

**Obesity and its Concomitant Illnesses;
the Results of a Screening Programme in Adolescents
Doctoral Thesis**

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Introduction, Raising the Subject

Obesity is a problem that in recent decades has not only been threatening the adult population, but a health disorder that has also been affecting children more and more. As of 1998 WHO defines obesity as an illness. Obesity is the breeding ground or forerunner of cardiovascular diseases, carbohydrate metabolism disorders and also unfavourably influences blood lipid parameters. Childhood obesity shows a close correlation with adult obesity and the concomitant illnesses. In Hungary in addition to tumorous diseases leading causes of death include cardiovascular diseases. In recent decades a new type of human has been emerging the formation of which originates from changed lifestyle, eating habits and sedentary lifestyle. In the course of evolution the human genome could not prepare for such a fast and radical change. It is significant from the public health point of view to analyse the direction of the change and to reveal the underlying social factors.

According to estimated data –no standardized survey has been made for Europe – in 2006 22 million overweight and 5 million obese children lived in Europe and their number is continuously increasing amounting to about 20% in Hungary.

Family, professionals working in the area of paediatric childcare: family paediatricians, district nurses, district nurses for youth, teachers and professionals working in the area of nutrition science play a big role in the prevention of the development of obesity. Primary prevention first highlights the role of nutrition and regular exercise. Already the expectant mother's nutrition, her weight gain during pregnancy and her smoking habits can influence the eating habits of the child.

Childhood Consequences of Obesity

- 25-80% of obese children are also obese in their adulthood.
- Adolescent obesity - regardless of the weight at a later age - influences adult mortality and morbidity.
- The presence and accumulation of cardiovascular risk factors (hypertension, hyperinsulinaemia, reduced glucose tolerance, dyslipidaemia) can also be found in obese children.
- Certain consequences of obesity occur already in childhood.

The role of primary care professionals such as paediatricians, general practitioners and district nurses lies in the prevention of the development and early detection of obesity. In primary prevention the goal is to prevent the occurrence of new cases. In secondary prevention the main goal is the early detection and treatment, furthermore the reduction of the frequency and severity of obesity. In tertiary prevention our main goal is to mitigate the consequences of obesity. In addition to healthcare professionals, obviously nutrition science professionals, dieticians, the advertising industry, the media, the food industry, trade, teachers, parents and representatives of civil organisations will also be key players of prevention.

In view of international data it has emerged how typical obesity and the concomitant illnesses are among adolescents in Budapest nowadays.

Hypotheses

1. The ratio of the obesity among Budapest adolescents are in concordance with the national data.
2. Obesity occurs in higher numbers among boys from Budapest adolescents.
3. The body fat value of obese girls is higher than the body fat value of boys.
4. Primary hypertension is frequent among obese children in Budapest.
5. Cholesterol levels vary among genders and are higher for girls.

Introduction of the independent research conducted to verify the hypotheses

The research examinations were conducted in the Pál Heim Children's Hospital in Budapest; my work was guided by Professor Antal Czinner then by Dr. László Szabó professor. In the survey conducted from April 2010 until May 2011 15-18 years old students were involved from 19 high schools in Budapest. Altogether 2467 students, of which 1509 girls and 958 boys participated in the screenings.

In the survey it was my independent task to conduct cardiovascular screenings: measuring height and body weight, BMI calculation, determining body composition, recording data, processing data and assisting with implementation when needed. Decree no. 19/2009 (VI. 18.) of the Minister for Health prescribes the health status assessment of 16 years old children. The recording of the examination results into the Personal Child Health Record Booklet, which is the responsibility of doctors working at schools and district nurses. We started the organisation of the screening examination by joining into this work and in accordance with the same. During the screenings we tried to use the modern equipment of Pál Heim Children's Hospital.

The 'Clean Slate' screening programme was implemented with the tender support of the Metropolitan Municipality. The goal of the programme was to conduct a complex, health status assessment. A complex screening involving the adolescent children in such high numbers had never been conducted in Budapest. The screening was issued an institutional research permit.

The Screening

The schools for the screening were selected from the list of vocational training schools and vocational secondary schools received from the Municipality of Budapest. When selecting the schools we sought to involve out of the secondary school students (about 60 000 children) the 14-16 years old age groups, (about 30 000 children) into the programme with 3000 children. We contacted the school principals and then we also informed the contact person appointed by them and the school doctors about the goal of the programme. With the contribution of the schools we contacted the parents who gave their written consent to their children's examinations after the appropriate information. After making appointments we sent the schools the information materials of the programme and the poster in an electronic format and the parental consent declarations for the students.

The screening involved the following areas according to the previously specified professional medical protocol. Internal medical examination with special regard to the measuring the risk factors of adult cardiovascular diseases (height, body weight, BMI=Body Mass Index calculation, determining body composition, blood pressure, blood test for cholesterol and blood sugar levels). Sensory screening: otolaryngological, audiological and ophthalmological examination. Musculoskeletal examinations, dental screening, screening for celiac disease, mental status assessments.

The Number of Children Involved in the Screenings

In the screening programme the students of 19 schools (secondary grammar school, vocational secondary school, vocational training school) participated. 2878 students signed up for the screening in advance, but finally only 2467 people participated. Unfortunately, with the referrals received at the hospital only about 20% of the students visited the relevant specialist consultation later. The differences between the final figures derive from that fact that although their parents previously accepted and approved the examinations with their signatures, on the spot several students did not agree to the examinations.

Statistical Evaluation

The data were recorded in a Microsoft Office Excel table and using the IBM SPSS2000 statistical programme we calculated the average (\bar{x}), Standard Deviation (SD), Standard Error (SE), and a 95%-os confidence interval. The significance value was $p < 0.05$ volt, we applied the Two-sample T-test for hypothesis testing.

Testing Methods, Data Recording

1, Measuring Height

Heights were measured with a certified length measurement instrument in light clothing, without shoes. Heels had to be pushed against the wall, heads turned straight ahead. Height was recorded in centimetres. The average references and percentiles of the height (body length) from birth until the age of 18 based on the reference data of the Hungarian Longitudinal Child Growth Study.

2, Body Weight Measurement

The measurement was done in the morning hours after a normal, light breakfast, in light clothing and without shoes. We used a certified body weight measurement instrument and the value was provided in kilograms.

The reference averages and percentiles of body weight from birth until the age of 18 based on the reference data of the Hungarian Longitudinal Child Growth Study.

3, Body Mass Index – (BMI - **B**ody **M**ass **I**ndex)

Based on the measured body weight we calculated the value with the well-known formula (body weight, kg/ height, m²). The rating was done using the reference data of the National Centre of Health Statistics and of the Hungarian Longitudinal Child Growth Study.

4, Measuring Body Composition (BF – Body Fluid)

Body composition measurement was done with the InBody3.0 multi frequency segmental impedance measurement device. The device measures body fat, lean body mass, muscle mass, intra and extracellular water content. For the current study the body fat values were used. Body fat was regarded as pathological above 25% for boys and above 30% for girls.

5, Blood Pressure Measurement

We tried to ensure calm circumstances for the blood pressure measurement. The measurement was done at a measuring station set up in a classroom. The healthcare professional conducting the measurement was wearing casual clothes. We explained previously the essence of blood pressure measurement. The measurement was done after 5-10 minutes of rest, in a seated position. Feet positioned on the floor, their back leaning against the back of the chair, the left arm resting on the table, the upper arm at the height of the heart. No talking during the measurement. The cuff was placed on the left arm; its size depended on the length and diameter of the upper arm. For adolescents the 16 cm size was used. Adolescents were requested not to drink coffee and not to smoke 1 hour before the examination if possible.

The blood pressure was measured with a validated oscillometric OMRON M4 (OMRON Healthcare GmbH, Hamburg, Germany) automatic, digital blood pressure measuring device.

Systolic blood pressure value was determined at the first Korotkoff sound (appearance of the sound). Diastolic value was determined at the fifth Korotkoff sound (disappearance of the sound). Adolescents younger than 18 years were classified to have hypertension when their systolic or diastolic blood pressure values reached or exceeded the 95% value according to their gender, age and height.

Our Most Important Results

For the cardiovascular screening the values of 2202 people can be fully taken into consideration since not all adolescents participated in all examinations despite the previously provided consent declarations.

Results of the Body Height Measurement

The average height value for girls was 164.45 cm, and for boys it was 178.77 cm. The highest measured value for girls was 186 cm, the lowest was 147 cm. The highest value for boys was 197 cm and the lowest was 154 cm. When comparing the measured values with the Hungarian standards, the girls involved in the study were 2 cm higher. The average height for boys was 4 cm higher than the average value in the Hungarian standard.

Results of the Body Weight Measurement

The average value for the body weight of girls was 58.33 kg; the average value for the body weight of boys was 69.37 kg. The highest body weight value for girls was 115 kg; the lowest value was 39 kg. The highest body weight value for boys was 160 kg; the lowest value was 32 kg. In each age group boys had significantly higher body weight.

BMI Value Results

The body mass index was pathologically high for 382 people (17.34%) in total, of which 239 were girls (18%) and 143 (16.32%) were boys. The distribution of BMI values according to thresholds below 85% and above 95%, and case numbers, age and gender are shown in Table I. For girls 20% of the 14-year-old, 13.95% of the 15-year-old, 19.42% of the 16-year-old 19.4% of the 17-year-old and 22.2% of the 18-year-old age group were overweight and obese. For boys 17.1% of the 14-year-old, 20.2% of the 15-year-old, 15.6% of the 16-year-old, 9.9% of the 17-year-old and 18.5% of the 18-year-old age group were overweight and obese.

Table I.

BMI percentile thresholds and case numbers according to age and gender

Age (years)	Gender	BMI 85%>	BMI 85% <	BMI 95%
	Cases (n)	Threshold		Threshold
14	Girls	23.2		27
	n 79	63	13	3
	Boys	22.8		26
	n 70	58	7	5
15	Girls	24		28
	n 387	333	42	12
	Boys	23.5		27
	n 287	229	44	14
16	Girls	24.6		29
	n 520	419	79	22
	Boys	24.1		27.5
	n 371	315	44	12
17	Girls	25.2		29.7
	n 268	216	36	16
	Boys	25		28
	n 121	109	10	2
18	Girls	25.8		30.2
	n 72	56	11	5
	Boys	25.2		29
	n 27	22	3	2
Total	Girls			
	n 1326	1087	181	58
	Boys			
	n 876	733	108	35

The BMI averages grouped according to normal body weight, overweight and obese categories are shown by gender on Figure 1.

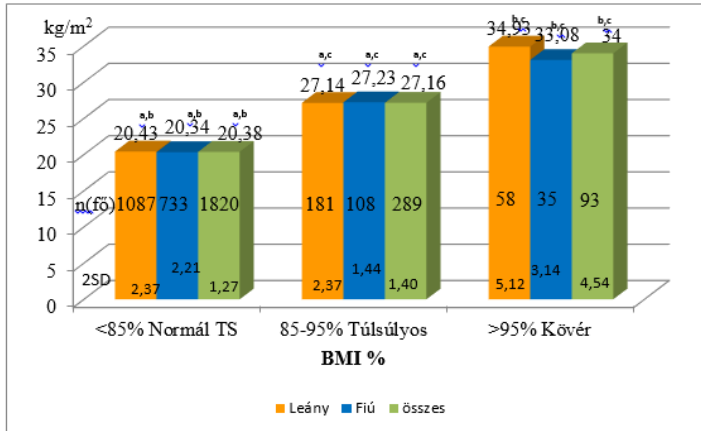


Figure 1. BMI averages (2SD), case numbers for the normal body weight, overweight and obese groups according to gender,

$p < 0.001$ Two-Sample T-Test

^a – Normál TS (Normal Body Weight)/Túlsúly (Overweight), ^b – Normál TS (Normal Body Weight)/Elhízott (Obese), ^c – Túlsúly (Overweight)/Elhízott (Obese)

Results of Determining the Body Composition

In the cardiovascular screening out of 2467 people, for 231 people (9.3%) high body fat values were found. For girls out of the 1509 people in 177 cases (7.12%) the body fat values were found to be higher than 30%, for boys out of 958 people in 54 cases (2.17%) the body fat values were found to be higher than 25%. The average BF and SD values by gender and BMI are shown in Figure 2. The body fat values both for girls and boys were significantly higher for the overweight and obese group and than of those with normal body weight and the same is true for the comparison of the overweight and the obese group.

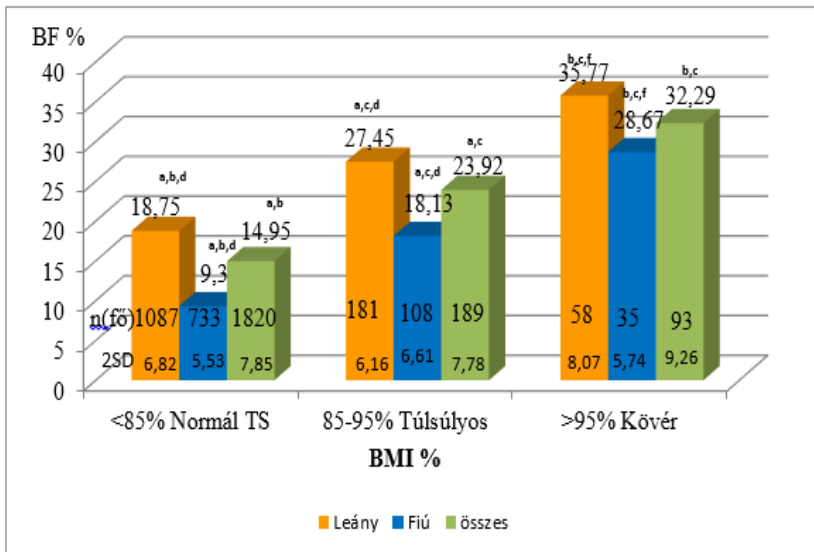


Figure 2. Body composition averages (BF) by BMI and gender and 2SD values $p < 0.001$, ^a – Normál TS (normal body weight)/Túlsúly (Overweight), ^b – Normál TS (normal body weight)/Elhízott (Obese), ^c – Túlsúly (Overweight)/Elhízott (obese) ^d – Girl/Boy, ^f – $p < 0.026$ Obese girls/Obese boy

Results of the Blood Pressure Measurement

For the blood pressure measurement the data of 1326 girls and 876 boys were evaluable out of the 2226 screened adolescents. In 671 cases (27.2%) the measured value was above 130/85 Hgmm for 234 girls and 437 boys. The averages of systolic and diastolic blood pressure classified by BMI and gender are shown in Figure 3.

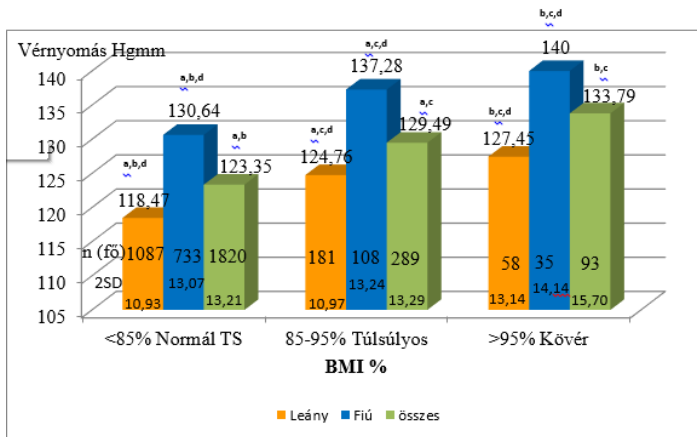


Figure 3. Systolic blood pressure (SBP) averages by BMI and gender and 2SD values. $p < 0.001$, ^a – Normal weight/Overweight, ^b – Normal weight/obese, ^c – Overweight/Obese, ^d – Boy/Girl

For girls we measured systolic blood pressure over 95% for 18.82% of the normal weight group, 39.88% for the overweight group and 49.38% for the obese group. The same ratio for boys was 40.97%, 62.76% and 72.28%. For girls we measured systolic blood pressure over 95% for 18.85% of the girls with body fat lower than 30% and for 35.03% of girls with body fat higher than 30% and for boys 35.96% where body fat was lower than 25% and 76.59% where body fat was above 25%.

Cholesterol level trends

Trends of serum cholesterol levels: in 264 cases (10.7%), for girls in 166 cases, for boys 98 in cases the value was higher than 5.22 mmol/l. The averages of the values for girls/boys, for normal body weight were 3.69/3.67

for the overweight it was 4.09/3.99, for the obese it was 4.29/3.79 mmol/l. Elevated cholesterol levels together with higher body fat values were found for 6 boys and 27 girls.

Discussion and Evaluation of Hypotheses

We used the Two-Sample T-test for the examination of the hypotheses.

1, The ratio of obesity among adolescents in Budapest is on concordance with the national data.

In our study 13% of the participants were overweight and 4% were obese children. These values correspond to the national values, our hypothesis is proven based on the two-sample T-test of the BMI and BF values.

2, Obesity among adolescents in Budapest occurs in higher numbers for boys.

Form the evaluation of the results, following the application of the two-sample T-test it turned out that BMI values exceeding 85% occurred for 18.02% of girls and 16.32% for boys so our hypothesis was not proven.

3, The body fat value of obese girls is higher than the body fat value of obese boys.

The average BF (body fat) based on the two-sample T-test was significantly higher for girls in case of the normal body weight group (<85%), the overweight group (85-95%) and the obese group (>95%), too. However, the average BF was in the pathologically high range only in the obese group both for boys and girls. For girls it was 66%, for boys it was 81. Our hypothesis was proven.

4, Primary hypertension is more frequent among obese children in Budapest.

We showed that both the systolic and the diastolic blood pressure increase was significantly more frequent in the groups with higher BMI values. We measured systolic blood pressure over 95% for girls in case of normal body weight in 18.82%, in case of overweight girls in 39.88% and in case of obese girls in 49.38%. The same ratio for boys was 40.97%, 62.76% and 72.28 %. We measured systolic blood pressure over 95% for girls with body fat lower/higher than 30% in 18.85% and 35.03% accordingly and for boys with body fat lower/higher than 25% in 35.96% and 76.59% accordingly. Our examinations have also proven the close correlation between Excess weight and the occurrence of primary hypertension. We have shown that there were significantly more children with hypertension among obese children than among children with normal body weight based on the first measurement. Further examinations for adolescents screened positive for hypertension was done in the Pál Heim Children's Hospital, where $\frac{1}{4}$ of them was proven to have hypertension. Therefore, the actual prevalence was 8.06%. For girls it was lower: 5.79% and for boys it was 11.5%, which correspond to international data.

5, Cholesterol levels vary by gender and it is higher for girls.

Serum cholesterol level trend: in 264 cases (10.7%), for girls in 166 cases, for boys 98 in cases the value was higher than 5.22 mmol/l. The averages of the values for girls/boys, for normal body weight were 3.69/3.67 for the overweight it was 4.09/3.99, for the obese it was 4.29/3.79 mmol/l. Elevated cholesterol levels together with higher body fat values were found for 6 boys and 27 girls.

In our study the elevated cholesterol level for girls in more cases was accompanied by pathological body fat values. Furthermore, in our study the high blood pressure values for 7 boys and 23 girls were accompanied by higher cholesterol levels and in 84 cases (36 boys and 48 girls) with high body fat values. Our hypothesis was proven.

The Most Important Conclusions

For the students participating in the research Excess weight and obesity was found in a rate similar to the national data. For them it would be important to set up a special, personalized diet and exercise and psychological support. Seeking and continuing best practices such as e.g. Siker Klub (Success Club) in the Pál Heim Hospital where lifestyle knowledge is also transferred. It is obvious that it would be important to involve in the programmes not only the screened child, but also the parents. The family background adds a lot to achieving successes also for weight loss.

For the accurate assessment of obesity the best method is body composition analysis since it provides information on the ratio of fat tissue and the lean body mass as well. The hospital's InBody3 device is in a fixed position and connected to the computer, which allows for the quick and accurate recording and storage of results. Furthermore, it is of course important that primary care professionals should have access to devices determining body composition in a portable form, too. This is already available to a lot of district and school nurses. In the future the use of the device can be an important part of the measurements.

In the tested population and especially in case of the screened overweight and obese children we found a significant correlation between obesity and the elevated blood pressure values. In many cases the normalization of body weight already influences blood pressure values in a favourable direction. It

is important that in the diet the salt intake should also be restricted for these children. Since hypertension is in a leading place among adult cardiovascular problems if children learn that they need to pay attention to their blood pressure and regularly check it or have it checked, maybe as adults they will pay more attention to that, too. It is extremely important for them to learn and keep the rules of measurement and the self-testing should be done according to the recommendations of the Hungarian Society of Hypertension (MHT). The education of children can be started in at a very early age e.g. with the help of short films made by the Society.

In the course of our study we also found a correlation between blood lipid values and obesity, for this reason it is especially important to pay attention in the diet to the consumption of lean meat and meals and to avoid food with hidden fats. Not only the public catering, but the home diet also needs to be shaped according to the nutritional recommendations. During the kitchen technological processes frying in a lot of oil and fat must be avoided and simmering, using baking bags and grilling should be placed in the forefront.

In view of the results it would be recommended to continue the study and to organize the follow-up with the participants of the study.

Summary

Obesity and the concomitant symptoms and diseases such as high blood pressure, elevated blood lipid values are more and more significant all over the world. Obesity and childhood obesity has become one of the most significant public health problems especially in developed countries. Several health problems can stem from the ground of obesity and childhood obesity also affects adult cardiovascular conditions and mortality rates.

The path leading to the development of chronic illnesses can be avoided if firstly, the illness is prevented and the detected problems are treated as soon

as possible. However, preventing obesity, achieving or restoring the normal body weight is not an easy task. It is practical already during health promotion to set the goal to prevent the development of obesity. In our study conducted in the Pál Heim Children's Hospital in Budapest, in which we involved more than 2000 adolescents in one year, we wanted to measure the prevalence of childhood obesity and the related health problems. Another objective we had was to try the body composition test on a bigger sample.

In our study 13% of participants were overweight and 4% were obese children. We showed that both systolic and diastolic blood pressure increase was significantly higher on groups with high BMI values. For girls we measured systolic blood pressure over 95% for 18.82% of the normal weight group, 39.88% for the overweight group and 49.38% for the obese group. The same ratio for boys was 40.97%, 62.76% and 72.28%. For girls we measured systolic blood pressure over 95% for 18.85% of the girls with body fat lower than 30% and for 35.03% of girls with body fat higher than 30% and for boys 35.96% where body fat was lower than 25% and 76.59% where body fat was above 25%.

The close link between Excess weight and the prevalence of hypertension was also proven by our tests. We showed that there were significantly more hypertensive children among overweight and obese children than among those with a normal body weight based on the measurement. Further testing of children screened positive for hypertension was conducted in Pál Heim Children's Hospital, where $\frac{1}{4}$ of them was found to have hypertension. Therefore, the actual prevalence was 8.06%. For girls it was lower at 5.79% and for boys it was 11.5%, which corresponds to international data.

Our results call attention to the fact that the role of primary prevention is essential, where the key role is played by primary health care professionals.

Our New Results:

1. Cardiovascular screening for adolescents in Budapest with a high number of participants.
2. It was the first time that 19 secondary schools in Budapest were involved in the screening for prevention.
3. Collection, analysis and evaluation of a large amount of data on a large sample with the InBody3 device in a hospital setting.

Original publications on the topic of the dissertation:

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