Prevalence of arterial hypertension in obese high school population in Zenica, Bosnia and Herzegovina

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ABSTRACT

Aim To determine the significance of obesity as a risk factor in high school population with hypertension.

Methods Testing was conducted during the school year 2006-2007 on a sample of 1121 students, 15-18 years of age (306 boys and 815 girls) from three high schools in Zenica (Grammar School, Teacher Training High School and Secondary School for Nurses). Increased relative risk factor with reliability coefficient that points to the significance of the correlation of risk factors and development of a disease was examined using analytical epidemiological research methods and statistical analysis (the linear correlation coefficient, χ² test, and the relative risk).

Results Obesity, e.g. Body Mass Index (BMI) ≥ 95 was found in 15 (5%) boys and 57 (7%) girls. Increased relative risk of developing essential arterial hypertension was found in obese boys (RR=9.00) and girls (RR=2.66) with the coefficient of reliability which pointed to the significance of the relationship between obesity and arterial hypertension morbidity.

Conclusion Obesity is a significant risk factor for the occurrence of essential arterial hypertension in boys and girls. Monitoring the nutritional status of youth, regular systematic medical examinations with measuring tension and implementing measures to control nutrition, are important preventive public health tasks.

Key words: obesity, correlation, risk factor, essential arterial hypertension
INTRODUCTION

On the basis of evidence of the development of hypertension it is obvious that essential hypertension is also diagnosed among youth (1). Obesity is one of the leading risk factors for the development of hypertension and cardiovascular disease. Global obesity rate is increasing, both in developed and developing countries (2). Ignoring children’s and adolescent’s obesity threatens the health of the cardiovascular system in child and adolescent population, and it is likely to lead to a serious public health problem in the future (3). Research by Canadian authors show early effects of increased body weight, lack of physical activity, positive family history of hypertension and socio-economic instability on the values of the blood pressure (4). Early interventions in reducing child obesity could, among other things, reduce the risk of developing high blood pressure and reduce the risk of cardiovascular disease (4).

According to Chinese authors, the level of systolic and diastolic blood pressure increases with age and it is strongly positively correlated with Body Mass Index (BMI) in boys and girls, and overall incidence of relatively high blood pressure was 24.07% in boys and 23.36% in girls (5).

Prevalence of isolated systolic hypertension was 6.9% in young men and 2.3% in young women according to French authors (6). Croatian authors, Contosic and colleagues, have found the prevalence of systolic arterial hypertension of 8.6% and the prevalence of diastolic arterial hypertension of 2.1% in boys aged 18 years (7).

The aim of this study was to determine the association between essential arterial hypertension, increased body weight and BMI in high school population in Zenica city.

PATIENTS AND METHODS

Study was conducted on a sample of 1121 respondents of three high schools in Zenica (Grammar School, Teacher Training High School and Secondary School for Nurses), during the school year 2006/2007, which included 306 boys and 815 girls, 15 to 18 years of age. Each student had a written consent of a parent or guardian for their being subjected to the research. The Ethical Committee of the Pedagogical Institute of Zenica municipality had given approval to conduct the research in those schools.

Systolic and diastolic arterial blood pressure was measured by mercury sphygmomanometer (Riva-Rocci, 0197 CE WOMD Wenzhou, China), with the appropriate cuff width and length, which covered 2/3 forearm and with free access to cubital pit (1).

In order to eliminate factors of effort and excitement that significantly affect the current level of arterial tension in respondents ("situational hyper-
tension”), each respondent rested for half an hour, brief interview was conducted and then they were prepared for measurement. If elevated tension had been found, measurement was repeated three times, at intervals of 10 minutes, and the average value was taken as the relevant one. Among the respondents who, after the first measurement had tension with the values of ≥95 percentile pressure distributions for the same age, sex and height, the measurement was performed two more times within seven days, each time three measurements were performed and average value of the pressure was taken as the relevant one.

The measurement was performed in the respondent supine position with cubital pit at heart level and scale of pressure gauge at the eye level of the examiners. Measurement was performed on both hands and average value of the pressure was taken. The height of the first appearance of a tone after a gradual release of pressure in the cuff was taken as the level of systolic pressure. The height when the tone loses D5, Phase V by Korkotov was taken as the level of diastolic pressure (1). The research did not include children who had already been previously diagnosed with arterial hypertension.

Body weight was measured by means of medical decimal scale, with incorporated anthropometry used to measure body height (Detecto, USA), which was calibrated before the measurements. Body weight was measured to the value of a dekagram and body height to the nearest centimeter. Respondents were measured after physiological bowel and bladder discharge. They were measured barefoot, in their underwear. The value of the weight of the underwear was deducted from the measured values of body mass (10).

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The nutritional status of respondents was determined by calculating the body mass index (BMI), which was obtained by dividing weight in kilograms by the square of body height in meters (10,11). In this research the percentile value BMI ≥ 15 to BMI <85 were marked as (physiological) normal body weight, BMI ≥ 85 percentile to BMI <95 percent as of those with increased body weight, and BMI ≥ 95 percentile as obesity. Prevalence of frequency, coefficient of linear correlation (r) at a significance level of 0.01, χ2 test for p<0.05, and the relative risk (RR) were used as statistical parameters.

RESULTS

Obesity for BMI> 95 was found in 15 (5%) boys and 57 (7%) girls aged 15-18 years. Systolic blood pressure in the total sample of boys and girls correlated significantly with BMI (r=0.278) and body mass (r=0.439) (p<0.01). Diastolic blood pressure in the total sample of boys and girls correlated significantly with BMI (r=0.252) and body mass (r=0.258) (p<0.01).

Systolic blood pressure in the total sample of boys showed mild degree (small) correlation (+/- .20 to 0.40) with BMI (r=0.329) and body mass (r=0.398) (Table 1).

Diastolic blood pressure in the total sample of boys showed mild degree (small) correlation (+/- .20 to 0.40), with BMI (r=0.238) and body weight (r=0.283) (Table 1).

Systolic blood pressure in the total sample of girls showed mild degree (small) correlation (+/- .20 to 0.40) with BMI (r=0.296) and body weight (r=0.302) (Table 1).

Diastolic blood pressure in the total sample of girls showed mild degree (small) correlation (+/- .20 to 0.40) with BMI (r=0.259) and body weight (r=0.231) (Table 1).

There was a positive linear increase of prevalence of arterial hypertension in relation to the linear increase in obesity, expressed as BMI (0 <r <1). There was a statistically significant difference in the occurrence of arterial tension between the patients with hypertension and a group of those who were physiologically proper tension (p<0.05). The relative risk of the increased rate of arterial hypertension in obese respondents was 9.00 (p=0.01), indicating that there was a 9 times greater risk of developing hypertension in obese boys than in those of normal weight (OR=12.6) (Table 2).

Based on the statistical analysis of the number of respondents with hypertension and the number of respondents who were normotensive in relation

<table>
<thead>
<tr>
<th>Boys</th>
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<tbody>
<tr>
<td>Systolic pressure</td>
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</table>
| Body weight | 0.398*  
| Body mass index | 0.329*  
| Diastolic pressure | 0.283*  
| P | 0.0001  
| Systolic pressure | 0.302*  
| Diastolic pressure | 0.231*  
| P | 0.0001  

<table>
<thead>
<tr>
<th>Girls</th>
</tr>
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<tbody>
<tr>
<td>Systolic pressure</td>
</tr>
</tbody>
</table>
| Body weight | 0.238*  
| Body mass index | 0.259*  
| Diastolic pressure | 0.296*  
| P | 0.0001  

*significant correlation
to nutritional status, among girls there was a statistically significant difference in the occurrence of arterial hypertension between the two groups (p<0.05). The relative risk of increased morbidity rate of arterial hypertension in obese respondents was RR=2.6667 (p=0.03) indicating that there was a 2.7 times greater risk of hypertension morbidity in obese girls in this age group than in the normal weight girls (OR=3.13) (Table 2).

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Hypertensive</th>
<th>Normotensive</th>
<th>RR</th>
<th>p</th>
<th>OR (Odds ratio)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obese respondents boys</td>
<td>9</td>
<td>1</td>
<td>9.00*</td>
<td>0.01*</td>
<td>12.6</td>
</tr>
<tr>
<td>Obese respondents girls</td>
<td>10</td>
<td>6</td>
<td>2.66*</td>
<td>0.03*</td>
<td>3.13</td>
</tr>
</tbody>
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*significant correlation; RR, relative risk; OR, odds ratio

**DISCUSSION**

This study showed that among hypertensive boys age group 15-18 years 31% were obese, and among normotensive boys 3.44% were obese. Among hypertensive girls 13.7% were obese, and among normotensive girls 8.21%. Almost identical recent prevalence results of obesity (2), hypertension (3) and the correlation between obesity and hypertension have been found by Indian and German authors (2.3), Canadian researchers (4), Chinese (5) and other authors. According to the research by French and US authors, the prevalence of isolated systolic hypertension was 6.9% in young men and 2.3% in young women (6,12).

Examining the association of hypertension and obesity in Spain (Estepa), in the U.S. (Sorof) and Italy (Adam) it was concluded that the increase in the prevalence of essential hypertension was correlated with an increase in the degree of obesity (13-15). Croatian authors have found a significant correlation between hypertension, body weight and BMI in men aged 18 years (7). Carabajal et al. found a significant correlation between hypertension and obesity, and suggested measures for the control of body weight (16). Januš et. al. (17) have found that the prevalence of hypertension in obese children is significantly higher than in normal subjects. Systolic hypertension was found in 0.9 respondents and 11.1% in obese respondents (17).

Diastolic hypertension was found in 21.3% of obese children and 1.4% of normal weight children (17). Research by Canadian authors shows early effects of increased body weight, lack of physical activity, positive family history of hypertension and socio-economic instability on the systolic blood pressure (4). According to the findings of Chinese authors, the level of systolic and diastolic blood pressure had a positive correlation with BMI in boys and girls. The prevalence of relatively high blood pressure increased with the increase of BMI percentile, and the trend was especially pronounced in high BMI percentile (5). This study has found that obesity is a significant risk factor for the occurrence of essential hypertension in boys and girls of age groups from 15 to 18. There is a relative risk of a high rate of developing essential hypertension in obese subjects in this age group, particularly pronounced in male subjects. The results indicate a need for systematic monitoring of blood pressure in adolescents, particularly risk groups (obese youth), including undertaking of preventive public health measures in the prevention of obesity in adolescents.

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**TRANSPARENCY DECLARATION**

Competing interests: none to declare.

**REFERENCES**

Prevalencija arterijske hipertenzije kod gojazne srednjoškolske omladine u Zenici (Bosna i Hercegovina)

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SAŽETAK

Cilj Uvrstiti prisustvo gojaznosti kao faktora rizika, te njegovu povezanost s pojmovom arterijskih hipertenzija kod srednjoškolske omladine.

Metode Ispitivanje je vršeno tokom 2006/2007. školske godine, na uzorku od 1121 učenika (306 mladića i 815 djevojaka) tri srednje škole u Zenici (Opća gimnazija, Pedagoška gimnazija i Srednja medicinska škola), dobne skupine od 15 do 18 godina starosti. Epidemiološkim analitičkim metodama i statističkom obradom podataka (određivanje koeficijenta linearna korelacija (r), χ² test, te relativni rizik pojave), ispitan je relativni rizik obolijevanja s koeficijentom pouzdanosti povezanosti faktora rizika i obolijevanja od hipertenzije.

Rezultati Gojaznost za vrijednost BMI ≥ 95 utvrđena je kod 5% mladića i 7% djevojaka. Kod gojaznih mladića (RR=9,00) i djevojaka (RR=2,66) nađen je povećan relativni rizik obolijevanja od esencijalne arterijske hipertenzije s koeficijentom pouzdanosti koji ukazuje na značajnost povezanosti gojaznosti i obolijevanja od arterijske hipertenzije.

Zaključak Gojaznost je značajan faktor rizika za pojavu esencijalne arterijske hipertenzije kod mladića i djevojaka dobne skupine od 15 do 18 godina. Praćenje uhranjenosti omladine, redovni sistematski ljekarski pregledi s mjerenjem tenzije, te provođenje dijetetskih mjera regulacije uhranjenosti, jesu značajni preventivni javnozdravstveni zadaci.

Ključne riječi: hipertenzija, gojaznost, faktor rizika, korelacija