

ROLE OF LIFESTYLE IN OBESITY PREVENTION

- A CROSS-SECTIONAL STUDY IN METROPOLITAN
SCHOOLS -

Abstract of PhD thesis

by

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INTRODUCTION

Obesity can be defined as the pathological accumulation of excess body fat in relation to lean body mass. The prevalence of overweight and obesity is commonly assessed by using body mass index, defined as the weight in kilograms divided by the square of the height in metres (kg/m^2). Although it is widely used, its value is limited, due to the inability to distinguish between fat mass and non-fat mass. Moreover, it gives no indication with regard to fat disturbances, although the amount of excessive body fat, especially visceral, is known to be associated with several pathological conditions.

Obesity is a complex disease, with serious social and psychological dimensions, affecting virtually all ages and socioeconomic groups, including children and adolescents. Obesity has reached epidemic proportions all over the world, and is a major contributor to the global burden of chronic disease and disability. Research suggest that there are at least three major factors affecting the storage of fat in obesity: These are caloric intake, physical activity and genetic predisposition. In addition, social, cultural, familiar, psychological factors are often critical in understanding the complex problem of childhood/adolescence obesity.

According to previous studies, childhood/adolescence obesity is related to changes in lifestyle. A sedentary lifestyle and the reduction of physical activity of children/adolescents is a crucial cause for the obesity epidemic in the developed countries. Several epidemiological studies established that a high percentage of school children living in urban areas have a sedentary life, are inactive and overweight or obese. It is also known that primary coronary heart disease risk factors are mainly associated with physical activity levels and nutritional habits. Lifestyle during

childhood/adolescence is therefore important as it is a significant determinant of high risk behavioural habits. Overweight and obesity in childhood, adolescence and adulthood are of public health concern because of their deleterious effects on risk factors for chronic diseases, morbidity from chronic conditions, reproductive outcomes, and mortality.

According to epidemiological investigations, association between birth weight and overweight/obesity in childhood/adolescence is ambiguous. Some studies indicate that birth weight is associated with later lean body mass instead of overweight/obesity. In compliance with it, due to the high lean body mass, the childhood/adult body mass and BMI of persons with high birth weight will be high as well. At the same time other authors regard high birth weight as a risk factor of childhood/adult obesity.

THE AIM OF THE STUDY

The need for effective primary prevention of both overweight and obesity is generally considered to be urgent. The prevention cannot be effective without knowledge of prevalence of overweight, obesity and thinness, and youth's lifestyle, respectively. For this purpose, a complex representative lifestyle and nutritional hygiene survey was performed among 7-14 year-old elementary school children and 15-19 year-old secondary school students from Budapest in the academic year 2005/2006. The specific scientific questions of the study were the followings:

- What kind of characteristics has the physical activity of the investigated population (leisure activities, sport activity)?
- What is the body image and self-estimation of the investigated age-group like?

- What are the nutritional habits of the youngsters like and how much do they know about healthy nutrition?
- What kind of smoking habits adolescents have?
- What is the prevalence of thinness, overweight and obesity in the investigated population by body mass index, body fat percent and waist circumference?
- On population level, is it satisfactory to establish the body mass index for the assessment of overweight/obesity, or even the epidemiological investigations need the modern technics?
- Concerning the investigated group, is the following hypothesis true or false: Body weight is determined by birth weight already in school-age?

METHODS

School children attending elementary schools were investigated in 2005 and students attending secondary schools in 2006, respectively. The sampling sites were randomly assigned by an expert from Hungarian Central Statistical Office (Budapest), using a 3-stage cluster-stratified system: Primary units were the districts, secondary units were the schools and the final sample-collecting sites were the classes. The sampling was representative to the capital city.

School children and students were asked to answer questions about their favourite leisure activities, daily length of time spent outdoors, physical training and fitness. We were also interested to know whether the school children and students were satisfied with their own body weight and if they had ever been on a slimming diet. To test the school children's and

students' knowledge, we also included general questions about right eating habits, healthy nutrition and lifestyle and nutrition hygiene. The questionnaires contained inquiries on use of vitamin and mineral supplements, eating frequency and smoking habits. The following anthropometric parameters were measured: body height and waist circumference, carried out according to the World Health Organization (WHO) recommendation. Body mass and body composition were measured by 8-electrode bioimpedance analyser (InBody3.0) following the instructions given in the manufacturer's manual. Body mass index (BMI) and body fat percentage (%BF) were calculated by the equipment. Gender and age specific diagnostic criteria were used to establish thinness, overweight and obesity on the basis of BMI. Children and adolescents have to be considered as obese, if %BF \geq 25 (boys), or \geq 30 (girls), %BF of thin boys \leq 5, %BF of thin girls \leq 15. Visceral obesity of secondary school students was established on the strength of waist circumference, adopting as limit values waist circumferences at 90th percentile from our former national representative survey (\geq 86.5 cm for boys and \geq 78.5 cm for girls). In case of thinness, limit values were determined at 5th percentile (\leq 64.5 cm for boys and \leq 59.3 cm for girls). Birth weights of the participants were demanded from the Hungarian Central Statistical Office.

RESULTS

The data for a total of 1 930 **school children** (7-14 years, 1 003 boys and 927 girls) were evaluated from 17 districts, 18 schools and 119 classes. Independent of age, boys spent more time using the computer or watching

television than girls ($p < 0.001$), while girls' *favourite leisure activities* were listening to music and reading. The former hobby is more popular among girls in upper than in lower classes ($p < 0.001$). There was no significant difference between gender in time spent walking, but older girls devoted less time to sport than younger girls ($p < 0.01$). School children passed 1-2 hours or more per day *in the open air*, but 6.1-9.9% were outdoors only on their way to school. Daily *physical exercise* was typical of just above half of school children. Less than half of pupils participated in competitive sports and the enthusiasm of school children in upper classes decreased in both gender. In the upper classes fewer adolescents reported a positive feeling of wellbeing after physical education than in the lower classes (boys: $p < 0.001$, girls: $p < 0.01$) and in this case there was no gender difference. Among 11-14 year-old school children, 61.3% of the boys and 51.2% of the girls considered their physical condition and efficiency as good. About 43.5% of the 7-14 year-old boys and more than the half (51.5%) of girls were dissatisfied with their body weight. Independent of age, 29.5% of the boys and 42.5% of the girls would like to be thinner and therefore one in five boys (21.0%) and one in three girls (29.0%) had been on a *slimming diet* at least once between the age of 7 and 14 years. According to the evaluation of school children's *dietary and hygiene knowledge*, 7-10 year-old pupils practically did know how often they should clean their teeth (98.1%), when they should wash their hands (99.0%) and why is it important to drink milk (96.9%). Just over half of them (56.8%) knew how much fruit should be eaten daily and only 30.9% knew the recommended daily meal frequency. Only 47.7%, 58.9% and 63.8% of the 11-14 year-old school children knew how much fat-, protein- and energy different foodstuffs contain. There were more correct answers (87.0%) regarding the main roles of vitamins and mineral substances in the

human body and nearly everybody (90.3%) knew how much time they should spend on physical exercise a day. Almost two-thirds of the adolescents aged 11-14 years consumed *vitamin and/or mineral supplements*. The *daily eating rhythm* of school children in the upper classes was irregular; 71.1% of them had breakfast, 90.5% had lunch and 84.5% had dinner. About 11.5% of the 11 year-old youngsters made at least one attempt to *smoke* and this rate was 50.1% for 14 year-old students. Among school children, 5.4% of the boys and 10.1% of the girls smoked regularly.

The data for a total of 1 273 secondary school students (15-19 years, 670 boys and 603 girls) were evaluated from 11 districts, 17 schools and 98 classes. The most popular hobbies among boys were using the computer and watching television, while girls' *favourite leisure-time activities* were listening to music and reading. About 7.0% of boys and 15.7% of girls indicated walking as favourite leisure-time activity; these rates concerning sports were 29.4% for boys and 16.4% for girls, respectively. Secondary school students usually spent 1-2 hours per day *in the open air*, but about 13.6-19.3% were outdoors only on their way to school. Among 15-19 year-old secondary school students, daily *physical exercise* was typical only of 24.2% of boys and 13.5% of girls. Slightly more than the half of the students reported wellbeing after general training. About 63.0% of the boys and 45.6% of the girls considered their physical condition as good. The rate of those boys and girls who never or rarely did physical training was 21.0% and 23.0%, respectively. Nearly half (49.2%) the boys and more than half (58.9%) the girls were dissatisfied with their body weight. About 44.1% of the boys and 91.0% of the girls would like to be thinner, and therefore 13.0% of the boys and 41.1% of the girls had been on a *slimming diet* at least once between the age of 15 and 19 years.

According to the evaluation of secondary school students' *dietary knowledge*, more than half of 15-19 year-old adolescents did know how often they should eat during a day, nearly 50% (49.8%) have not heard about unsaturated fatty acids, nearly 30% (29.7%) about dietary fibre and more than 30% (30.4%) about the food pyramid. Independent of gender, nearly half of the students consumed *vitamin or combined (vitamin + mineral) supplements*. Consumption of mineral supplements alone was negligible. Secondary school students did not have a regular *daily eating rhythm*: 74.8% of the students had breakfast, 92.5% had lunch and 90.5% had dinner. About 40.6% of the 15 year-old students made at least one attempt to *smoke* and this rate was 73.4% for 19 year-old youngsters. Among 17 year-old students, about 47.1% of the boys and 38.0% of the girls smoked regularly (daily or weekly); these rates among 19 year-old school-leavers were 59.1% for boys and 39.8% for girls, respectively.

Among school children, boys' body height, weight and waist circumference was higher among older children and adolescents, while in case of *BMI* this tendency stopped at the age of 13 years. Up to the age of 12 years *%BF* was more and more higher but thereafter it was more and more lower. On the other hand, in older girls, all parameters were higher but *%BF* was slightly lower at ages 11 and 12. Girls from the age of 11 had significantly smaller waist circumference than boys, and with the exception of ages 10 and 12, *%BF* was significantly higher than in boys. Students were classified as thin when the age and gender specific BMI was below the 5th percentile, using WHO reference data, with the exception of cut offs regarding ages 7 and 8, which were own extrapolations. The International Obesity TaskForce (IOTF) proposed BMI cut offs to identify age and gender specific values of overweight and obesity. According to these criteria, the percent distribution of *thin*, *overweight* and *obese* boys was 5.1,

18.1 and 7.4%, in girls it was 6.8, 19.6 and 6.3%, these data for the total were 5.9%, 18.8% and 6.9%, respectively. Lean body mass was significantly higher in normal than in thin school children, and lower than in overweight or obese students in both sexes. *On the basis of %BF*, the prevalence of obesity was 17.9% among boys and 12.7% among girls, as obesity was accepted when %BF ≥ 25 for boys and ≥ 30 for girls. These values are more than double the values based on BMI. About 49.1% of overweight boys and 28.0% of girls were obese in overweight groups according to %BF as reference basis. In overweight boys and girls classified by BMI, *waist circumferences* were 13.4 cm and 11.6 cm higher than in respective normal groups, meanwhile these differences were 11.3 and 8.9 between overweight and obese boys and girls, moreover these data were 24.7 and 20.5 cm between normal and obese boys and girls, respectively. The differences were statistically significant in all instances. The average %BF was 13.6 for non-obese boys and 31.4 for obese boys; 17.4% and 34.4% for non-obese and obese girls, respectively. The waist circumference was 17.6 cm higher in obese boys and 18.1 cm higher in obese girls compared to their non-obese counterparts, the differences were statistically significant in all cases.

Concerning secondary school students, the period of rapid growth terminates by 15 years in both gender, since the mean growth of the next four age-groups was only 6.8 cm in boys, while the girls practically did not grow any more. The difference between *BMI*-means in 15-19 year-old boys was 1.5 kg/m², in girls it did not change practically (0.32 kg/m²). The mean waist circumference was 4.7 cm higher among 19 year-old boys in comparison with their 15 year-old counterparts; in case of girls it showed physiological inconsiderable fluctuation. %*BF* was in the optimal range in both genders. Relying upon these findings, 15.9% of boys, 7.9% of girls

was *overweight* and 4.1% and 1.9% was *obese*, respectively. It is noteworthy that 6.7% of boys and 7.2% of girls was *thin*. **On the basis of %BF**, 5.1% of boys, 16.2% of girls can be considered as obese, 1.5% and 3.1% as thin, respectively. On the basis of **waist circumference**, android-type obesity was revealed in 10.5% of boys and 7.9% of girls; 2.8% of boys and 2.6% of girls was thin. There is no internationally accepted limit value for overweight by %BF- and waist circumference-categorization. In the categories classified by BMI, %BF varied from 9.1% to 28.3% in case of boys and from 18.6% to 37.1% in case of girls from thin to obese groups. The mean waist circumference of obese boys and overweight and obese girls exceeded the limit value. On the basis of BMI the prevalence of obesity by %BF-classification was 65.4% and 64.0% among obese, and 10.5% and 77.0% among overweight boys and girls. In the optimal category 6.7% of girls can be considered as obese. Visceral obesity was demonstrable in 96.3% of boys and 100% of girls considered obese by BMI. Deserves attention that 38.0% of overweight boys and 55.0% of girls can be regarded as obese on the basis of waist circumference. Boys considered obese by %BF had about 19 cm higher waist circumference in comparison with the non-obese group. Among girls this value was 11 cm. Visceral obesity was established in 76.5% of boys and 40.0% of girls considered obese by %BF.

The Hungarian Central Statistical Office provided **birth weight** data of 1 334, 7-19 year-old school children and students (725 boys, 609 girls) investigated by us in the survey. On the basis of BMI, in the investigated sample 19.63% of the persons was overweight/obese. The rate of obesity was 15.59% by %BF and 4.64% by BMI, respectively. From the investigated school children and students 1 145 were born with normal (2 500-3 999 g) and 127 with high ($\geq 4\ 000$ g) weight. The rate of

overweight/obesity among persons born with normal weight was 18.96%. This rate was 25.98% among persons born with high weight. The prevalence of obesity on the basis of %BF was 12.66% and 18.11% in the groups with normal- and high birth weight, respectively. The prevalence of overweight/obesity among elementary school children (7-14 y) and secondary school students (15-19 y) was also assessed. The highest rates can be found among school children born with high weight: 16.54% and 11.81%, classified by BMI and %BF, respectively.

CONCLUSIONS

According to our results, the following main conclusions can be drawn from this representative nutritional hygiene survey performed among metropolitan elementary school children and secondary school students, aged 7-19 years:

- Many youngsters lived a sedentary life, were physically inactive.
- A high percentage of the children and adolescents would like to be thinner, many of them have been on a slimming diet without any professional supervision.
- The eating rhythm of the youngsters was not appropriate and their knowledge on healthy nutrition was not satisfactory, either.
- The rate of regular smokers was high, especially among secondary school students.
- On the basis of BMI, the prevalence of overweight and obesity was
18.1%, 7.4% among elementary school boys,
19.6%, 6.3% among elementary school girls,
15.8%, 4.1% among boys from secondary schools
and

7.9%, 1.9% among girls from secondary schools, respectively.

- On the basis of %BF, the prevalence of obesity was
17.9% among elementary school boys,
12.7% among elementary school girls,
5.1% among boys from secondary schools and
16.2% among girls from secondary schools,
respectively.
- On the basis of %BF, the prevalence of obesity among overweight youngsters (classified by BMI) was
49.1% among elementary school boys,
28.0% among elementary school girls,
10.5% among boys from secondary schools and
77.0% among girls from secondary schools,
respectively.
- In epidemiological investigations, besides the establishment of BMI, it is necessary to measure the waist circumference as well. As far as possible, it is also expedient to analyze the body composition.
- The results of my investigations support the hypothesis, that the prevalence of later overweight/obesity is higher among persons born with high weight.

According to our study's results, lifestyle plays a crucial role in obesity prevention. The findings of this descriptive epidemiological investigation underline the importance of lifestyle factors in the complex approach of obesity development and prevention. A coordinated cooperation is necessary among stakeholders to support the aim of changing nutritional and exercise behaviour of Hungarian children and adolescents.

PUBLICATIONS OF THE AUTHOR

Publications related to the PhD thesis

- **Péter S**, Regöly-Mérei A, Biró L, Nagy K, Arató G, Szabó C, Martos É, Antal M: Lifestyle of school children. Representative survey in metropolitan elementary schools - part one., *Annals of Nutrition and Metabolism*, 2007; 51: 448-453.
- **Péter S**, Regöly-Mérei A, Biró L, Nagy K, Arató G, Szabó C, Vámos A, Martos É, Antal M: Lifestyle of Hungarian adolescents - observations among metropolitan secondary school students, *Annals of Nutrition and Metabolism*, 2008; 52: 105-109.
- **Péter S**, Biró L, Németh Á, Antal M: Association between birth weight and childhood obesity in a metropolitan survey (in Hungarian)., *Orvosi Hetilap*, 2008; 149: 407-410.
- Biró L, Regöly-Mérei A, Nagy K, **Péter S**, Arató G, Szabó C, Martos É, Antal M: Dietary habits of school children. Representative survey in metropolitan elementary schools - part two., *Annals of Nutrition and Metabolism*, 2007; 51: 454-460.
- Antal M, Biró L, Regöly-Mérei A, Nagy K, Arató G, Szabó C, Martos É, **Péter S**: Methods for the assessment of adolescent obesity in epidemiological studies (in Hungarian), *Orvosi Hetilap*, 2008; 149: 51-57.

Abstracts

- **Péter S**, Regöly-Mérei A, Biró L, Nagy K, Arató G, Szabó C, Vámos A, Martos É, Antal M: Role of lifestyle in obesity prevention – a representative survey in metropolitan elementary schools., *Obesity Reviews*, 2007, 8, Suppl. 3: S13
- **Péter S**, Regöly-Mérei A, Biró L, Nagy K, Arató G, Szabó C, Martos É, Antal M: Lifestyle of Hungarian school children – a representative survey in metropolitan elementary schools., *International Journal of Obesity*, 2007, 31, Suppl. 1: S197
- Biró L, Regöly-Mérei A, Nagy K, **Péter S**, Arató G, Szabó C, Martos É, Antal M: Dietary habits of Hungarian school children – a representative survey in metropolitan elementary schools., *International Journal of Obesity*, 2007, 31, Suppl. 1: S197
- Antal M, Regöly-Mérei A, Nagy K, **Péter S**, Biró L, Szabó C, Arató G, Martos É: Assessment of body composition in school aged children and adolescents, *International Journal of Obesity*, 2007, 31, Suppl. 1: S198
- **Péter S**, Regöly-Mérei A, Beretvás E, Arató G, Vámos A, Martos É, Antal M: Lifestyle of school-aged children – A representative survey in metropolitan elementary schools., *Hungarian Review of Sports Medicine*, 2006, 47 (1): 75

- Arató G, Beretvás E, Szabó C, Németh I, Kui Á, **Péter S**, Biró L, Regöly-Mérei A, Antal M: Általános iskolai tanulók táplálkozása – Reprezentatív felmérés a fővárosban (in Hungarian), *Metabolizmus*, 2006, 4 (4): 307
- Biró L, Arató G, Beretvás E, Németh I, Kui Á, Regöly-Mérei A, Nagy K, **Péter S**, Szabó C, Antal M: Középiskolás tanulók táplálkozása – Reprezentatív felmérés a fővárosban (in Hungarian), *Metabolizmus*, 2006, 4 (4): 308-309
- Szabó C, **Péter S**, Regöly-Mérei A, Beretvás E, Arató G, Vámos A, Martos É, Antal M: Budapesti általános iskolások életmódjának felmérése reprezentatív minta alapján (in Hungarian), *Metabolizmus*, 2006, 4 (4): 316

Other publications

- **Péter S**: “How to conserve good health?” (in Hungarian), *Bulletin of Medical Sciences*, 2005, 78 (2): 236-240

Abstracts

- Pavlovic M, Finglas P, Witthoft C, Pepping F, Holman P, Glibetic M, Demes M, Biro L, **Péter S**, Oshaug A, Nemeth K: A partnership between network for capacity development in nutrition (NCDN-CEE) in central and eastern Europe and European food information resource network (EuroFIR)., *Annals of Nutrition and Metabolism*, 2007, 51, Suppl. 1: 322

- Pavlovic M, Pepping F, Demes M, Biro L, **Péter S**, Dimitrovska Z, Duleva V, Parvan C, Oshaug A: Capacity development in public nutrition: A network in central and eastern Europe (NCDNCEE)., *Annals of Nutrition and Metabolism*, 2007, 51, Suppl. 1: 324