QUANTITATIVE METHODS TO ANALYZE THE SEVERE OBESITY IN ROMANIA AND ITS IMPACT OVER PUBLIC ADMINISTRATION HEALTH EXPENDITURES

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Abstract

In this article we present the situation of the Romanian population suffering from severe obesity (measured using BMI), focusing on specific situations with regard to age, gender, residence, development region or educational level. The main dataset used for the current paper is extracted from the Romanian Report for 2008 European Health Interview Survey (EHIS). The sample (a representative one) consists of more than 10,000 randomly selected households. Also, the article shows the consequences of this economic and social state especially for people who have been forced to seek surgical treatment. All financial estimates regarding the obesity burden are produced at country level.

Keywords: obesity, quantitative methods, body mass index, BMI.

1. Introduction

Since its creation by the Belgian scientist, Quetelet, more than a century and a half ago (Garrow and Webster, 1985), the body mass index (BMI), because of its ease of calculation and interpretation, has emerged as a good predictor of positioning a particular person regarding what accepted standards (e.g., WHO, 2006) consider as normal.

Certainly there are many works (Sturm, 2007 or Farrant *et al.*, 2013 just to name a few) who consider that BMI should be contextualized by region (country, continent), age or gender. However, BMI continues to be successfully used in measuring the desirable weight that a person ought to have according to height. As it is known, the formula for calculating this indicator is:

$$BMI = \frac{Mass(kg)}{\left(Height(m)\right)^2}$$

According to WHO (2006) obesity (OB) occurs when BMI>30, severe obesity (SO) occurs when BMI> 35 and severe extreme obesity (SEO) occurs when BMI> 40. Just as in other Western countries the prevalence of obesity in recent years in Romania is in a continuous growth (Afshin *et al.*, 2017; Barbu *et al.*, 2015). The negative effects of SO and SEO become, nowadays, common knowledge (Haslam and James, 2005; Afshin *et al.*, 2017). Firstly, a major impact was observed on life expectancy where persons with SO may register 6-7 lost years while SEO may induce a loss of 10 years. The second negative effect is related to the morbidity. There are major demonstrated connections between SO and SEO and illnesses like: diabetes, hypertension, coronary artery disease, stroke and arthritis (Wang *et al.*, 2017). Thirdly, it is about higher costs regarding health care for persons being affected by SO and/or SEO (Andreyeva, Sturm and Ringel, 2004). One of the aims of our paper is to provide an estimation for this third negative effect in Romania.

The paper is structured in a classical manner. The second section highlights the data and the methods, the third one provides mainly data analysis, and the fourth section estimates the financial burden of the obesity in Romania while the last section concludes.

2. Source of data and methodology

This article analyzes statistical information published by the National Statistics Institute in 2008 (like Ausloos, Herteliu and Ileanu, 2014) following the implementation of an EU-funded project by a consortium of Statistics Sweden, ICON Institute, Digital Data Services and Irecson Institute. The project was entitled 'The health of the population of Romania'. This project was part of a wider European one: European Health Interview Survey (EHIS) which occurred in all EU countries in 2008 (Eurostat, 2015). In the 2008 project, a questionnaire was applied to a representative sample consisting of 10,140 regional households all over the country. Within these households, 21,428 interviews were conducted (about 88% of them comprised adult persons, while 12%

children). In the analysis of BMI only those persons with at least 18 years were taken into account.

In terms of territorial analysis, it is worth mentioning that according to the European body for statistics (Eurostat) the national territory is divided into hierarchical levels according to the NUTS classification (Nomenclature of territorial units for statistics)[1].

In our approach we will use specific methods (descriptive statistics) and, where appropriate, some statistical tests (Chi Square and other similar) to validate or not the consistency/ associations between variables. Statistical analyzes were performed using Excel. Graphs were designed with PowerPoint, and maps using ArcGIS software. Following this approach, our paper aims to provide an answer for the following research questions (RQ).

RQ1: Is the prevalence of obesity in Romania different from Europe?

RQ2: Are there any differences in the prevalence of obesity in Romania when broken down by population, geographical regions, age or gender?

RQ3: What is the potential level of the annual financial burden of obesity in Romania?

3. Data analysis

Before answering these research questions, we have to analyze the data within an international context. Unfortunately, data on each category of obesity is not available on Eurostat (2015). Thus, an international comparison regarding SO and SEO cannot be performed. Even so, under the assumption that the distribution of SO and SEO has good chances to be quite similar to OB ones, we present the situation of obesity at the European level in Figure 1.

As one can observe, Romania registered the best situation within all the EU countries involved within EHIS. The share of people over 18 years who were obese (OB) ranges between 7.6% (for male) and 8.0% (for female). It is important to state that Romania is the only country in the list with an OB share lower than 10%. The worse situation was registered in Malta (22.9%). Moreover, there are plenty of Eastern European countries (Hungary, Estonia, Latvia, and Czech Republic) with higher registered values compared to Western European countries (France, Spain, Belgium).

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1   Thus, in Romania (Eurostat, 2014) NUTS1 are called macroregions. There are four such macroregions. The first one includes the North-West region (Bihor, Bistrita-Nasaud, Cluj, Maramures, Satu Mare and Salaj counties) and Center (Alba, Brasov, Covasna, Harghita, Mures and Sibiu counties). The second comprises the North-East region (counties of Bacau, Botosani, Iasi, Neamt, Suceava and Vaslui) and South East (Braila, Buzau, Constanta, Galati, Tulcea and Vrancea counties). The third macro includes the Southern Region (Arges, Calarasi, Dâmboviţa, Giurgiu, Ialomita and Prahova counties) and Bucharest-Ilfov (Bucharest and Ilfov). The Last macroregion includes the South-West region (Dolj, Gorj, Mehedinti, Olt and Valcea counties) and West (Arad, Caras-Severin, Hunedoara and Timis counties).
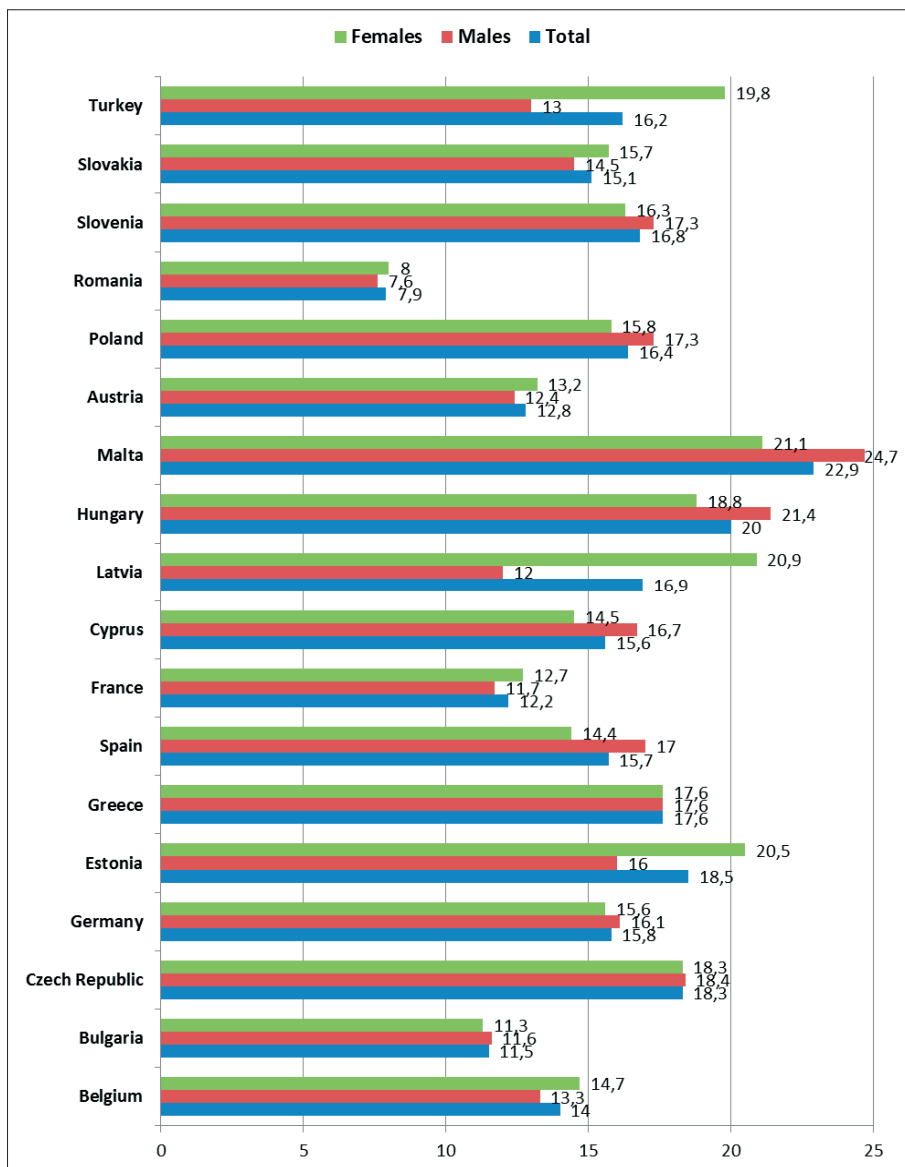
Figure 1: The prevalence of obesity within EU countries in 2008

In Romania, the share of people over 18 years who were severely obese (SO) or extremely severely obese (SEO) nationwide was 1.5%, representing almost 260,000 people in absolute value. This value should raise awareness in Romania as socio-economic impacts of SO and SEO cannot be neglected, knowing that the financial effort induced by treatment increases geometrically (Mora, Gil and Sicras-Mainar, 2014) with the inclusion of the patients in the category SO or SEO. Unlike other countries like USA, Germany, where the share of the SO or SEO population is located at a level higher than 6% (Sturm, 2007 or Palmo, 2013), Romania has a much better position yet.

This level of prevalence of SO and SEO was not evenly distributed within the population. An illustration of the situation according to gender and age is shown in Figure 2.

Severe obesity (SO) and severe extreme obesity (SEO) significantly affect the cost of public health. Recent research (Mora, Gil and Sicras-Mainar, 2014 or Sturm *et al.*, 2013) have demonstrated that SO cost increases can be higher than 11%-16% while SEO can lead to costs higher by 23%-25% compared to normal patients. The additional costs are also related to the need for special facilities for patients affected by the SO and SEO that present comorbidities. When we say special infrastructure, we refer primarily to the need to equip with beds, chairs, surgical tables, imaging equipment (computer tomography, magnetic nuclear resonance) appropriate for persons with special dimensions. Additional costs due to SO and SEO refers to the fact that the existence of comorbidities complicate their treatment and the costs further increase.
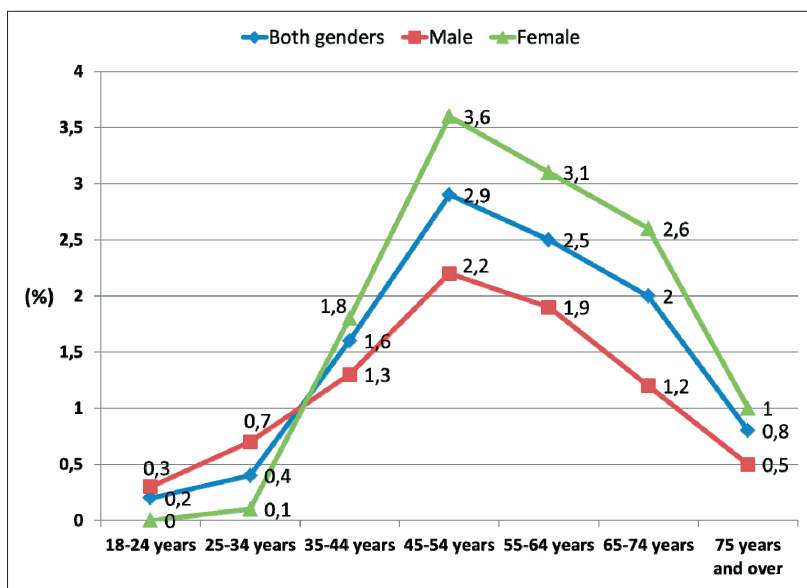

Figure 2: Prevalence SO and SEO by age and gender in Romania

For lower age groups SO and SEO prevalence is much higher in the male contingent: levels of 0.3% (3.3 thousands persons) and 0.7% (12.4 thousands persons) than female where values are below 0.1% (1.7 thousands persons). Starting with the 35-44 years age group, there is a reversal which then keeps all age groups. The gap between the maximum achieved in the female population: 3.6% (53.4 thousands persons) in case of 45-54 years group and male: 2.2% (31.1 thousands persons) in the same age group is pretty consistent. Also, for the 65-74 years age group the level for males: 1.2% (9.7 thousands persons) is less than half of that for women: 2.6% (28.4 thousands persons). Such situations are consistent with other research in the field (Ogden *et al.*, 2006). These differences are statistically significant after applying the Chi Square test with a probability higher than 95%.

In terms of area of residence (Figure 3) we found that there are three age groups: (i) 18 to 25 years; (ii) 55-64 years, and (iii) more than 75 years where the prevalence is lower than in urban areas (with low relative gap – less than 1 percentage point).
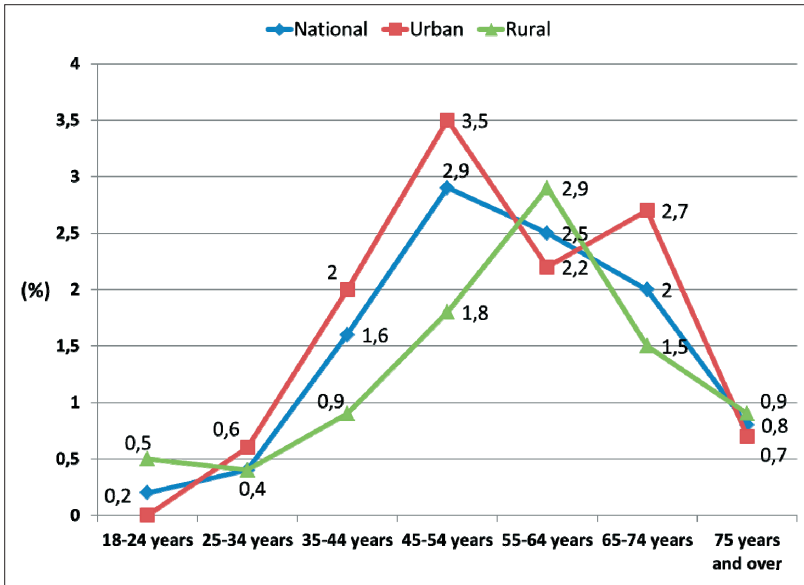

Figure 3: Prevalence of SO and SEO on age groups and residence area in Romania

The 25-34 age group records levels close to 0.5% (5.7 thousands persons in the rural and 12.2 thousands persons in the urban area) in the prevalence in both areas of residence while in the other three age groups left, in urban areas the prevalence has always a higher prevalence (maximum 3.5% – representing 64.5 thousands persons – for those between 45 and 54 years) with gaps greater than 1 percentage point (19.0 thousands persons) compared to rural areas. This situation can be explained by the lower level of motorization and the availability of non-desk jobs, which leads to a non-sedentary life-style, in the rural areas.

Figure 4 presents the SO and SEO prevalence values depending on gender and educational level (like Isaic-Maniu and Herteliu, 2005). The level of education corresponds to the ISCED 2011[2] classification. The 'lower' category includes the persons who had graduated, at the most, from secondary schools (ISCED level 2011: 2). The 'secondary' category includes the persons who had graduated, at the most, from ISCED 2011: 4 (post-secondary non-tertiary education), while the 'tertiary' category includes ISCED 2011: 5-8 (from short-cycle tertiary education to doctoral).

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2 ISCED is a codification system for educational levels created by UNESCO. The 2007 version is available at http://www.uis.unesco.org/Education/Documents/isced-2011-en.pdf.

Figure 4: Prevalence of SO and SEO by gender and education in Romania

It can easily be seen that the state of facts is different. In interpreting the data, we could take into account the fact that as a person has a higher educational level, the probability of her/ him having a job with physical demands, is lower. Thus, the prevalence levels for males tend to match this scenario with a 1% probability for those with lower education and up to a 2% in the case of those graduating higher education. In this context, the pattern for females (with an incidence dropping from 2% for those with lower education to 1.3% for those with tertiary education) is quite unnatural. This still may be explained by fertility behavior (Herteliu *et al.*, 2015) with a clear tendency of postponing baby conception for female persons with higher education who are trying, in the same time to have a career. Also, nowadays, higher educated female persons are much more interested about the correct/ recommended lifestyle and subsequently they are acting accordingly.

If we bring up the residence area (Figure 5), we can observe that the prevalence levels no longer seem to fit a certain pattern. The urban area registers the highest value: 2.3% of the people with lower education (38.8 thousands persons) followed by a decrease down to 1.5% (96.6 thousands persons) for those with secondary level education and an increase of up to 1.7% (28.2 thousands persons) for those with tertiary education. For the people living in rural areas, the values are lower with a maximum of 1.4% (53.0 thousands persons) registered in the case of the persons with lower education.
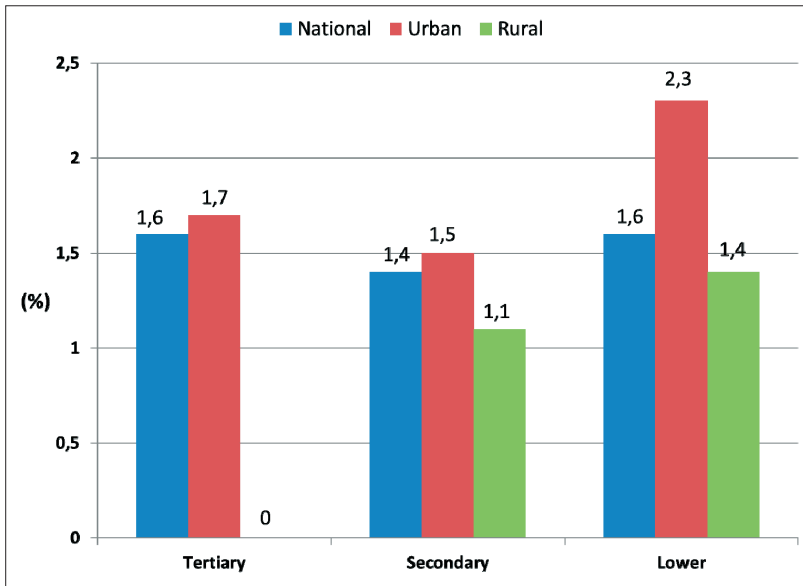
Figure 5: The SO and SEO prevalence by residence areas and educational levels in Romania

Table 1 presents the situation of SO and SEO prevalence by development regions. The higher levels registered by the female population in the above sections are most of the time present (except for the Bucharest-Ilfov, North-West and Center regions) at regional level also. Even when the situation is reverse, gender differences are small (under 0.2%). However, when the levels for the female population are higher, there are regions where these differences are extremely conclusive (1.5% for the South region or even 1.8% in the West region).

Table 1: The SO and SEO prevalence by region, gender and residence area in Romania

Region	Male	Female	Urban	Rural
North-West	1.9	1.8	1.3	2.4
Centre	1.5	1.3	1.5	1.4
North-East	1.1	1.7	2.2	0.7
South-Est	1.2	1.4	1.2	1.5
South	0.5	2.0	1.5	1.1
Bucharest-Ilfov	2.5	2.2	2.2	2.9
South-West	0.7	1.4	1.3	0.8
West	0.7	2.5	2.4	0.3

Figure 6 presents the information about the number of episodes of hospitalization due to obesity related disorders, at county level (localized adiposity, obesity due to caloric excess, extreme obesity with alveolar hypoventilation, drug induced obesity, unspecified obesity, intake excess after-effects, other obesities) per 100 thousand inhabitants. The information is aggregated by hospital address. Like in other researches

(Gavriluta, 2013 or Sinescu *et al.*, 2014), we can observe superior levels registered, generally, in clinics belonging to traditional university centers (Bucharest, Cluj Napoca, Iasi, Timisoara or Targu Mures). Surprisingly, Maramures and Arges are found among the counties with the higher levels. The fact that obesity (most of the time induced by sedentariness) is more frequent in the areas with a higher economic development can also be seen on the map, the counties in Transylvania or Banat having higher levels versus others less economically developed.
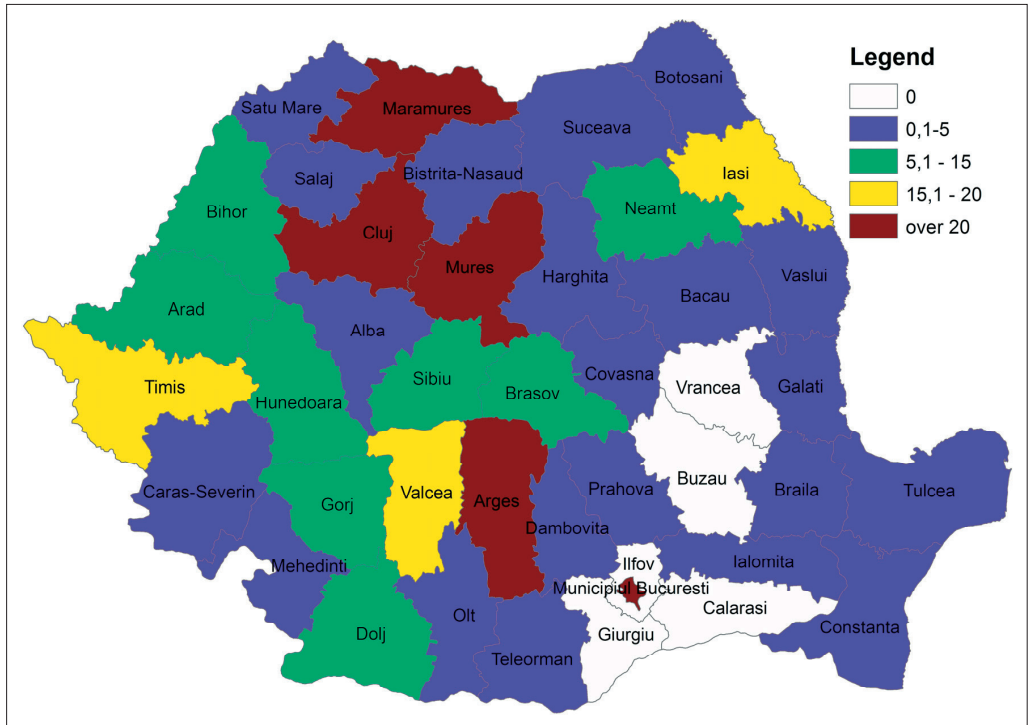

Figure 6: The number of hospital admissions for obesity related disorders (per 100 thousand inhabitants, by county)

4. Public administration's health costs for obesity

In order to estimate the additional financial burden induced by SO and SEO we will apply a macro process. Knowing the incidence of SO (1.1%) and SEO (0.4%) and knowing the total government public expenditure and from the National Health Insurance House for health we consider estimation in two ways (consistent with the percentage limits extracted from the literature) of the financial efforts induced by the two categories of patients. The Unique National Fund for Health Insurance (FNUAS) has provided a budget of 22.56 billion lei in 2014 (CNAS, 2014). At the same time the Ministry of Health estimated budget for 2014 was 7.96 billion lei (Ministry of Health, 2014). This results in a total budget of 30.52 billion lei for health. The population of Romania (INS, 2014) was equal to 21.26 million people at the beginning of 2014. It follows that the amount of allocated funds for health per capita in Romania was 1,436 lei

in 2014. On the other hand, incidence rates of SO was 1.1% (191,900 people) and SEO 0.4% (68,900 people). If these people wouldn't have been affected by obesity, expenditures on health should be less than 1.11 to 1.16 times for SO and 1.23 to 1.25 times for SEO. In this manner we are able to identify additional money spent as shown in the following table. We performed for the data from table the estimations in Euro in order to make the comparisons easier.

Table 2: Estimates of additional amounts spent on treating patients with SO and SEO

Indicator	SO	SEO
Persons	191,853	69,765
Health costs per capita (lei)	1,436	1,436
Health costs per capita (Euro)	319	319
Global costs for obese patients (lei)	275,500,908	100,182,540
Global costs for obese patients (Euro)	61,222,424	22,262,787
Minimum correction coefficient	1.11	1.23
Theoretical costs (unaffected by obesity) (lei)	248,199,016	81,449,220
Theoretical costs (unaffected by obesity) (Euro)	55,155,337	18,099,827
Minimal obesity costs (lei)	**27,301,892**	**18,733,320**
Minimal obesity costs (Euro)	6,067,087	4,162,960
The maximum correction coefficient	1.16	1.25
Theoretical costs (unaffected by obesity) (lei)	237,500,783	80,146,032
Theoretical costs (unaffected by obesity) (Euro)	52,777,952	17,810,229
Maximal obesity costs (lei)	**38,000,125**	**20,036,508**
Maximal obesity costs (Euro)	8,444,472	4,452,557

Source: Authors' own calculation (the exchange rate used: 1 Euro = 4.5 lei)

This way it is very easy to see that under a minimal version SO and SEO costs are 46 million lei (a little bit over 10 million Euro) annually, while the maximal version reached 58 million lei annually (almost 13 million Euro). It should be noted, however, that these estimates are closely related to per capita health expenditure and are underestimated. This underestimation is induced by the fact that the SO and SEO patients have most of the time other comorbidities which results in an average costs for them higher than the national average.

Our methodology to estimate the financial burden of SO and SEO is innovative (to the best of our knowledge there are no other similar reports elsewhere). In the same time, the approach is quite robust being driven by logic and strong basic indicators from the health system. Of course, we have to acknowledge that there are some limitations of the approach: (i) the use of average health cost per capita (further studies should contextualize more the analysis based on co-morbidities specificities); (ii) the multipliers of additional costs are provided by international academic literature (further studies could estimate them for Romania).

5. Conclusions

Compared to other Western countries, Romania has a better position when it comes to the incidence of severe obesity (SO) and severe extreme obesity (SEO), with a level of 1.5% (almost 260 thousand persons). Similarly to other countries, there are some gender differences (with a higher prevalence among the female segment). From the prevalence of the OB, SO and SEO Romania may be considered as a good practice example. It is uncertain which is the most important factor having such an influence. May be governmental approach (through Ministry of Education and Research) to maintain compulsory Physical Education classes at all levels of pre-university education and in first year of the undergraduate cycle? Or do the mainly agricultural occupations in the rural area lead to somewhat more reduced values relative to SO and SEO prevalence in this type of environment? The very recent report released Sustainable Development Goals (SDG) by European Commission (Eurostat, 2017) put the BMI as an indicator to measure the 2nd goal: Zero hunger. Maybe this is the advantage of Romania's lack of development. Of course BMI is also mentioned within SDG as an indicator which is used to measure obesity.

As it happens in other countries, the persons most affected are of mature age (the 35-64 years segment); consequently, the active population in its second half of the career is most affected. Education has a different influence on the prevalence of SE and SEO, with a directly proportionate relationship with the male segment, and an inversely proportionate relationship with the female or rural population. There are also territorial differences, the available statistical information confirming the fact that economic prosperity leads to higher values of SO or SEO. As for the SO and SEO costs we can say that the forecasts made based on the above methodology are ranging from 46 to 58 million lei (10-13 million Euro) per year. Certainly, the methodology must be improved, and we must also take into account the fact that comorbidities can lead to significant increases of these amounts. This is a far-reaching project and can be accomplished in the future.

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