated (15.3%, 23.2% vs. 13.9%). Surprisingly, significantly more normal weight persons declared that they eat while watching TV or working on a computer (51.8% vs. 42.2% and 41.5%, $p < 0.001$).

DISCUSSION

The objectives of the present study were to assess the prevalence of overweight and obesity in the Romanian general population and to explore the relationship between BMI status and various lifestyle factors. Our data showed that more than half of the participants enrolled were above the normal body weight: 31.1% of the participants were overweight and

21.3% were obese. The prevalence of both overweight and obesity varied according to the country region: the highest prevalence was recorded in participants from Moldavia and the lowest one in participants from Banat, Crisana, and Transylvania. Our results are in line with the ones reported in 2008 and which placed Romania among the 46 countries with more than 50% of the adult population having a BMI > 25 kg/m² and among the 40 countries with more than 20% having obesity (16). Similar results were reported in The Study for the Evaluation of Prevalence of Hypertension and Cardiovascular Risk in Adult Population in Romania (SEPHAR) (12). SEPHAR, the first epidemiological study based on a representative sampling for the entire country population was performed in 2 waves: the first one from February to November 2005 (SEPHAR I) and the second from October 2011 to March 2012 (SEPHAR II). In the SEPHAR I study, which enrolled 2017 persons from all regions of Romania, the prevalence of obesity classified according to BMI values was 24% (12). The most recent study performed at national level was the Prevalence of Diabetes, Prediabetes, Overweight, Obesity, Dyslipidemia, hyperuricemia and chronic kidney disease (PREDATORR) study. It started in 2013, enrolled 2728 patients 20-79 years of age and its preliminary results showed a prevalence of overweight of 34.6% and of obesity of 31.4% (17). Other results available for Romania were reported from studies performed in specific regions or age ranges. In Transylvania, a small study enrolling 312 participants showed an increased BMI prevalence of 32.38% (13). For Moldavia, previous studies in adults from an urban population and in a rural community reported sets of results different from the ones observed in our study (18, 19). The reported prevalence of overweight and obesity in the urban population was higher than the

Table 3. Health-related lifestyle factors according to body mass index categories

	BMI			P
	<25 kg/m ²	25-29.99 kg/m ²	≥30 kg/m ²	
Intense professional physical activity	16.8%	22.1%	19.2%	0.022
No. of days with intense professional physical activity/week	3.4±2.3	3.9±1.9	4.26±1.9	0.001
Moderate professional physical activity	64.5%	59.8%	53.1%	0.001
No. of days with moderate professional physical activity/week	4.7±1.6	4.6±1.6	4.9±1.6	0.110
Intense leisure time physical activity	38.1%	27.8%	21.7%	<0.001
No. of days with intense leisure time physical activity/week	3.0±1.9	3.0±1.8	3.2±2.0	0.621
Moderate leisure time physical activity	61.2%	48.8%	40.2%	<0.001
No. of days with moderate leisure time physical activity/week	3.8±2.0	3.9±1.9	4.2±1.9	0.040
No. of hours being sedentary/day	5.4±3.2	5.1±2.9	5.2±3.1	0.085
No. of hours slept/night	7.2±1.3	7.0±1.3	7.0±1.3	0.003
Eating 3 meals/day				
Every day	29.8%	36.0%	38.8%	0.002
Most of the times	40.1%	40.1%	36.5%	
Rarely	30.1%	23.9%	24.7%	
Eating breakfast every day	48.3%	55.1%	52.5%	0.086
Snacks				
Every day	22.1%	23.9%	24.1%	0.432
Most of the times	43.6%	39.3%	39.5%	
Rarely	34.3%	36.8%	36.4%	
Eating the most consistent meal after 21:00 pm				
Every day	3.0%	3.9%	3.4%	0.013
Most of the times	15.4%	14.9%	22.8%	
Rarely	81.4%	81.1%	73.8%	
Eating during nights	7.2%	10.6%	13.2%	0.003
No. of nights when eating/week	2.2±1.2	2.5±1.4	2.9±1.4	
Eating large quantities of food less than 2 hours following another consumption of large quantity of food and although you are feeling satiated	13.9%	15.3%	23.2%	<0.001
Eating while watching TV	51.8%	42.2%	41.5%	<0.001
Drinking water from tap when being thirsty	37.1%	48.0%	51.1%	<0.001
Drinking bottled water when being thirsty	56.1%	45.6%	40.8%	<0.001
Drinking fresh fruit juices when being thirsty	7.2%	5.8%	3.8%	0.072
Drinking bottled fruit juices when being thirsty	6.5%	5.5%	5.4%	0.509
Drinking sugar sweetened carbonated drinks once/day or more	6.6%	4.5%	6.2%	0.006

The data are presented as mean ± standard deviation for continuous variables and as number (percentage) for categorical variables BMI, body mass index; %, percentage of participants within a given category

one we observed: 43.1% of male and 47.3% of female participants were overweight and 21.5% of male and 21.6% of female participants, respectively (18). In the rural population, overweight and obesity were reported in 33.9% and 12.2% of men and 35% and 21.3% of women (19). This prevalence was slightly lower than the one reported in the rural population in our study (33% with overweight and 25.7% with obesity). The differences in the reported prevalence between our study and the previous ones may be explained by the structure of the population included in the studies and the methods used for participant selection. Except for the SEPHAR study, participants in all other studies were recruited through their family physicians. Therefore, those patients who did not have health insurance or were not registered with a family physician could not be enrolled. To overcome this, we have chosen a different method of

recruitment. However, this recruitment method has its own shortcomings and may explain the high proportion of participants who were <40 years of age and which may have negatively influenced the observed prevalence of increased BMI. Indeed, in our study, as in previous ones, the lowest prevalence of overweight and obesity was observed in this age category (20,21).

The variation in the prevalence of increased BMI between country regions observed by us and in previous studies can be partially explained by different socioeconomic conditions, lifestyle and nutritional factors. This hypothesis is further supported by the difference in the prevalence that we observed in the participants from urban and rural areas. Although we expected to have a higher prevalence in urban areas due to certain lifestyle factors, such as a sedentary lifestyle and easier access and probably higher consumption of

dense caloric foods and drinks, we observed a higher prevalence of overweight and obesity in rural areas (58.7% vs. 50.0%, $p=0.004$). These results should be interpreted taking into account the age of the population included and the socio-economical and educational status that have been shown to be associated with an increased prevalence of obesity (2, 22). The population from rural areas was significantly older than the one in the urban areas (46.7 years vs. 39.8 years, $p < 0.001$), more participants were unemployed (6.1 vs. 1.8%, $p < 0.001$), retired (27.0% vs. 13.5%, $p < 0.001$) or homemakers (8.3% vs. 2.7%, $p < 0.001$) and had a lower educational status (fewer university graduates: 25.3% vs. 60.4%, $p < 0.001$).

The results of our study showed that a higher number of persons with a normal BMI declared that they perform intense and moderate leisure time physical activity. Surprisingly, the number of hours that a participant reported as being sedentary per day was similar among the 3 BMI groups (5 hours), the percentage of participants who declared that they have 3 meals per day every day was higher among the overweight and obese participants. The participants with a normal BMI, which were also younger than the ones with overweight and obesity (35.4 vs. 47.1 vs. 51.9 years, $p < 0.001$) had irregular meals and were eating while watching TV. These are habits that may increase the risk of weight gain and need to be corrected using programs to promote healthy eating habits. Similar behaviors have been previously reported and a perceived lack of time was identified as the reason for unhealthy eating (23, 24). In a population-based study enrolling 2287 young adults, working > 40 hours per week was associated with time-related barriers to healthful eating (23). Similarly, in another sample including both men and women, irregular work hours were the most frequently reported cause of time pressure (24).

Additionally, the results regarding the health-related lifestyle factors showed that compared to the normal weight participants, the overweight and obese participants display a different pattern of eating - they consume more frequently 3 meals/day every day, eat during night more frequently, eat large quantities of food less than 2 hours following another consumption of a large quantity of food and although feeling satiated and sleep less during the nights. Another important factor is the amount of food consumed during the meals. Eating 3 or more meals/day is considered a healthy habit that prevents weight gain and help losing weight through preventing the increased appetite that follows a starve-all-day behavior (25). But, more important is the total energy intake. A healthy eating pattern with 3

meals/day but associated with an intake of energy-dense foods and drinks and large portion sizes cannot prevent weight gain (26). The consumption of additional calories during night and eating although feeling satiated further increase the daily caloric intake, therefore promoting weight gain or at least maintaining an increased body weight. The sleep duration is another factor that has been linked to the current epidemic of obesity, with numerous evidences associating the reduced sleep duration with an increased BMI (27-29). In our study the reported sleep duration was lower in the overweight and obese participants as compared to the normal weight ones (7.0 vs. 7.2 hours). The potential physiological mechanisms of this association are represented by the effect of sleep reduction on the levels of hormones associated with appetite regulation: decrease of the circulating levels of the anorexigenic hormone leptin, increase of the levels of the orexigenic hormone ghrelin and a consequently increase in of the sensations of hunger and appetite (30, 31).

Although our study enrolled a representative sample size at a country level, we must acknowledge that it has limitations. First, the study is a cross-sectional one, thus we were able to explore the associations between obesity and lifestyle factors but we could not explore any cause-effect relationship. The proportion of people ≥ 60 years of age does not reflect the proportion of this age category in the Romanian population. Therefore we may underestimate or overestimate the prevalence of overweight or obesity in this age category. Additionally, we must acknowledge some limitations related to the collection of self-reported patterns of eating, physical activity and sleep which may have influenced the participants' ability to correctly report lifestyle habits and may be associated with an unintentional under-reporting of unhealthy habits.

In conclusion, we found a high prevalence of overweight and obesity among the participants enrolled. Irregular meals together with eating while watching TV were the most frequent unhealthy eating habits of the participants. Our study has important implications for increasing the knowledge on the prevalence of overweight and obesity in Romania and associated lifestyle habits. Together with PREDATORR, this study offers a panoramic view of this health problem in all age groups and provides valuable information needed for planning future preventive strategies.

Conflict of interest

The authors declare that they received fees from Research Consulting Association for the conduct of the study.

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References

1. World Health Organization. Obesity. Situation and trends. (Accessed December 08, 2014, at site: http://www.who.int/gho/ncd/risk_factors/obesity_text/en/).
2. World Health Organization. Global Status Report on noncommunicable diseases. Chapter 1. Burden: mortality, morbidity and risk factors. 2010. (Accessed December 08, 2014, at site: http://www.who.int/nmh/publications/ncd_report_chapter1.pdf?ua=1).
3. Sobal J, Stunkard AJ. Socioeconomic status and obesity: a review of the literature. *Psychol Bull* 1989; 105(2):260-275.
4. Martínez JA, Kearney JM, Kafatos A, Paquet S, Martínez-González MA. Variables independently associated with self-reported obesity in the European Union. *Public Health Nutr* 1999; 2(1A):125-133.
5. van Lenthe FJ, Schrijvers CT, Droomers M, Joung IM, Louwman MJ, Mackenbach JP. Investigating explanations of socioeconomic inequalities in health: the Dutch GLOBE study. *Eur J Public Health* 2004; 14(1):63-70.
6. Gutiérrez-Fisac JL, Regidor E, Banegas Banegas JR, Rodríguez Artalejo F. The size of obesity differences associated with educational level in Spain, 1987 and 1995/97. *J Epidemiol Community Health* 2002; 56(6):457-460.
7. Sundquist J, Johansson SE. The influence of socioeconomic status, ethnicity and lifestyle on body mass index in a longitudinal study. *Int J Epidemiol* 1998; 27(1):57-63.
8. Committee Obesity: third report of session 2003–2004. Volume 1: Report, together with formal minutes. London: House of Commons, 2004. (Document HC 23-1) (Accessed December 08, 2014, at site: <http://www.publications.parliament.uk/pa/cm200304/cmselect/cmhealth/23/23.pdf>).
9. World Health Organization. The world health report 2002: Reducing risks, promoting healthy life. Geneva: World Health Organization, 2002.
10. World Cancer Research Fund/American Institute for Cancer Research. Policy and action for cancer prevention. Food, nutrition, and physical activity: a global perspective. Washington DC: AICR, 2009.
11. Cinteza M, Pana B, Cochino E, Florescu M, Margulescu A, Florian A, Vinereanu D. Prevalence and control of cardiovascular risk factors in Romania cardio-zone national study. *Mædica A Journal of Clinical Medicine* 2007; 2(4):277-282.
12. Dorobantu M, Badila E, Ghiorghe S, Darabont RO, Olteanu M, Flondor P. Total cardiovascular risk estimation in Romania. Data from the SEPHAR study. *Rom J Intern Med* 2008; 46(1):29-37.
13. Zapîrtan H, Ionut C, Vlad M, Creteanu E, Sinca A. Dietary imbalance in some communities of Transylvania. *Rev Med Chir Soc Med Nat Iasi* 2006; 110(4):993-998.
14. World Health Organization. Global Physical Activity Questionnaire. (Accessed December 08, 2014, at site: http://www.who.int/chp/steps/GPAQ_EN.doc?ua=1).
15. Nurses Health Questionnaires. (Accessed December 08, 2014, at site: http://www.channing.harvard.edu/nhs/?page_id=52).
16. World Health Organization. Country profiles on nutrition, physical activity and obesity in the 53 WHO European Region Member States. 2013. (Accessed December 09, 2014, at site: http://www.euro.who.int/__data/assets/pdf_file/0004/243337/Summary-document-53-MS-country-profile.pdf?ua=1).
17. Mota M, Mota E, Popa SG, Catrinou D, Cheta D, Graur M, Guja C, Hancu N, Ionescu-Targoviste C, Lichiardopol R, Mihai B, Popa A, Radulian G, Roman G, Serafinceanu C, Serban V, Timar R, Veresiu IA, Vlad A. The national study on the prevalence of diabetes mellitus, prediabetes, overweight, obesity, dyslipidemia, hyperuricemia and chronic kidney disease in Romania – Final results. *Acta Diabetologica Romana* 2014; 40:24-26 (Abstract).
18. Chirila I, Drug VL, Petrariu FD, Gavut V. Overweight and gastrointestinal symptoms among adults of working age in Iasi City, Romania. *Rev Med Chir Soc Med Nat Iasi* 2012; 116(1):268-273.
19. Mihalache L, Popescu D, Graur M. Prevalence of overweight and obesity in a rural population. *Rev Med Chir Soc Med Nat Iasi* 2010; 114(3):715-720.
20. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity among adults: United States, 2011-2012. *NCHS Data Brief* 2013; (131):1-8.
21. Public Health Agency Canada. Obesity in Canada. Health and Economic Implications. (Accessed December 09, 2014, at site: <http://www.phac-aspc.gc.ca/hp-ps/hl-mvs/oic-oac/econo-eng.php>).
22. The Organisation for Economic Co-operation and Development. Obesity Update 2012. (Accessed December 09, 2014, at site: <http://www.oecd.org/health/49716427.pdf>).
23. Escoto KH, Laska MN, Larson N, Neumark-Sztainer D, Hannan PJ. Work hours and perceived time barriers to healthful eating among young adults. *Am J Health Behav* 2012; 36(6):786-796.
24. Lappalainen R, Saba A, Holm L, Mykkanen H, Gibney MJ, Moles A. Difficulties in trying to eat healthier: descriptive analysis of perceived barriers for healthy eating. *Eur J Clin Nutr* 1997; 51(Suppl 2):S36–S40.
25. American Heart Association. Is 3 Meals a Day the Only Way? Available at: http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/HealthyEating/Is-3-Meals-a-Day-the-Only-Way_UCM_449551_Article.jsp. Accessed on 07 January 2015.
26. Swinburn BA, Caterson I, Seidell JC, James WP. Diet, nutrition and the prevention of excess weight gain and obesity. *Public Health Nutr* 2004; 7(1A):123-146.
27. Patel SR, Malhotra A, White DP, Gottlieb DJ, Hu FB. Association between reduced sleep and weight gain in women. *Am J Epidemiol* 2006; 164(10):947-954.
28. Cappuccio FP, Taggart FM, Kandala NB, Currie A, Peile E, Stranges S, Miller MA. Meta-analysis of short sleep duration and obesity in children and adults. *Sleep* 2008; 31(5):619-626.
29. Dashti HS, Follis JL, Smith CE, Tanaka T, Cade BE, Gottlieb DJ, Hruby A, Jacques PF, Lamon-Fava S, Richardson K, Saxena R, Scheer FA, Kovanen L, Bartz TM, Perälä MM, Jonsson A, Frazier-Wood AC, Kalafati IP, Mikkilä V, Partonen T, Lemaitre RN, Lahti J, Hernandez DG, Toft U, Johnson WC, Kanoni S, Raitakari OT, Perola M, Psaty BM, Ferrucci L, Grarup N, Highland HM, Rallidis L, Kähönen M, Havulinna AS, Siscovick DS, Rääkkönen K, Jørgensen T, Rotter JJ, Deloukas P, Viikari JS, Mozaffarian D, Linneberg A, Seppälä I, Hansen T, Salomaa V, Gharib SA, Eriksson JG, Bandinelli S, Pedersen O, Rich SS, Dedoussis G, Lehtimäki T, Ordovas JM. Habitual sleep duration is associated with BMI and macronutrient intake and may be modified by CLOCK genetic variants. *Am J Clin Nutr* 2015; 101(1):135-143.
30. Spiegel K, Tasali E, Penev P, Van Cauter E. Brief communication: sleep curtailment in healthy young men is associated with decreased leptin levels, elevated ghrelin levels, and increased hunger and appetite. *Ann Intern Med*. 2004; 141(11):846–850.
31. Chaput JP, Després JP, Bouchard C, Tremblay A. Short sleep duration is associated with reduced leptin levels and increased adiposity: results from the Quebec Family Study. *Obesity (Silver Spring)* 2007; 15(1):253–261.

