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Source / Izvornik: *Collegium Antropologicum*, 2009, 33, 25 - 29

Journal article, Published version

Rad u časopisu, Objavljena verzija rada (izdavačev PDF)

Permanent link / Trajna poveznica: <https://urn.nsk.hr/urn:nbn:hr:105:685247>

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Download date / Datum preuzimanja: **2024-06-19**



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# The Prevalence of Overweight, Obesity and Central Obesity in Six Regions of Croatia: Results from the Croatian Adult Health Survey

Kristina Fišter<sup>1</sup>, Ivana Kolčić<sup>1</sup>, Sanja Musić Milanović<sup>2</sup> and Josipa Kern<sup>1</sup>

<sup>1</sup> »Andrija Štampar« School of Public Health, School of Medicine, University of Zagreb, Zagreb, Croatia

<sup>2</sup> Croatian National Institute of Public Health, Zagreb, Croatia

## ABSTRACT

*Our aim was to estimate the prevalence of overweight, obesity and increased waist circumference in the adult population of Croatia and investigate regional differences in six regions of Croatia. Using the data from the 2003 Croatian Adult Health Survey we estimated the overall prevalence of overweight, obesity and increased waist circumference for the entire population of Croatia at 38.11%, 20.34% and 43.52%, respectively. For men, this was 43.2%, 20.1% and 34.98% and for women 33.6%, 20.6% and 51.13%, respectively for the three indicators of increased body weight. We found conflicting evidence as to whether the Mediterranean part of the country, compared with the continental part, bears a lesser degree of cardiovascular risk. Planners should pay particular attention to the Northern region, where the burden of increased body weight was the highest.*

**Key words:** obesity, prevalence, regionalism, cardiovascular diseases, Croatian Adult Health Survey, Croatia

## Introduction

Increased body weight, one of the world's most prominent health challenges and public health problems, is widely accepted as an important modifiable risk factor for chronic diseases, both in developed and in developing countries. The World Health Organization (WHO) identified obesity as one of the ten leading risk factors globally<sup>1</sup>. The size of the affected population has increased to the epidemic proportions, with more than one billion adults worldwide being overweight at the turn of the millennium, and at least 300 million obese<sup>2</sup>.

Complications of obesity include various health problems, from arthritis and pain, sleep disturbance, dyspnoea on mild exertion and excessive sweating, to social stigmatization and discrimination, all of which can contribute to lowering the quality of life and increasing the risk of depression<sup>3,4</sup>. The most serious medical consequences of obesity result from endocrine and metabolic changes – most notably increased risk of type 2 diabetes mellitus, cardiovascular diseases (CVD) and some types of cancer. Obesity has also been shown to have a sub-

stantial negative effect on longevity: severe obesity has been estimated to reduce the length of life by 5 to 20 years<sup>5</sup>.

Central obesity in particular has been associated with increased health risks. It has been shown to causally and unfavourably affect insulin resistance<sup>6</sup>, increase the risk of cardiometabolic disease<sup>7</sup>, the incidence of CVD events<sup>8</sup>, as well as all-cause, CVD and cancer mortality<sup>9</sup>. Moreover, people with normal body mass index but increased waist circumference have been shown to have about 20% higher risk of dying than people with normal body mass index and waist circumference below the cut-off values recommended by the WHO (102 cm for men and 88 cm for women)<sup>10</sup>.

Our aim was to estimate the prevalence of overweight, obesity and central obesity in the adult population of Croatia and to investigate any regional differences in these indicators of body weight in six parts of the country.

## Materials and Methods

The data for this study was obtained from the Croatian Adult Health Survey in 2003 (CAHS). CAHS was a nationally representative population-based survey of cardiovascular risk factors in Croatian adults, aged 18 years or older. The first wave of the survey was performed in 2003 and yielded 9,070 responses with an overall response rate of 84%. The sampling approach was based on six regions in Croatia: Eastern, Central, Northern, Mountainous, Coastal region and the City of Zagreb. After stratification according to the region, random household sampling scheme was applied and, finally, one random adult from each household was selected. Specially trained visiting nurses carried out the survey in respondents' homes. A complex seven-step weighting scheme was applied to the collected data, in order to increase the sample's representativeness. Further details on the CAHS are provided elsewhere<sup>11</sup>.

We defined overweight as body mass index (BMI) 25.0–29.99 kg/m<sup>2</sup> and obesity as BMI ≥ 30.0 kg/m<sup>2</sup>. Waist circumference was used as a surrogate marker for measuring central obesity. Central obesity was defined as waist circumference of 102 cm or longer for men and 88 cm or longer for women.

### Statistical analysis

All variables were analyzed as binary outcomes. All estimates were based on weighted data, therefore representing the entire population fraction that fulfilled the analysed criterion. The prevalence of overweight, obesity and increased waist circumference were expressed as percentages with 95% confidence intervals (95% CI). SAS version 8.02 (SAS Inc, Carry, NC) with bootstrap variation estimates (Bootvar) was used in the analyses.

## Results

Overall, the prevalence of overweight, obesity and central obesity (increased waist circumference) for the entire population of Croatia was estimated at 38.11%, 20.34% and 43.52%, respectively. For men, this was 43.2%, 20.1% and 34.98% and for women 33.6%, 20.6% and 51.13%, respectively for the three indicators of body weight.

The highest prevalence of overweight among men was 71.57% (95%CI 67.12–76.01) found in the Northern region, which was significantly higher only when compared with the Eastern region where the prevalence of overweight among men was the lowest in the country, at 55.91% (95%CI 51.28–60.54) (Table 1). The prevalence of overweight among men in the Eastern region was also significantly lower than that in the City of Zagreb, where 66.98% of men were overweight (95%CI 61.18–72.79). In contrast, women in the City of Zagreb had only slightly higher prevalence of overweight than women in the Coastal region, with the latter being the lowest reported nation-wide (50.81% and 50.03%, respectively). Both were significantly lower than the prevalence of over-

weight among women living in the Eastern and in the Central region, and the difference with the figures from the Northern region was borderline significant (Table 1).

The highest prevalence of obesity in men was also recorded in the Northern region (28.62%, 95%CI 24.62–32.61), and this was significantly higher than the prevalence found in any other region (Table 2). The lowest prevalence of obesity was recorded among the men living in the Mountainous region (13.75%). In women, the highest prevalence of obesity was found in the continental parts of Croatia, i.e. in the Eastern, Northern and Central regions (23.83%, 25.59% and 26.24%, respectively). The lowest prevalence of obesity among women was found in the Coastal region (13.62%, 95%CI 11.46–15.78).

Estimates for the prevalence of increased waist circumference in men were, again, highest in the Northern region (41.90%, 95%CI 34.71–49.10), which was immediately followed by the Coastal region (37.68%, 95%CI 32.20–43.16) (Table 3). Men in the Mountainous region showed the lowest prevalence nationally of increased waist circumference (28.74%), which was closely followed by the men in the Eastern region (30.51%). Among women, the highest prevalence of increased waist circumference was recorded in the continental parts of the country (ranging from 54.73% in the Mountainous region to 58.45% in the Central region), while the lowest prevalence was found in the City of Zagreb (44.71%) and the Coastal region (45.80%).

**TABLE 1**  
PREVALENCE OF OVERWEIGHT, BY SEX AND REGION

	Men		Women	
	Prevalence	95% CI	Prevalence	95% CI
Eastern	55.91	51.28–60.54	57.80	55.12–60.48
Northern	71.57	67.12–76.01	58.25	53.84–62.66
Central	61.96	56.64–67.28	58.01	54.59–61.43
The city of Zagreb	66.98	61.18–72.79	50.81	47.75–53.86
Mountainous	65.64	52.11–79.17	53.42	37.47–69.37
Coastal	64.40	59.08–69.73	50.03	46.57–53.48

**TABLE 2**  
PREVALENCE OF OBESITY, BY SEX AND REGION

	Men		Women	
	Prevalence	95% CI	Prevalence	95% CI
Eastern	19.34	16.03–22.64	23.83	21.15–26.52
Northern	28.62	24.62–32.61	25.59	22.21–28.97
Central	23.35	19.71–26.99	26.24	22.79–29.68
The city of Zagreb	16.82	12.78–20.85	21.04	18.52–23.56
Mountainous	13.75	11.29–16.21	16.85	7.75–25.95
Coastal	19.45	15.06–23.84	13.62	11.46–15.78

**TABLE 3**  
PREVALENCE OF INCREASED WAIST CIRCUMFERENCE, BY SEX  
AND REGION

	Men		Women	
	Prevalence	95% CI	Prevalence	95% CI
Eastern	30.51	26.05–34.97	55.06	51.72–58.39
Northern	41.90	34.71–49.10	56.45	51.14–61.75
Central	36.91	32.07–41.75	58.45	54.78–62.12
The city of Zagreb	34.93	28.88–40.99	44.71	41.62–47.80
Mountainous	28.74	12.80–44.68	54.73	42.28–67.17
Coastal	37.68	32.20–43.16	45.80	43.44–48.15

Figures show the geographic variation in the prevalence of overweight, obesity and central obesity, separately for men and women, with darker shades indicating higher prevalence.

## Discussion

We found that almost 60% of the Croatian adult population have increased body weight and more than 40% are centrally obese according to the criteria set by the WHO. These findings are comparable with the most unfavourable estimations of body weight indices reported for populations globally. In the USA, the prevalence of overweight and obesity in the adult population has been



*Fig. 1. Geographic variation in the prevalence of overweight among men, based on the data from the Croatian Adult Health Survey 2003; shades of grey denote the gradient across regions, from the lowest prevalence (lightest grey) to the highest prevalence (darkest grey).*



*Fig. 2. Geographic variation in the prevalence of obesity in men, based on the Croatian Adult Health Survey 2003; shades of grey denote the gradient across regions, from the lowest prevalence (lightest grey) to the highest prevalence (darkest grey).*



*Fig. 3. Geographic variation in the prevalence of central obesity in men, based on the Croatian Adult Health Survey 2003; shades of grey denote the gradient across regions, from the lowest prevalence (lightest grey) to the highest prevalence (darkest grey).*



*Fig. 4. Geographic variation in the prevalence of overweight in women, based on the Croatian Adult Health Survey 2003; shades of grey denote the gradient across regions, from the lowest prevalence (lightest grey) to the highest prevalence (darkest grey).*



Fig. 5. Geographic variation in the prevalence of obesity in women, based on the Croatian Adult Health Survey 2003 data; grey color denotes the gradient from the lowest prevalence (lightest grey) to the highest (darkest grey).



Fig. 6. Geographic variation in the prevalence of obesity in men, based on the Croatian Adult Health Survey 2003 data; grey color denotes the gradient from the lowest prevalence (lightest grey) to the highest (darkest grey).

reported to exceed 60%, and is rising among adults, children and adolescents<sup>12,13</sup>. In Europe, the highest prevalence of obesity was recorded in Spain for men (28.3%) and in Poland for women (36.5%)<sup>14</sup>, whereas the highest prevalence of overweight was found in Slovakia (51%) and Slovenia (50%) for men and in Portugal, Malta and Cyprus for women (34%)<sup>15</sup>. Generally, the prevalence rates for overweight and obesity are higher in Central, Eastern, and Mediterranean Europe than those in Western and Northern Europe<sup>14</sup>. Our data fit well with this pattern, since they place Croatia among the countries with higher burden of overweight and obesity, when compared with other European countries.

A previous study suggested that a traditionally assumed gradient in CVD risk factors between the continental part and the Mediterranean part of Croatia might indeed be in place, with lower prevalence of CVD risk factors, morbidity and mortality in the coastal region when compared with the continental part of the country<sup>16</sup>. We found evidence that supports such a regional pattern, but also some evidence that disputes it. In support of this thesis, we found that women in the Coastal region had the lowest prevalence of both overweight and obesity, and showed the second lowest prevalence of central obesity. Also, women in the Eastern region, which is traditionally thought of as the region with the heaviest nutrition, showed the highest prevalence of overweight, compared with other regions. However, paradoxically, men in the Eastern region had the lowest prevalence of overweight, when compared with other regions, and also ranked only fourth out of six regions in the prevalence of obesity, with the prevalence lower than that which was found among the men in the Coastal region. Also, concerning the prevalence of central obesity, men in the Coastal region ranked second highest while men in the Eastern region ranked second lowest.

It has been suggested that urbanisation and globalisation processes might lead to unfavourable lifestyle factors having a negative effect on the traditional Mediterranean diet<sup>17</sup>. It may be that Croatian men are more affected by these processes than women. In any case, it seems that at least our observations for women support the traditional views and fit well with a number of previous studies that suggested better health related indicators in the coastal parts of the country<sup>11</sup>. Possible explanations of this pattern could include a wide range of factors, including overall lifestyle, diet, health practice and disease awareness, as well as potential genetic differences between the coastal and continental populations<sup>11,18–21</sup>. In the absence of comprehensive studies that would take into account all of these and possibly other as yet unknown factors, the true explanation of these regional differences remains only speculative.

However, particularly worth noting is that, in the Northern region, the prevalence of overweight, obesity and central obesity are the highest in the country. This suggests that the population of this region has by far the highest burden of excess body weight and is a clear message for policy makers. Differences between sexes are also noteworthy. While obesity rates are similar in men and women, overweight is a more serious problem among men than women. However, central obesity is much more prevalent in women than in men, with more than a half of the adult female population being centrally obese. Planners of health interventions need to take this important information into account.

Changes in health related behaviours and health practices in Croatia in the last two decades have largely resulted from the 1991–1995 war<sup>22</sup>, subsequent transition<sup>23</sup> and recent changes in the health care system<sup>24</sup>. Studying these changes, including body weight patterns, should be high on the national research agenda, provid-



ing a better understanding of the population's major health risks and enabling provision of more and better information for policy makers. Detailed and targeted interventions would then become possible. Despite the shortcomings, our study represents the currently best possible framework for the investigation of the risk factors at the national level. The results are therefore poten-

tially interesting for a broad range of public health practitioners and other health workers and stakeholders.

### Acknowledgements

The study was supported by the Croatian Ministry of Science, Education, and Sports, grant number 108-1080135-0264.

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K. Fišter

»Andrija Štampar« School of Public Health, School of Medicine, University of Zagreb, Rockefellerova 4  
HR-10000 Zagreb, Croatia  
e-mail: kristina.fister@snz.hr

### PREVALENCIJA PREKOMJERNE TJELESNE TEŽINE, DEBLJINE I ABDOMINALNE DEBLJINE U ŠEST REGIJA HRVATSKE

#### SAŽETAK

Cilj rada bio je procijeniti prevalenciju prekomjerne tjelesne težine, debljine i centralne debljine (povećanog opsega struka) u odrasloj populaciji Hrvatske, te istražiti eventualne razlike između pojedinih geografskih regija. Koristeći podatke iz Hrvatske zdravstvene ankete 2003., procijenili smo da je ukupna prevalencija u populaciji 38,11% za prekomjernu tjelesnu težinu, 20,34% za debljinu i 43,52% za centralnu debljinu. Za muškarce, odgovarajuće prevalencije su 43,2%, 20,1% i 34,98%, a za žene 33,6%, 20,6% i 51,13%. Naši rezultati ne mogu sa sigurnošću utvrditi je li kardiovaskularni rizik u priobalju manji nego u kontinentalnom dijelu zemlje. Posebnu pozornost nužno je posvetiti sjevernoj regiji, gdje smo našli uvjerljivo najveće breme prekomjerne tjelesne težine, debljine i centralne debljine.