

## The problem of obesity in adolescent primary school students from rural and metropolitan areas

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Agnieszka Lintowska<sup>1</sup>, Agnieszka Filipczak<sup>2</sup>, Joanna Dadacz<sup>2</sup>, Felicja Lwow<sup>2</sup>

<sup>1</sup> Dept of Health Promotion, Faculty of Health Science, Wrocław Medical University

<sup>2</sup> Dept of Health Promotion, Faculty of Physiotherapy, University School of Physical Education, Wrocław

### Abstract

**Introduction:** Obesity and overweight are health problems that particularly increase the risk of metabolic diseases, being a disease entity itself. It is confirmed that nutritious mistakes and hypokinesia constitute the basic threats in alimentary obesity.

**The aim of the study:** An attempt was made to evaluate the frequency of prevalence of obesity due to consumption habits and motor preferences of children aged 12-13 residing in the Tarłów Commune representing a rural area and children from the Primary School in Wrocław representing a metropolitan area.

**Subjects and methods:** The scope of the study covered 148 children from both rural and metropolitan areas. The children were divided into 4 groups of 37 based on gender and place of living. BMI indicator and centile charts prepared in OLAF studies for the Polish population were used to evaluate the level of obesity. Custom surveys concerning consumption habits and children motor activity were used to evaluate lifestyle habits. The results of the study were subjected to statistical evaluation using Statistica v. 10 software.

**Results:** Within the studied group of children aged 12-13 obesity and overweight occurred among 30% of girls and 25% of boys, whereas a tendency for more frequent occurrences of overweight was observed within girls (26%) and obesity within boys (5%). Everyday diet among the studied group depends on their place of living. Girls from a metropolitan area more frequently ate high-fiber products, unsaturated fatty acids and vitamins relative to girls from the rural area. Differences in preferred forms of physical activity based on gender were shown.

**Conclusions:** There is an urgent need to implement education and preventive or health promotion programs in the field of obesity prevention in rural areas, with special attention to physical activity and modification of consumption habits.

**Key words:** obesity, lifestyle, rural area, metropolitan area, percentile

### Introduction

According to the World Health Organization since 1980 the number of overweight and obese people has doubled. Currently, it is estimated that 65% of global population is exposed to the risk of death due to obesity and its complications [1]. Relations between prevalence of obesity among adults and excessive weight in childhood were confirmed [2-4]. It was also indicated that obesity complications described for the population of adults (hypertension, disorders of carbohydrate metabolism and lipid metabolism, metabolic syndrome or emotional disorders) occur already in early childhood [5].

According to the Report by the International Obesity Task Force (IOTF) 20% children in Europe were obese in 2005. Poland was one of seven countries where obesity and overweight concerned 20% of the population of young people aged 13-17 [6]. While in the USA over the last 20 years a two-fold increase in the number of obese people aged 6-19 was observed. The prognosis for 2015 assumed that the number

of overweight people in the USA will increase to 75%, including 42% of obese people [7].

However, latest reports suggest certain positive changes in prevalence of obesity worldwide, although certain differences are observed. Estimated forecasts differ depending on ethnic group, economic status of a country or a region [7-9]. During the International HBSC Studies (*Health Behavior of School Children*) a plateau effect in prevalence of overweight and obesity in 25 European countries, in Canada and in the USA was observed [10]. However, other studies [11] also indicated a decrease of overweight in nine countries worldwide among children and youth aged 2-19. The tendencies were different depending on sociodemographic conditions. An increase in overweight and obesity was registered more frequently among youth from wealthy families of Western Europe as well as Central Europe. In the HBSC studies conducted in the countries of Central and Eastern Europe, including Poland, a constant growth of overweight and obesity among children and youth was observed regardless of

Table 1. Centile measures for assessment of obesity for boys and girls aged 12-13 based on the Polish OLAF assessments

Gender	Age	Underweight		Normal weight		Overweight		Obesity	
		Centile	BMI kg/m <sup>2</sup>	Centile	BMI kg/m <sup>2</sup>	Centile	BMI kg/m <sup>2</sup>	Centile	BMI kg/m <sup>2</sup>
Boys	12	< 5	< 14	6-84	14-21.9	85-95	22-25	> 95	> 25
	13	< 5	< 15	6-84	15-22.9	85-95	23-26	> 95	> 26
Girls	12	< 5	< 14	6-84	14-20.9	85-95	21-25	> 95	> 25
	13	< 5	< 15	6-84	15-21.9	85-95	22-26	> 95	> 26

the sociodemographic status. Recently in HBSC Report for Poland (2015) a certain reversal of the tendency is observed, as it was demonstrated that the number of overweight and obese children and youth is currently decreasing (in the group of boys by 1.6% vs. 3% in the group of girls) [10].

Excessive fat tissue is related to unhealthy behaviors considering diet and sedentary lifestyle [12]. Potential differences in prevalence of obesity depending on the continents and countries were indicated. Among children aged 5-17 in Greece, the USA and Italy one in three children had excessive weight (while in the OECD countries one in five). While in China, Korea, and Turkey overweight children constituted approximately 10% of the population. Boys had higher indices of overweight and obesity than girls in most countries, however, a reverse dependency was observed in Scandinavia (Sweden, Norway, Denmark), Great Britain, Holland and Australia. The growth of obesity was reduced initially in France, then in England, Korea and the USA [13, 14]. A different approach to obesity depending on the cultural context is indicated in papers [15]. The OECD Report (2015-2016) emphasizes more frequent prevalence of obesity among populations with a lower educational level, in particular referring to girls and women [16]. In Poland varied prevalence of obesity depending on the region was confirmed. [17].

Therefore, the objective of our paper was the assessment of potential differences in obesity among children during early adolescence depending on the place of residence in comparison to selected lifestyle elements.

## Materials and methods

### Research material

In the studies implemented from September to December 2015 148 children aged 12-13 participated; they attended 5th and 6th grade of primary schools from rural and metropolitan areas. Children from rural areas were represented by 37 boys and 37 girls attending the Secondary School Complex in Tarłów (pre-school, elementary and junior high school). Children from metropolitan areas (37 boys and 37 girls) attended the No. 34 Primary School which belongs to the No. 6 School and Pre-School Complex in Wrocław, ul. Gałczyńskiego 8. Legal guardians of the children and heads of the educational institutions gave permission to the participation of the children in the survey.

### Research methods

#### Anthropometric studies

In our paper assessment of prevalence of overweight and obesity among children aged 12-13 from two different areas was undertaken. Applying the anthropometric methods in the case of studies concerning children and youth, dynamics of changes of the studies parameters are taken into account based on centile charts which are created for particular developmental age populations [3, 18]. In the paper, the OLAF as-

sessments were implemented upon consent of the Commission of Bioethics at the Medical University of Białystok for a group of 17,573 children and youth from 416 primary and secondary schools from all over Poland. The authors of OLAF study created a set of centile charts for the Polish population aged 7-18, referring to the WHO recommendations for 2007 as well as the population of Warsaw and other studies from 1990-1999 [19, 20].

Measurements of height and weight were performed using a medical scale with the stadiometer (CE Class III). The obtained results were used to calculate BMI, and then they were applied to the centile charts developed during OLAF population assessments. The criteria to assess underweight, normal weight, overweight and obesity for boys and girls aged 12-13 were presented in Table 1. For each group, appropriate BMI values (kg/m<sup>2</sup>) corresponding to centile measures were provided.

### Surveys

Surveys were conducted applying the PAPI (*Paper and Pen Interview*) method using two original survey questionnaires to assess selected behaviors in the field of nutrition and physical activity. In our article, we answer the survey questions concerning nutritional habits, such as a quality structure of products eaten for breakfast, a frequency of consuming products containing protein, fruits, vegetables, fiber and products with a high content of saturated fatty acids and monosaccharides in diet were used. The physical activity questionnaire contained questions about frequency of undertaking physical activity, expectations of the form of a physical activity implemented within classes at school and motivation to undertake physical activity during free time as well as positive effects of physical activity in the children's self-assessment.

### Statistical calculations

For nominal variables, the percentage value and cardinality were provided. Normal distribution of the studied continuous variables was assessed using the Kolmogorov-Smirnov test. Differences in the frequency of selected lifestyle elements and overweight and obesity in the studied groups were assessed using the  $\chi^2$  test. The level of  $p < 0.05$  was assumed as statistically significant. In the paper, Statistica v. 10 was used.

### Results

In the studied population of children during early adolescence, an average value of BMI in the group of boys was  $19.619 \pm 3.25$  and in the group of girls –  $18.607 \pm 3.43$ .

Prevalence of overweight and obesity in the studied population taking gender into account was presented in Fig. 1.

Most studied boys (70%) and girls (64%) presented BMI appropriate to gender and age. Overweight was more frequent in the case of girls than boys (26% vs 20%). While obesity was more frequent in the case of boys than girls (6% vs 3%). Excessive weight, i.e. overweight and obesity, was the-

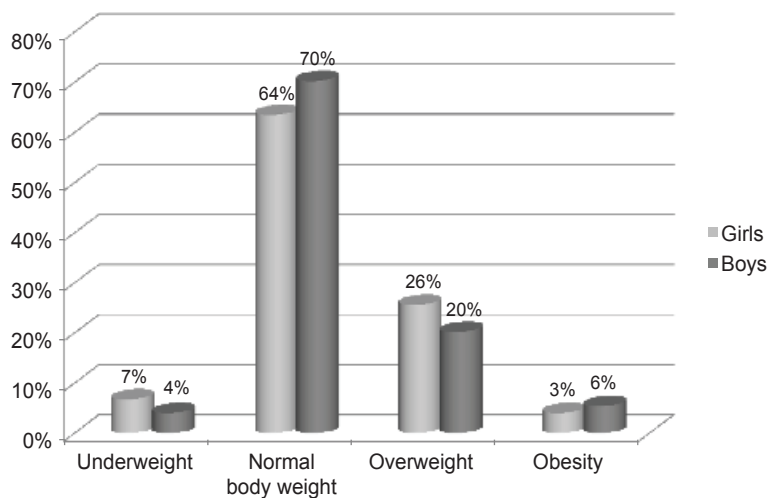


Figure 1. Prevalence of overweight and obesity in the studied population according to gender

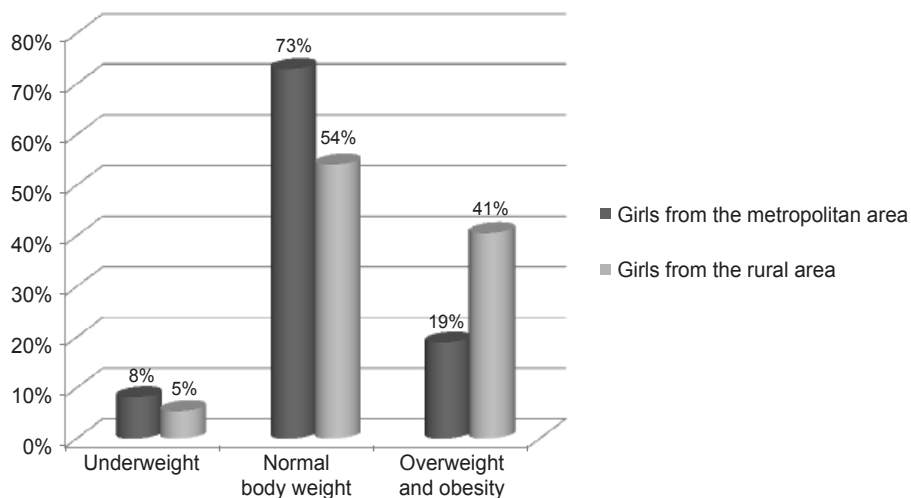


Figure 2. Prevalence of overweight and obesity in the studied group of girls depending on the place of residence

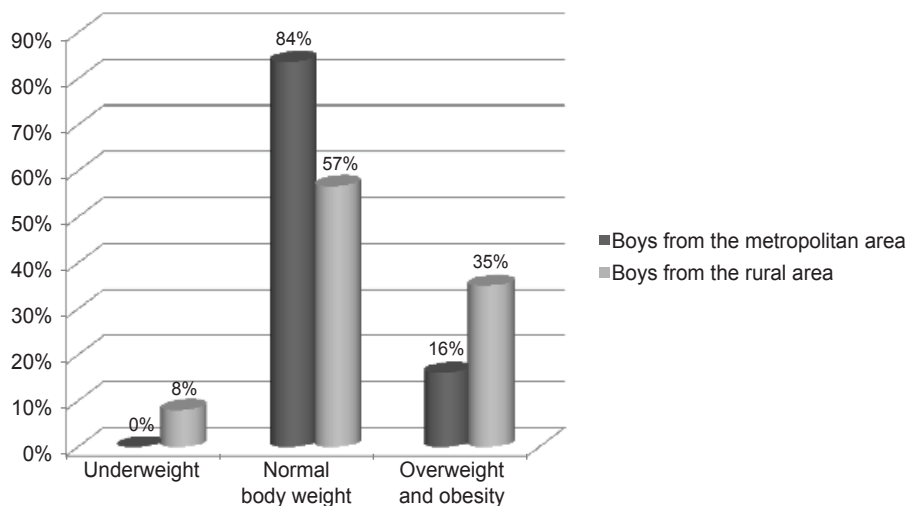


Figure 3. Prevalence of overweight and obesity in the studied group of boys depending on the place of residence

refore observed in 29% of girls and 26% of boys. Differences in the prevalence of overweight and obesity between genders were not statistically significant ( $\chi^2 = 3.131$ – $p = 0.372$ ).

Overweight and obesity were more (Fig. 2) frequent among girls from the rural area (41%) in comparison to girls from the metropolitan area (19%). The differences between groups received  $\chi^2=5.800$ ,  $p= 0.055$  but did not reach statistical significance. A similar analysis was performed in the case of boys (Fig. 3).

The differences between boys were respectively 35% vs 16% (boys from Tarłów vs boys from Wrocław) and were statistically significant ( $\chi^2 = 9.857$ ,  $p = 0.007$ ).

Alimentary obesity is related not only to the quantity structure, but also to diet quality. Children and youth should derive energy from food in 5 meals according to the hygiene recommendations. This recommendation was declared more frequently by children from Wrocław (49% of boys vs 41% of girls), while in the case of children from the school in Tarłów it was 28% of boys vs 19% of girls. Eating breakfast is one of the important health behaviors. This behavior was more frequently declared by children from Wrocław regardless of gender (68% of boys vs 71% of girls), while the frequency of eating breakfast by children from the rural area was respectively 51% of boys vs 56% of girls. Girls from the metropolitan area most frequently indicated products with a high content of monosaccharides (pastries), fruits and high-protein products (yogurts, eggs) as the basis of the first meal. While girls from the rural area also indicated high-protein products eaten for breakfast, however, the source of protein was different (milk, milk soup) and it was supplemented with bread with a low fiber content (wheat bread). While boys from the school in Wrocław preferred high-protein products for breakfast (hard cheese, eggs) and bread with a high fiber content (brown bread) and raw vegetables. Boys from the rural area preferred white bread, pastries and high-fat meat products (smoked meat).

The studied children also indicated food products consumed as part of their daily diet. In the assessment products with a confirmed positive impact on health were distinguished, i.e. milk and dairy products, vegetables, fruits, bread with a high fiber content and animal products with a low content of saturated fatty acids. The second group included products with a confirmed negative impact on health, i.e. sweets, products with a high content of saturated fatty acids and bread with a low fiber content as well as sweet drinks.

Milk and dairy products were most frequently consumed by boys from the rural area (46%) vs boys from the metropolitan area (32%). Also, girls from the rural area consumed milk and dairy products more frequently in comparison to girls from the metropolitan area (38% vs 32%). A characteristic feature was that both boys and girls from the metropolitan area equally often declared consumption of milk and dairy products. Vegetables and fruits were more frequently consumed by girls from the metropolitan area in comparison to girls from Tarłów (81% vs 54%). This dependency was similar in the group of boys (51% vs 19%). However, in the consumption structure, vegetables and fruits were more frequently present in the diet of girls than boys. Bread with a high fiber content was more frequently consumed by girls from Wrocław than boys (35% vs 27%), while the tendency was similar regarding gender, frequency of consumption of this kind of bread was lower among the rural population (16% of girls vs 2% of boys).

Consumption of sweets in daily diet was most frequently declared by girls from the rural area (97%), while girls from Wrocław similarly to boys from the rural area declared daily consumption of monosaccharides 57% of the time. It should be emphasized that the consumption level of sweets was

from 49% among boys from Wrocław to 97% among girls from the rural area. Animal products with a low content of saturated fatty acids were most frequently consumed by girls from the metropolitan area (27%) and boys from the rural area (10%). While animal products with a high content of saturated fatty acids were most frequently consumed by children from the rural area (43% of boys vs 35% of girls).

Girls and boys from the rural area preferred bread with a low fiber content (65% vs 58%). However, children diet concerned nearly half of the group of boys (49%) and 27% of girls. Daily consumption of highly sweetened drinks was more frequently declared by children from the Primary School in Tarłów (68% of girls vs 72% of boys). While, pupils from Wrocław declared consumption of these drinks less frequently (36% of girls vs 38% of boys), as they chose mineral water more often.

The subject of the research also involved the preferred way of spending free time according to the place of residence and gender. Comparison of these preferences in the group of girls indicates a low frequency of undertaking physical activity in free time. Only 17% of girls from Wrocław and 9% of girls from Tarłów prefer such an activity. In the group of boys physical activity as a form of spending free time was declared by 29% of boys from Wrocław and 17% of boys from Tarłów.

The authors analyzed causes of undertaking physical activity in free time. Girls from the metropolitan area most frequently indicated improvement of physical condition (54%), while girls from the rural area – reduction of body weight (51%). Furthermore, boys from the metropolitan area are motivated most frequently by improvement of physical condition (46%), and reduction of body weight (51%) than boys from the rural area.

About 42% of boys from Tarłów and 38% boys from Wrocław declared undertaking physical activity for 45 or more minutes daily. While among girls it was only 16% in Wrocław vs 23% in Tarłów.

What beneficial effects of undertaking physical activity are observed by students was also analyzed. Girls from the school in Tarłów most frequently indicated aesthetic effects regarding their body (28%), while girls from Wrocław believed that improvement of wellbeing is a beneficial effect (21%). Boys most frequently associated effects of undertaken physical activity with benefits in somatic health (26% of boys from Wrocław vs 23% of boys from the rural area).

In the reported studies we observed the diversity of expected forms of physical activities implemented within school classes. Girls from Wrocław the most commonly declared swimming (18%), while girls from Tarłów – dance classes (20%). Boys were mostly interested in team sports, especially football (26% of children from Wrocław vs 22% of children from Tarłów). It should be emphasized that boys from the rural area also indicate elements of strength sports (20%) and martial arts (17%). Boys from the metropolitan area were more interested in team sports in comparison to individual sports in the case of boys from Tarłów.

## Discussion

Overweight and obesity affects more than 33% of children [21]. Epidemiology of obesity is diverse depending on the country and area of residence. In countries with high prevalence of obesity among adults, obesity among children is also more frequently observed [8]. Relations between obesity and an increased risk of metabolic diseases were indicated [22]. Etiology of obesity is multifactorial; great significance of environmental factors is also indicated [15, 23]. Within the studies



conducted among children aged 12-13 residing in the rural area and metropolitan area at the same age it was indicated that overweight and obesity is more frequently observed in the group of girls (30%) than boys (25%). Similar studies were conducted between 1986 and 2006 among schoolchildren from the Podlasie Region. Overweight and obesity were presented more often in the boys group (15.8%) than the girls group (11.9%) [24].

Different prevalence of obesity in our study may be a result of another age of the group and earlier time of the research. In our studies, overweight and obesity were demonstrated more frequently in the rural area which was statistically significant. Other authors also indicated that more obese people live in rural than metropolitan areas regardless of age [25, 26]. We confirmed that obese girls and boys more frequently represented the rural area, 41% vs 35%, respectively. Another studies between children aged 13 in Wrocław in 2004 concluded that obesity was more frequent among girls (22,6%) than among boys (16,9%) [23], which confirms our results. Furthermore, 30 years of observation (1971-2000) among young people in Kraków showed an increase in obesity and overweight (7,5% boys vs 5,3% girls) [27].

Differences between voivodeships in Poland were observed earlier among adults and children [17]. These studies concerned many years of observations of adults and children from Lower Silesia, Lublin and Łódź areas. Our results are also confirmed by other authors [24], explaining the difference by promotion of healthy lifestyle in metropolitan areas.

In many papers, relations between obesity with the unhealthy nutrition model were indicated [5, 8, 12]. Moreover, unhealthy nutrition model was observed more frequent among children from the rural area. The quality analysis of food model showed that girls from the metropolitan area consumed products with a high fiber content, unsaturated fatty acids, and vitamins more frequently than girls from the rural area, but we didn't exhibit an association between the number of nutrition mistakes and BMI (results were not included). Similar conclusions were drawn by authors of another paper concerning teenagers aged 13-15 from Lubartów [28].

One of the important behaviors regarding diet is eating breakfast. In the studied group of children aged 12-13 eating breakfast is more often declared by children from Wrocław regardless of gender (68% of boys vs 71% of girls), while the frequency of eating breakfast by children from the rural area was 51% of boys vs 56% of girls respectively. While the studies on the risk factors concerning obesity and overweight conducted in 2003 by Veugelers and Fitzgerald involving 4,298 children and their families from New Scotland confirmed that children who do not eat first breakfast at home, purchase second breakfast at school instead of taking food from home, do not consume meals with their family members and consume meals in front of the TV or computer are more at risk of abnormal body weight [29].

Therefore, it confirms the fact of a more frequent prevalence of excessive body weight among the rural population, as these children eat breakfast less frequently. The structure of daily diet of pupils analyzed in this paper indicates that children from the Primary School in Tarłów consume products with a high fiber content and a high content of unsaturated fatty acids less frequently than children from the Primary School in Wrocław.

A high frequency of eating fruits and vegetables is typical for the group of girls from Wrocław. In studies conducted by

other authors, girls consumed whole wheat bread more frequently (80%) in comparison to boys (65%). In the case of consuming vegetables and fruits, authors highlighted a higher frequency of consuming these products by boys (88%) than girls (70%) [28]. In the current studies, the structure is different as approximately 65% of girls and 35% of boys consume fruits or vegetables every day.

Undertaking daily physical activity for at least 45 minutes a day was declared by 42% of children in Tarłów and 38% of children in Wrocław. However, in the case of girls, it was only 16% in Wrocław vs 23% in Tarłów. Other authors indicated that a higher BMI was observed in children whose physical activity was less frequent than twice a week, who traveled to school longer than 30 minutes and who did not have educational classes about healthy lifestyle at school [29]. The analyzed preferences in the selection of the forms of physical activity were also diverse depending on gender and place of residence. Girls from Wrocław most frequently indicated volleyball, cycling and horse riding, while girls from Tarłów – volleyball, cycling and swimming. In the group of boys from Wrocław the most frequently chosen forms of physical activity were football, cycling, and basketball, while boys from Tarłów preferred football, cycling, strength training and swimming. Results of this part of the studies can be considered to be an initial diagnosis of the local health promotion program.

The analysis of dependencies between obesity and mental wellbeing in Korean children indicated that obesity is related to low self-esteem, negative assessment of their own appearance and symptoms of depression [30, 31]. It is an important indicator for people implementing health promotion programs. Studies conducted on the German population from 1975-2001 showed that a higher economic status is a factor protecting children from excessive body weight [32]. It was also indicated that people with a low economic status less frequently prefer spending their free time actively [33]. Studies showed that the lower the economic status of citizens, the higher the risk of frequent prevalence of overweight and obesity [34].

An abnormal BMI in childhood increases the risk of overweight and obesity in adulthood [26, 35]. This statement can constitute the basis to undertake actions to prevent obesity and to promote health among young people considering preferred forms of physical activities.

## Conclusions

1. Prevalence of overweight and obesity was higher among children from the rural area regardless of gender.
2. Overweight was observed more often in the group of girls and obesity in the group of boys.
3. Children from the rural area consumed fewer meals a day than recommended in comparison to children from Wrocław regardless of gender. Also eating first breakfast was more frequently declared by children from Wrocław.
4. The structure of the daily diet in the studied groups depended on the place of residence. Girls from the metropolitan area consumed products with a high fiber content, unsaturated fatty acids, and vitamins more often than girls from rural areas. While children from the rural area more frequently preferred consumption of simple sugars regardless of gender.
5. The study concerning the preferred form of physical activity was diverse depending on gender and the place of residence of children.

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**Address for correspondence**

Joanna Dadacz  
Zakład Promocji Zdrowia, Wydział Fizjoterapii  
Akademia Wychowania Fizycznego  
al. Paderewskiego 35  
51-612 Wrocław  
e-mail: joanna.dadacz@awf.wroc.pl

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