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Professional Paper

OVERWEIGHT AND OBESITY IN CROATIA

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(mass (lb) / height (sq)) x 703

SUMMARY

Obesity is defined as a body mass index (BMI) of ≥30 kg/m², and overweight as BMI between 25 and 30 kg/m². The aim of the study of obesity in Croatia was to determine its prevalence and to establish connection with gender, age, education and urban/rural type of living. BMI was assessed in a survey of 270 randomly selected adult health care users from records of four family physicians; a questionnaire was sent by post. The prevalence of obesity was 11% and of overweight 46%, both higher in males than in females. Age showed positive correlation with obesity, stronger in males than in females. The critical age of getting overweight was 35-49 years. The mean BMI slightly declined with higher education. Urban/rural type of living showed no correlation with BMI. Since the population in Croatia is getting older, an epidemic of obesity is to be expected.

INTRODUCTION

Throughout progression of civilization many health welfares have been achieved, however, chronic noninfectious diseases still remain a problem that is only masked but not yet definitely solved. Lifestyle has been adjusted to please the individual person, unfortunately, it is not suitable to physical constitution of *Homo sapiens*. That is why many so-called 'diseases of civilization' have emerged, obesity being one of them. Obesity could be defined as a morbid condition *per se* but is more important as a premorbid condition for other diseases. Surveys have shown that there is a positive trend of getting higher body mass with time, and obesity is becoming an epidemic worldwide (1). This fact was recognized by the World Health Organization Statement from the year 1997 and has been ranged higher as a medical problem than 'traditional' world health problems such as malnutrition or infectious diseases (2). The widely accepted taxonomy of body weight is body mass index (BMI), also recommended by the WHO. It is a basis of many epidemiologic surveys. Recent surveys in industrialized European countries have demonstrated that approximately 15%-20% of the population have a BMI greater than 30 kg/m² (1). Higher BMI brings many other concomitant health problems, e.g., increasing growth of BMI is followed by higher incidence of type II diabetes (3), there is a well-known connection of obesity with hypertension (4,5), hyperlipidemia (5-7), coronary heart disease (8-11), sleep apnea (12,13), and a variety of metabolic disorders known as the polymetabolic syndrome. Of special relevance is the association of obesity with some malignant diseases, e.g., breast cancer (14,15), endometrial cancer (16), prostate cancer (17,18), and cancer of colon (19). The question whether obesity as an unacceptable physical appearance causes difficulties in social adjustment, or results in a disturbed psychological background is still controversial (20-22).

All these data point to obesity as a medical as well as social and ergonomic issue that is necessary to explore. The aim of the study in Croatia was to establish the prevalence of BMI in the general population and to

establish whether there are some patterns that could describe the population in a more specific way according to age, gender, level of education, and urban or rural type of living.

SUBJECTS AND METHODS

Early in the year 1999, an epidemiologic study of BMI was conducted in the Croatian population. The study included 270 subjects. The population sample were health care users. Data of the study subjects were obtained from their primary care physicians (family physicians). It is important to mention that at that time, health insurance in Croatia was covered by the state. It means that everybody in the country had health insurance. Almost every person had a file at the local family physician office (mostly the one closest to the place of residence). The fact that one is registered at a general physician does not mean that he/she is visiting the office regularly. It only implies the possibility to use health care, not the fact that it has been used. In this way, the study sample represented the general population, not only health care users. To avoid clustering of study subjects with previous organic pathology and to get a sample as representative as possible, double stratification was performed. Four health care centers were chosen from the table of randomly selected numbers, two of them also including rural population. From the selected health care centers, four family physicians were chosen using the same table of randomly selected numbers. From the records of the selected physicians every tenth health care user was taken by alphabetic order. In this way, 75 subjects were selected. Of these 75 persons, 68 were 'first choice' for the survey, and the rest of them being considered as 'reserves' in case the contact with the 'first choice' was not possible. The aim of the selection was to get a sample that would best match the Croatian population. The last census from 1991 was taken as a population model, as data from the 2001 census had not yet been available. Upon selection of 50% of the study participants, data were analyzed and the next ones were selected in a way to fit the gender and urban/rural ratio in Croatia (according to the Croatian Health Service Yearbook 1999) (23). Age distribution did not fit exactly the one in Croatia, as the study sample had more women in the 35-49 age group and more men aged >50 years. Questionnaires were posted to their home addresses. Some of them returned blank because of the persons' new and unknown address, migration, death, etc. When the new address could be identified, the questionnaire was posted again. When it was not possible to locate the selected subject, the 'reserve' from the same family physician office was included.

Study sample consisted of 152 (56.3%) females and 118 (43.7%) males. According to the 1991 census in Croatia, the population aged >18 had 52.5% of females and 47.55% of males.

The inclusion criterion was age over 18. Younger persons were not included because of the specific growth and development physiology in younger age. Medical history or other elements that could influence random selection were not considered. The oldest person was aged 97, and mean age was 52 years. Four age groups were formed: I - 18 to 34; II - 35 to 49; III - 50 to 64; and IV - over 65 years. These groups resembled the ones in the census.

Four educational groups were formed too: I - subjects without formal education or subjects with eight year elementary school; II - subjects with four year secondary school; III - subjects with two-year non-university college; and IV - subjects with university degree.

According to the type of living, the sample population were divided into urban and rural households. Study subjects were asked about the type of living in the last 3 months: 225 (94%) answered that they had lived in urban households and 15 (6%) in rural households. According to the census, 9% of the population were living on agriculture. Although no one can claim that all people living in rural households are living only on agriculture, these data are not essential, as the most important issue is lifestyle (urban or rural).

The method used in the study was a questionnaire; it consisted of demographic and anthropologic questions (first and second name, address, gender, date of birth, height, weight, educational level, urban or rural type of living). Upon data collection and BMI calculation, the study subjects were divided into four subgroups according to BMI: underweight or body mass <80% of normal – BMI <18.5 kg/m^2; normal weight or body mass from 80% to 120% of normal - BMI 18.5 –24.9 kg/m^2; overweight or body mass 20% to 30% higher than normal - BMI 25 –29.9 kg/m^2; grade I obesity or body mass 30% to 55% higher than normal - BMI 30 –34.9 kg/m^2: grade II obesity or body mass 55% to 80% higher than normal - BMI 35-39.9 kg/m^2; and grade III obesity or body mass >80% higher than normal - BMI >40 kg/m^2. These groups were formed according to the WHO recommendation (2).

A limitation of the study was the fact that the weight and height were self-reported, which could lead to underestimate. That was the reason why the participants were asked to be as objective as possible when answering this question.

Gender, age, educational level, and type of living were analyzed according to the BMI groups. Using Microsoft Excel program, these groups were analyzed by Pearson χ^2-test comparing actual and expected ranges, and determining whether the hypothesized result had been verified by the experiment. The ratio of BMI and age was analyzed by correlation test that determines the relationship between the two characteristics. The correlation between BMI and age was observed for males and females in separate. Finally, mean BMI was calculated according to age and educational groups.

RESULTS

Prevalence in the population

Age and gender distribution of the study sample is shown in Table 1. Analysis of BMI groups indicated the prevalence of overweight and obesity to be 46% and 11%, respectively.

Table 1. **Distribution of study subjects according to gender and age groups**

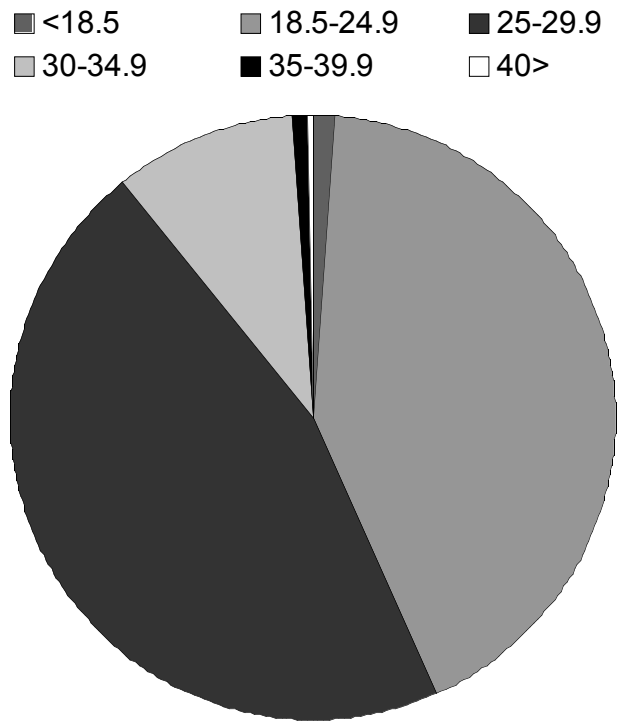
Age (yrs)	Male	Female	Total
18-34	20	28	48
35-49	24	52	76
50-64	37	41	78
>64	37	31	68
total	**118**	**152**	**270**

Table 2 and Fig. 1 clearly indicate that there were only few subjects with body mass lower than normal, and also few with extremely high body mass. Normal body weight subjects and overweight subjects accounted for 88% of the study sample, at an almost identical percentage. The mean BMI of 25.52 kg/m^2 confirmed this observation because it is at the borderline between normal weight and overweight.

Table 2. **Body mass index (BMI) distribution according to gender**

BMI (kg/m^2)	Male	Female	Total	%
<18,5	0	3	3	1.1
18.5-24.9	37	77	114	42.2
25-29.9	66	58	124	45.9
30-34.9	14	12	26	9.6
35-39.9	1	1	2	0.7
40>	0	1	1	0.4
Total	**118**	**152**	**270**	**100**

Figure 1. **Body mass index (BMI) distribution in the study population**



Body mass index and gender

The mean BMI was 24.9 kg/m^2 (lowest 17.3 kg/m^2, highest 41.5 kg/m^2) in female population, and 26.3 kg/m^2 (lowest 19.4 kg/m^2, highest 37.2 kg/m^2) in male population. ÷^{2}-test confirmed a statistically significant difference in BMI between men and women.

Of all female subjects, 38% were in the overweight group and 9% in the obese group. Of all male subjects, 56% were in the overweight group and 13% in the obese group according to the previously mentioned classification.

All data confirmed that men were more likely to become obese and overweight. As shown in Table 2 and Fig. 2, in the population with normal BMI the number of females was twofold that of males.

Figure 2. **Body mass index (BMI) according to gender**

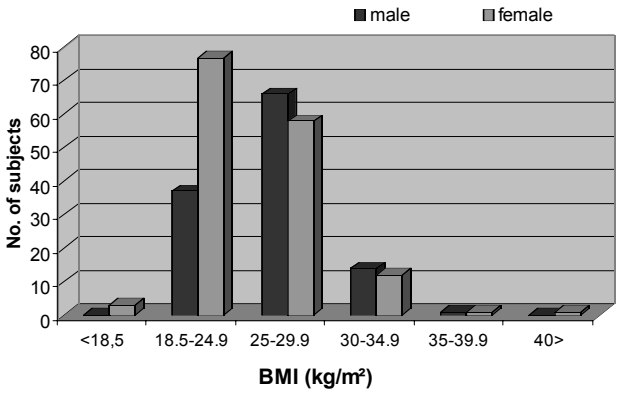


Figure 3. **Mean body mass index (BMI) according to age groups**

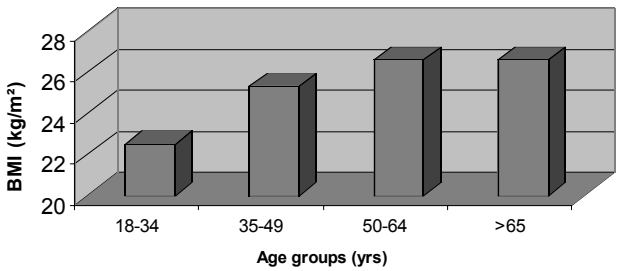
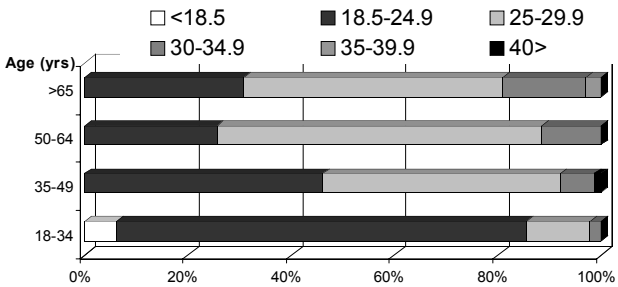


Figure 4. **Body mass index (BMI) according to age groups**



Body mass index and age

The mean BMI was 22.5 kg/m^2, 25.3 kg/m^2, 26.6 kg/m^2 and 26.6 kg/m^2 in the 18-34, 35-49, 50-64 and >65 age groups, respectively. Figure 3 shows that BMI value tended to rise with age, crossing the overweight line in the 35-49 age group and stagnating at the age >65.

χ^2-test confirmed a statistically significant age related difference in BMI values in different age groups. Figure 4 shows that BMI of normal body weight declined with age, and BMI in the overweight and obesity groups increased with age. It is interesting that the percentage of obese subjects in the >65 age group reached almost 20%.

There was also a positive correlation between BMI and age, with a correlation coefficient of 0.35. The correlation was stronger in male (correlation coefficient for male population was 0.36) than in female subjects (correlation coefficient for female population was 0.33).

Body mass index and education

The mean BMI values in educational groups were as follows: 25.9 kg/m^2 in subjects without formal education or subjects with eight year elementary school; 25.6 kg/m^2 in subjects with four year secondary school; 25.2 kg/m^2 in subjects with two-year non-university college; and 25.3 kg/m^2 in subjects with university degree. Although the mentioned BMI values did not significantly support the differences between the educational groups, Fig. 6 shows that the mean BMI declined with higher level of education.

Figure 5 clearly shows that the group with lower educational level had an almost twofold percentage of obese individuals recorded in the groups with two-year non-university college or with university degree. Since weight and BMI are strongly age-dependent variables, age distribution in each educational group was checked and analysis of variance yielded no significant difference.

Body mass index and type of living (urban/rural)

χ^2-test did not yield any statistically significant difference in BMI values between the subjects living in urban and rural households.

COMPARISON BETWEEN CROATIA AND OTHER COUNTRIES

Figure 7 shows the prevalence of underweight and obesity according to the level of development, with data from this survey for Croatia plotted in. According to this figure, Croatia cannot be compared with any group of countries. Although underweight and obesity are not the criteria for classifying the degree of a country's development, this comparison identifies the groups of countries with similar BMI. In the group of less developed countries, there is a higher percentage of underweight people, and in the group of transition countries a higher percentage of obese people than in Croatia.

Figure 5. **Body mass index (BMI) according to level of education**

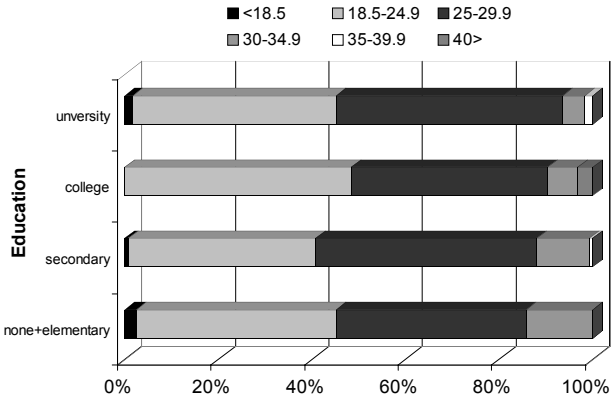


Figure 6. **Mean BMI according to educational groups**

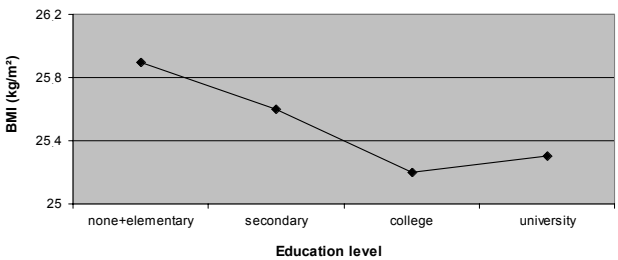
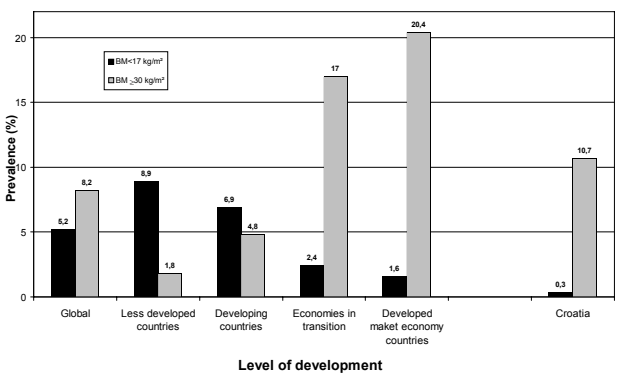


Figure 7. **Global distribution of adult population affected by underweight and obesity in 2000 according to the level of development (web page World Health Organization www.who.int/nut/research2.htm, Nutrition/Nutrition data bank, updated Feb 6, 2001) with interpolated data from the present survey for Croatia (on the right)**



DISCUSSION

The principal interest of the survey was to determine the place of Croatia according to the prevalence of obesity and overweight in the population. To include the specificity of the population, some relevant surveys will be mentioned: one of them conducted in the 1980s in Europe (MONICA) (24) showed the prevalence of obesity to range from 15% to 20% with a tendency to rise. This tendency was also confirmed in the USA (NHANES I, II, III studies) (25). In the year 2000, a study was published that included a local population of Dalmatia. The investigators compared the indicators of nutritional status to the reference data from NHANES I and II. The findings suggested the upper percentiles of BMI and triceps skin fold to be inadequate for the assessment of excess body fatness in the Dalmatian population. It pointed out that the high prevalence of overweight could partially reproduce muscularity and skeletal strength rather than excess body mass (26). Since WHO has mentioned that ethnicity is closely associated with the predisposition to obesity (2), this study is comforting for the Croatian population.

Furthermore, the Croatian population have some specific eating habits. In the report from the year 1998, WHO (27) compared food intake variation in Europe between northern countries (Denmark, Finland, Iceland, Norway and Sweden) and southern countries (Greece, Italy, Portugal and Spain). The northern Europe food intake pattern contains high quantities of saturated fat accompanied by low availability of fruit and vegetables. In southern Europe, the pattern consists of high quantities of fruit and vegetables and low amount of saturated fat. In this report, the Croatia's animal fat intake follows the southern Europe pattern, with the exception of low contents of cereals, fruit and vegetables. In the meantime, due to the development Croatia is gradually becoming part of the food market globalization that suppresses traditional food patterns. If one adds a sedentary lifestyle that is widely established, the prospective in general does not seem to be very good concerning the future prevalence of obesity. The fact that cardiovascular diseases are the main cause of death in Croatia, with a less declining trend than expected (27), is also a reason for alarm. WHO has pointed out four priorities of health promotion in Croatia by achieving a healthier lifestyle. Two of them directly address the lifestyle changing by reducing weight. These two are (27):

1. to achieve healthier eating habits by reducing the intake of salt, refined carbohydrates and fat, especially animal fat, while increasing the intake of micronutrients, and
2. to promote regular physical activity (especially walking at least 14 km weekly for exercise among sedentary people).

According to Fig. 7, the Croatia's pattern of BMI values is specific and cannot be compared with any other country. Although there is a relatively low percentage of obese people (11%), there is a quite high proportion of overweight people (46%). Since there is clear evidence for getting heavier with age, and we know that the Croatian population (as almost all European nations) is getting older, one could expect that a significant proportion of overweight people are going to join the obese group with time.

Contradictory to most other world surveys, the results of this study showed a higher incidence of obese male population (13% of males *versus* 9% of females). Other European studies indicate that women and men with BMI higher than 30 kg/m^2 account for 15%-20% and 10%-15% of the population, respectively (28). The studies also show that female population lead in the obese group, whereas male population lead in the overweight group (28). In the study of the Croatian population, males also prevailed in the overweight group (56% of males *versus* 38% of females). A typical southern 'macho' attitude towards outward appearance might also have something to do with this issue. In the year 2000, an interesting survey was performed in the European Union (29). The aim was to estimate the subjective judgment of body weight, and the question was whether the overweight and obese people underestimated their body weight. BMI was grouped into 4 categories. These categories were matched to the body image observed. Body image was presented by using a nine-silhouette illustration. The participants were asked to choose the silhouette that in their opinion resembled their body image. Men classified themselves worse than women, being more likely to undervalue their body weight. The highest degree of underestimate was recorded in the Mediterraneans (68.7% of men and 37.9% of women). Knowing that the Croatian population also belong to the Mediterranean to a great extent, it could be an explanation why we had male predominance in the obese and overweight groups. However, it should be remembered that men had a lower proportion of fat than women (30). The same result on males having a higher BMI than females in Croatia has already been reported (31). A project conducted under the Ministry of Health was conducted in 1997. It included around 5800 volunteers and found that 79.1% of males (in the present study 68.6%) and 49.9% of females (in the present study 47.4%) were overweight and obese. Although the figures are not the same, the ratio is similar.

A positive correlation between BMI and age is expected. Most people are neither obese nor overweight during the time of body development and at the end of growth (for males around the age of 20, and for females 18) (32). BMI value is an ideal measuring indicator for young people. At an older age, especially over 65, BMI is not so reliable. Although some individuals at an older age have normal BMI, it may also be due to the muscular tissue replacement with fat tissue. The elderly have different metabolism and their weight is not of the same value as in the young. That is why physicians who work with patients should consider tables that correct BMI value for age (33). For example normal BMI for age <35 is suggested to be from 19 to 25 kg/m^2, and for age >35 from 21 to 27 kg/m^2 (34). In the Croatian population, BMI value crosses the overweight line in the 35-49 age group. They are active, working population and getting extra body fat in 10-15 years could cause cardiovascular consequences. This is also the age group that should be the predominant target group for prevention actions. BMI is rising till the age of 65, than stagnating. Anyway, at the age over 65 there is a higher percentage of obese people; this means that some individuals tend constantly to get even more weight in the advanced age. The higher positive correlation between BMI and age in males than in females shows that male population tends to get more weight with age. The previously mentioned survey carried out in Croatia confirmed the association between age and BMI (31). The percentage of overweight and obese people was 24.3% (in the present study 14.6%) in the 18-29 age group, and 79.2% (in the present study 73.0%) in the 50-65 age group.

Lower level of education, an indirect indicator of the socioeconomic status, has been confirmed in many surveys to be connected with higher BMI (34,35). Some of these studies found stronger connection between lower educational level and high BMI in females. Poverty itself, according to these findings, is more strongly connected with higher BMI in females than in males (28,35,36). Although there was no statistical correlation between BMI and education, the mean BMI declined with higher level of formal education. Not only mean BMI but also the percentage of obese people declined with education. For example, in the group of subjects with non-university college degree and university degree, there were two times less obese people than in the group of people with no formal education or with elementary school. Appropriate education about the hazards of being overweight or obese could be an efficient way of prevention.

Analysis of data collected from the people living in urban and rural households yielded no difference in BMI value.

CONCLUSIONS

1. According to the internationally accepted BMI classification, the prevalence of obese adults in Croatia found in this study was 11%. This is a relatively low percentage as compared with the European average that ranges from 15% to 20%. WHO recognizes obesity as one of the priorities of health promotion. In the 1998, WHO issued recommendations to improve lifestyle: to change dietary habits and to promote regular physical activity.
2. There is almost the same percentage of Croatian population with normal weight and overweight but not yet obese. This percentage of overweight people could be expected to progress with time to the obese group because of the constant tendency of the general population to getting older.
3. In the Croatian population there is an evident rise of BMI with age. The critical age for crossing the line from normal weight to overweight is the 35-49 age group. After the age of 65, stagnation of the BMI value was verified.
4. Contrary to other European countries, in the present survey men prevailed in the obese and overweight population. Male population had a slightly higher tendency to become obese or overweight with advanced age.
5. There is no evident connection between the educational level and BMI, but the mean BMI slightly declined with higher education.
6. There was no evident difference in BMI value between the subjects living in urban and rural households.
7. The group of subjects carrying a higher risk of being overweight or obese could be characterized as follows: more likely to be men than women, aged 35-65, and with a lower level of education.

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