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## THE PREVALENCE OF OVERWEIGHT AND OBESITY AMONG POLISH PRE-SCHOOL-AGED CHILDREN

### CZĘSTOŚĆ WYSTĘPOWANIA NADWAGI I OTYŁOŚCI WŚRÓD POLSKICH DZIECI W WIEKU PRZEDSZKOLNYM

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#### Abstract

**The aim** of this study is to estimate the prevalence of overweight and obesity in a current, nationally representative, random sample of pre-school-aged children in Poland and to compare their overweight and obesity rates with their peers from the US and Norway.

**Material and methods:** The height and weight were measured in a total of 5026 randomly sampled children aged 2-6 years and their Body Mass Index was calculated. The prevalence of overweight including obesity was determined using three definitions, i.e. those formulated by the International Obesity Task Force (IOTF), the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC).

**Results:** The overall prevalence of overweight including obesity in boys was 12.2%, 12.2%, 17.2% and in girls 15.0%, 10.0%, 19.1% according to the IOTF, WHO, CDC definition, respectively, and did not significantly differ in comparison with their US and Norwegian peers. The overall prevalence of obesity in boys was: 4.4%, 4.9%, 8.9% and in girls: 3.8%, 3.4%, 7.6%, according to the IOTF, WHO, CDC definition, respectively. Among Polish girls the obesity rate was higher compared to the female US peers. The obesity rate was higher in Polish boys compared to their Norwegian peers.

**Conclusion:** The estimates of the prevalence of overweight and obesity varied substantially by age group, gender and depending on the definition used. Obesity rates among Polish girls and boys were higher compared to their American and Norwegian peers. The influence of overweight definitions should be taken into account when studying childhood overweight and obesity. Overweight and obesity preventive programs should be implemented at preschool age.

**Key words:** childhood, overweight, obesity, prevalence

#### Streszczenie

**Celem pracy** jest oszacowanie występowania nadwagi i otyłości na podstawie aktualnej, reprezentatywnej, losowej próby dzieci polskich w wieku przedszkolnym oraz porównanie częstości występowania nadwagi i otyłości wśród rówieśników z USA i Norwegii.

**Materiał i metody:** Na podstawie pomiaru wysokości i masy ciała wykonanych u 5026 losowo dobranych dzieci w wieku 2-6 lat wyliczono wskaźnik masy ciała. Częstość występowania nadwagi i otyłości łącznie oraz otyłości wyznaczono posługując się trzema definicjami: International Obesity Task Force, Światowej Organizacji Zdrowia (ŚOZ) oraz Centers for Disease Control.

**Wyniki:** Wśród chłopców częstość występowania nadwagi i otyłości łącznie wynosiła: 12,2%, 12,2%, 17,2%, a wśród dziewcząt: 15,0%, 10,0%, 19,1%, odpowiednio dla definicji IOTF, WHO, CDC i nie różniła się istotnie w porównaniu do rówieśników w USA i Norwegii. Częstość występowania otyłości wśród chłopców wynosiła: 4,4%, 4,9%, 8,9%, a wśród dziewcząt: 3,8%, 3,4%, 7,6%, odpowiednio dla definicji IOTF, WHO, CDC. Częstość otyłości była wyższa wśród polskich w porównaniu do amerykańskich dziewcząt. Częstość otyłości wśród polskich chłopców była wyższa w porównaniu do norweskich rówieśników.

**Wnioski:** *Oszacowanie częstości występowania nadwagi i otyłości różniło się istotnie w zależności od grupy wieku, płci oraz zastosowanej definicji. Częstość otyłości była wyższa wśród polskich dziewcząt w porównaniu do dziewcząt amerykańskich i wśród polskich chłopców w porównaniu do chłopców norweskich. W badaniach nad nadwagą i otyłością dzieci należy wziąć pod uwagę wpływ definicji nadwagi i otyłości. Programy zapobiegania nadwadze i otyłości powinny być wdrażane od wieku przedszkolnego.*

**Słowa kluczowe:** *dzieci, nadwaga, otyłość, częstość*

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## INTRODUCTION

In Poland, similarly to other countries, childhood obesity is a major health problem [1]. By the year 2010, the prevalence of overweight and obesity had reached 21-22% in the nationally representative sample of Polish school-aged children [2], which is a high level compared to other European countries [3]. Data on the prevalence of overweight and obesity among pre-school-aged children in Poland are scarce and the sample sizes were small [4]. Early childhood excess weight is important, because of Body Mass Index (BMI) rebound at pre-school-age and the need for overweight tracking into adolescence and adulthood [5-7]. Different definitions of childhood overweight and obesity yield different estimates of prevalence, which may limit the possibility of comparisons [8].

## THE AIM OF THE STUDY

The aim of this study is to estimate overweight and obesity prevalence among Polish pre-school aged children with the use of international definitions and to compare rates with current estimates from the USA and chosen European country.

## MATERIAL AND METHODS

The analysis was carried out using the data from a recent, nationally representative health survey, the OLA study (N R13 0002 06), which is the largest available project of this kind in Poland providing height and weight measurements for pre-school aged children [9]. Field examinations of children were conducted between November 2010 and May 2012 in 81 randomized family outpatient clinics. The approval of the Children's Memorial Health Institute Ethics Committee to conduct the study was obtained before its commencement. Informed consent was obtained in written form from one of the parents of each participating child.

### Study population sampling

Study participants were randomly selected using two-stage sampling. The primary units, i.e. family medicine outpatient clinics were sampled from a register of family medicine outpatient clinics provided by the Regional Offices of the National Health Fund. Sampling was stratified

by province. In the second stage, all the children aged 2-6 years within the family medicine outpatient clinics included in the project comprised the sampling frame. All the children in Poland are covered by a national health insurance scheme and registered at family medicine clinics. The method described above ensured the national representativeness of the sample. A total of 7545 children were drawn and invited to take part in the study. Out of this number the parents of 5119 children consented to the study and consequently their kids were enrolled.

### Height and weight measurements

Height and weight were recorded in duplicate by trained staff according to the standardized protocol. Height was measured using a SECA 214 stadiometer (Seca GmbH & Co. KG, Hamburg, Germany). The subject was in the standing upright position (no shoes), with hips and shoulders perpendicular to the central axis, heels against the footboard, knees together, arms hanging loosely at the sides, and the head in the Frankfurt plane. Height was recorded to the nearest millimeter; if the difference between measurements exceeded 4 mm, a third measurement was performed. Body weight was recorded in light underwear to the nearest 0.05 kg, using a digital medical scale (Radwag WPT 100/200, Poland). In the case of a difference between measurements equal to or exceeding 0.3 kg, a third measurement was taken.

### Classification of overweight and obesity

BMI was calculated as the ratio of weight in kilograms and the square of height in meters. There were missing or invalid data on height or weight in the case of 93 subjects and data from those children were excluded from the analysis. Thus, the sample with valid BMI data comprised 2477 boys (49.3%) and 2549 girls. Age and sex specific point estimates of the prevalence of overweight (in this paper, the term overweight always includes obesity) and obesity were calculated with a 95% confidence interval (CI) of the estimates based on: 1) the IOTF cut-offs [10], 2) the Centres for Disease Control and Prevention (CDC) 85<sup>th</sup> and 95<sup>th</sup> BMI percentiles [11] with the use of SAS macro provided by the CDC (free download: <http://www.cdc.gov/nccdphp/dnpao/growthcharts/resources/sas.htm> accessed on 21<sup>st</sup> of January 2016), and 3) the WHO standard: BMI values >2 standard deviations (SDs) and >3 SDs, respectively, above the WHO growth standard

BMI median for children under 5 years of age (exact age  $\leq 1856$  days) [12, 13] and BMI reference values  $>1$  SDs and  $>2$  SDs, respectively, above the WHO growth reference BMI median for children aged over 5 years (exact age  $>1856$  days) [14], with the use of SAS macros provided by the WHO (free downloads: <http://www.who.int/childgrowth/software/en/>; <http://www.who.int/growthref/tools/en/> accessed on 21<sup>st</sup> of January 2016). All the BMI cut-offs used are age and sex specific. Exact ages were used to calculate BMI z-scores for the WHO standard and reference and BMI percentiles for the CDC growth reference. For the IOTF reference, children's age was categorized in half-a-year increments. For the presentation of results, age was grouped according to the calendar age, i.e. age at last birthday.

### Statistical method

Differences in the prevalence of overweight and obesity between age and sex groups according to the applied definitions were tested using a chi-squared test and the comparison of 95% CIs of rates. Trends across one-year age categories were tested using the Cochran-Armitage trend test. Values of  $p < 0.05$  were considered significant. The statistical analysis was performed with SAS 9.3 for Windows.

## RESULTS

The characteristics of the children who were enrolled into the OLA study and provided valid BMI are presented in table I. On average, the boys in the sample were 1.3 cm taller and weighed 0.6 kg more than the girls.

### Overweight and obesity prevalence

Prevalence rates of overweight and obesity according to the IOTF, the WHO and CDC cut-offs by age for boys and girls are reported in table II. There were significant differences in overweight and obesity rates depending on sex, age group and applied definition. According to the IOTF definition, the prevalence of overweight was higher among girls compared to boys ( $p=0.004$  for  $\chi^2$  test), whereas there was no significant difference in obesity prevalence between boys and girls ( $p=0.32$ ). In the case of the WHO cut-offs, the prevalence of overweight and obesity was higher among boys than in girls ( $p=0.01$  and  $p=0.01$ , overweight and obesity, respectively). According to the CDC BMI percentiles, the prevalence of overweight and obesity did not differ significantly between sexes ( $p=0.08$  and  $p=0.08$ , overweight and obesity, respectively). The prevalence of overweight and obesity in both sexes and according to the three definitions used, significantly ( $p < 0.01$  for Cochran-Armitage trend test) increased with age with the exception of girls in the case of the CDC definition (tab. II). In younger ages (2 to 4-year-olds), the rates of overweight by single-year age-groups were higher according to the IOTF compared to the WHO definition, whereas in older children they were higher in the sample rates according to the WHO definition. The rates of overweight were the highest in the case of the CDC definition for 2 to 4-year-old boys and 2 to 5-year-old girls, whereas in the case of 6-year-olds, the

rates were the highest in the case of the WHO cut-off points (tab. II). In the case of boys, despite significant differences of overweight rates (non-overlapping CIs) between single-year age groups according to the IOTF and WHO definitions, the difference for grouped ages (2 to 6-year-olds) was insignificant (overlapping CI) (tab. II).

### Comparison with other countries

Figure 1 shows the current proportions of BMI for age and sex:  $\geq 85$ th percentile and BMI for age and sex  $\geq 95$ th percentile of the CDC Growth Charts among Polish children aged 2-5 years compared to the most recent US non-Hispanic white children [15]. In general, prevalence of overweight was higher among US children, however CIs are overlapping, which means that the difference is not statistically significant. On the contrary, prevalence of obesity alone was higher among Polish children aged 2-5 years and statistically significant in the case of girls. The prevalence of overweight based on the IOTF reference was in general higher among Polish boys aged 2-6 years compared to Norwegian peers [16] but only in the case of 6-year-olds was the difference statistically significant. There were no significant differences in overweight prevalence between Polish and Norwegian girls (fig. 2). The prevalence of obesity was significantly higher among Polish boys in comparison to their Norwegian peers, while in the case of girls, the difference was significant only for 5-year-olds (fig. 2) [16].

## DISCUSSION

The present study has been the first one in which the estimates of the prevalence of overweight and obesity with 95% CIs of the estimates based on data from a nationally representative sample of Polish children aged 2-6 years were presented. CIs make it possible to assess the precision of the calculated overweight and obesity rates and to check for the statistical significance of the differences in rates. In the OLA study sample size was large enough to allow making overweight and obesity prevalence estimates with fairly narrow confidence intervals not only for grouped ages but also for single-year-age categories. Reporting overweight and obesity rates (together with CIs) is important for monitoring changes over time (time trends) and to facilitate comparisons with other countries, which may, in turn, contribute to obtaining better insight into the determinants of obesity [16].

Identifying appropriate reference data is a task of great importance in childhood overweight and obesity research [17]. A properly chosen reference system allows not only to describe the phenomenon (here: overweight and obesity) but also to predict its occurrence. However, different references and standards are based on different criteria used to select samples and provide different cut-offs. The US 2000 CDC BMI-for-age revised references were developed with the use of data from 5 national surveys: National Health Examination Survey II and III, and National Health and Nutrition Examination Survey I, II and III without selection criteria for infant feeding practices and affluent neighborhoods [11], whereas these

Table I. Baseline characteristics of study sample.

Tabela I. Podstawowa charakterystyka próby badanej.

	Boys		Girls	
	N	Mean (SD)	N	Mean (SD)
Age in years, mean (SD)	2477	4.5 (1.12)	2549	4.5 (1.11)
Height, cm, mean (SD)	2477	108.3 (8.93)	2549	107 (8.82)
Weight, kg, mean (SD)	2477	18.8 (4.21)	2549	18.2 (4.05)
BMI, kg/m <sup>2</sup> , mean (SD)	2477	15.9 (1.83)	2549	15.8 (1.79)

Table II. Prevalence (95% CI) of overweight (including obesity) and obesity among Polish preschool boys and girls using the IOTF, WHO and CDC definitions.

Tabela II. Częstość występowanie (95% przedział ufności) nadwagi (włączając otyłość) oraz otyłości wśród polskich dzieci w wieku przedszkolnym z zastosowaniem definicji IOTF, WHO oraz CDC.

Age (years)	N	IOTF		WHO		CDC		
		Overweight % (95% CI)	Obesity % (95% CI)	Overweight % (95% CI)	Obesity % (95% CI)	Overweight % (95% CI)	Obesity % (95% CI)	
boys	2- <3	221	10.9 (7.1-15.7)	2.3 (0.7-5.2)	7.2 (4.2-11.5)	2.3 (0.7-5.2)	13.6 (9.4-18.8)	7.2 (4.2-11.5)
	3- <4	711	10.3 (8.1-12.7)	3.7 (2.4-5.3)	6.2 (4.5-8.2)	3.1 (2.0-4.7)	14.8 (12.2-17.6)	7.5 (5.6-9.6)
	4- <5	621	10.8 (8.5-13.5)	3.5 (2.2-5.3)	6.0 (4.2-8.1)	1.8 (0.9-3.2)	15.8 (13.0-18.9)	8.5 (6.5-11.0)
	5- <6	620	12.3 (9.8-15.1)	5.2 (3.6-7.2)	19.4 (16.3-22.7)	6.9 (5.1-9.2)	18.4 (15.4-21.7)	9.4 (7.2-11.9)
	6- <7	304	20.1 (15.7-25.0)	7.6 (4.9-11.1)	28.3 (23.3-33.7)	13.2 (9.6-17.5)	26.0 (21.2-31.3)	13.5 (9.9-17.9)
	2- <7	2477	12.2 (10.9-13.5)	4.4 (3.6-5.2)	12.2 (11.0-13.6)	4.9 (4.1-5.8)	17.2 (15.7-18.7)	8.9 (7.8-10.1)
girls	2- <3	243	13.2 (9.2-18.1)	1.2 (0.3-3.6)	5.8 (3.2-9.5)	0.4 (0.0-2.3)	20.2 (15.3-25.8)	6.6 (3.8-10.5)
	3- <4	691	12.7 (10.3-15.5)	2.5 (1.4-3.9)	4.6 (3.2-6.5)	1.6 (0.8-2.8)	17.4 (14.6-20.4)	6.5 (4.8-8.6)
	4- <5	712	14.9 (12.4-17.7)	3.4 (2.2-5.0)	4.9 (3.5-6.8)	1.8 (1.0-3.1)	20.1 (17.2-23.2)	8.0 (6.1-10.3)
	5- <6	594	14.1 (11.4-17.2)	5.6 (3.9-7.7)	15.5 (12.7-18.7)	6.1 (4.3-8.3)	16.7 (13.8-19.9)	7.7 (5.7-10.2)
	6- <7	309	23.0 (18.4-28.1)	6.5 (4.0-9.8)	26.5 (21.7-31.8)	8.4 (5.6-12.1)	24.6 (19.9-29.9)	9.4 (6.4-13.2)
		2- <7	2549	15.0 (13.6-16.4)	3.8 (3.1-4.6)	10.0 (8.9-11.2)	3.4 (2.7-4.2)	19.1 (17.6-20.7)

CI: confidence interval

were important criteria for the sample selection for the WHO 2007 growth standard [13]. The WHO standard, used for children 0-59 months of age, was based on a sample of healthy infants and children from 6 countries (including the USA), while the WHO growth reference for children and adolescents aged 5-19 years is based on data from the 1977 National Center for Health Statistics/WHO growth reference [14]. The IOTF reference BMI centiles were constructed on the basis of 6 nationally representative data sets (including data from four US national surveys in the years 1963-80) and BMI cut-offs were defined by the centile passing, at age 18 years, through adult overweight and obesity cut-offs [18] which is a different concept from defining cut-offs on arbitrarily selected specific centiles or standard deviation scores [17]. Up to the age of 5 years, the IOTF and CDC overweight and obesity cut-offs are lower compared to the WHO cut-offs, yielding significantly higher overweight and obesity rates, which is in line with the findings of others

[19]. With regard to the WHO childhood overweight and obesity cut-offs, it is important to underline "the transition at 5 years between the standard for children 0-5 years of age and the one for children and adolescents 5-19 years of age. Overweight and obesity are defined with 2SD and 3SD cut-offs in the former, and with 1SD and 2SD cut-offs in the latter" [19]. Estimation of overweight and obesity prevalence using the classification schemes, which differs between children under the age of 5 years and those over the age of 5 years results in a sharp rise in the prevalence of excess weight among children older than 5 years. Research is needed with regard to the health outcomes associated with different definitions [19, 20].

We report a significant age trend of increasing overweight and obesity prevalence among preschool children, which in the case of the WHO definitions (but not the IOTF) is partly attributable to the previously discussed differences in classification schemes. Moreover,

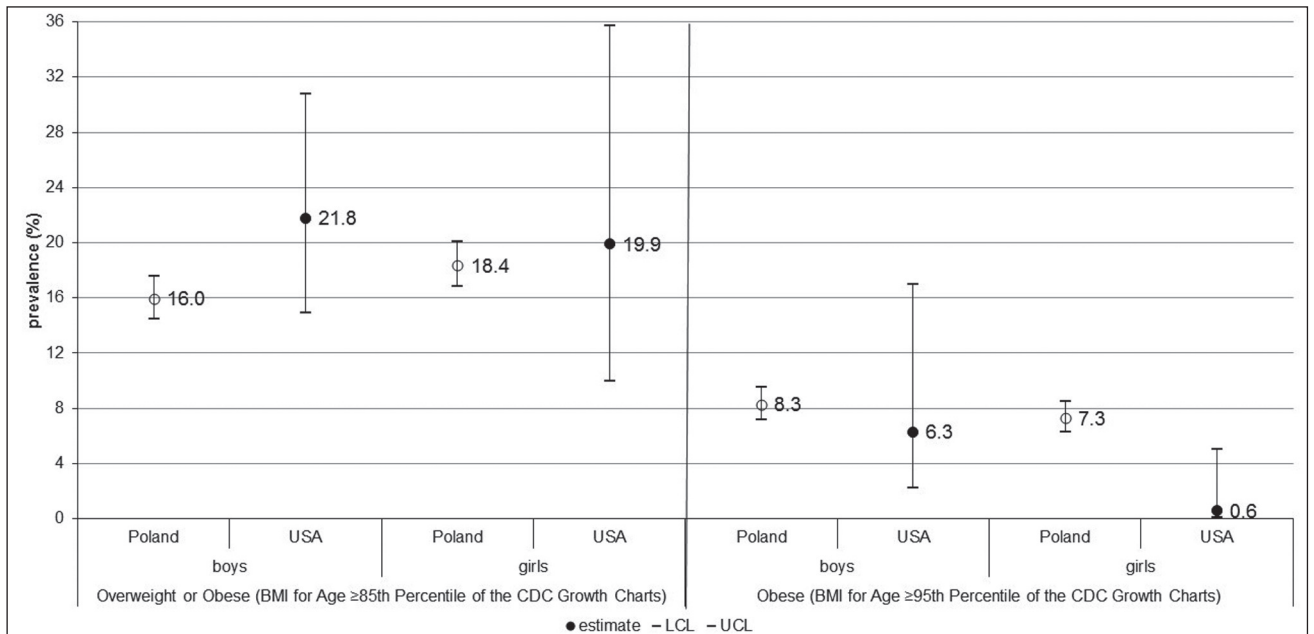


Fig 1. Comparison of overweight and obesity prevalence among children aged 2-5 years: Poland vs USA. Overweight and obesity definition according to the CDC [15]. LCL and UCL, the lower and upper bounds of a 95% confidence interval, respectively.

Ryc. 1. Porównanie częstości występowania nadwagi i otyłości wśród polskich i amerykańskich dzieci w wieku 2-5 lat. Oszacowanie częstości nadwagi i otyłości wg definicji CDC[15]. LCL i UCL - dolna i górna granica 95% przedziału ufności.

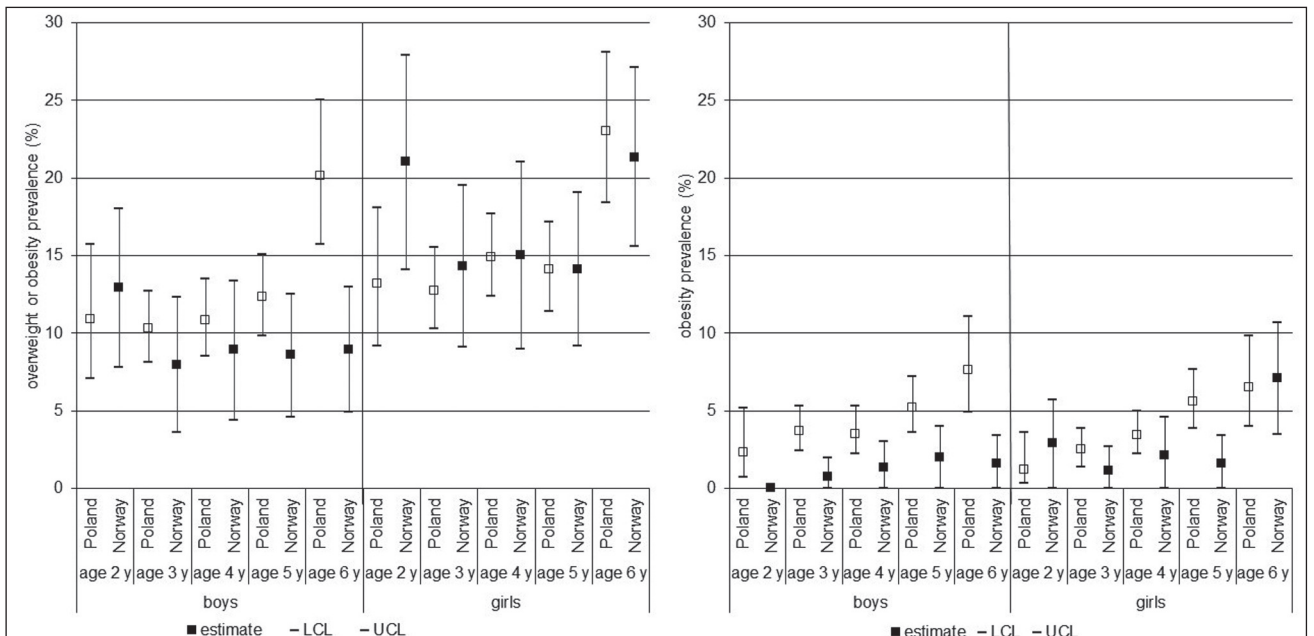


Fig. 2. Comparison of overweight including obesity and obesity prevalence among children aged 2-6 years: Poland vs Norway [16]. Overweight and obesity definition according to the IOTF [10]. LCL and UCL, the lower and upper bounds of a 95% confidence interval, respectively.

Ryc. 2. Porównanie częstości występowania nadwagi i otyłości wśród polskich i norweskich [16] dzieci w wieku 2-6 lat. Oszacowanie częstości nadwagi i otyłości wg definicji IOTF [10]. LCL i UCL – dolna i górna granica 95% przedziału ufności.

when compared with the 7 to 12-year-olds from the contemporary sample of Polish school-age children [2], high rates of overweight and obesity are sustained. A similar pattern of association between the age of pre-school and school-aged children and the prevalence of combined overweight/obesity, calculated with the use of the IOTF cut-offs, was reported from Australia, the Basque Country and Norway [16, 21, 22]. This finding may indicate that interventions to prevent overweight and obesity among children should be implemented no later than the preschool age.

## CONCLUSIONS

The paper provides population-based estimates of pre-school children overweight and obesity rates together with 95% CI, which may serve for future comparisons with other countries and rate changes over time. Obesity rates among Polish girls and boys were higher compared to American and Norwegian peers.

This study adds evidence to the scientific literature on the impact that the choice of each particular overweight and obesity reference standard has on prevalence estimates of overweight and obesity among pre-school-aged children.

Overweight and obesity preventive programs should be implemented at preschool age.

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