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The frequency of overweight and obesity occurrence among Polish children (age 6–7 years) in relation to the place of residence, the education level of parents and the number children in the family

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ABSTRACT: This study sought to evaluate the number of those overweight and the rate of obesity among 6- and 7-year-olds living in Poland with regard to their place of residence, the parental level of education and the number of children in the family. The analysis was based on a survey of 64 544 children (33 051 boys and 31 493 girls) living in Poland. Overweight and obesity were defined based on body mass index (BMI) using the IOTF cut-off points. To evaluate the rates of overweight and obesity occurrence in children with regard to family socio-economic status, parental level of education, the number of children in the family, and the place of residence (divided into city and village) was used. 'Only children' were the most likely group to be overweight or obese. These children were twice as likely to be obese as their peers living in families with four or more children. Overweight and obesity occurred more often amongst children living in cities rather than those living in rural areas. Moreover, these conditions were more frequent among children whose parents had higher levels of education. The most significant predictors of childhood overweight and obesity were the number of children in the family and the educational level of the mother.

KEY WORDS: body mass index, 6- and 7-year-olds, socio-economic factors

Introduction

Over recent decades, many countries throughout the world have witnessed a steady increase in the number of people with excess body weight. This problem has intensified over time: the number of people who are overweight or obese has clearly increased over consecutive age groups (Krawczyński et al. 2003, Dollman and Pilgrim 2005, Kozieł et al. 2006, O'Neill et al. 2007, Olds 2009;

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Kaczmarek et al. 2015). These problems affect younger children, adolescents and adults in developed and developing countries as well (Kalies et al. 2002, WHO 2003, Branca et al. 2007, Rodrigo 2013, Gomuła at.al. 2015). The study of the frequency of overweight and obesity occurrence among children and adolescents in 34 European countries in relation to the economic status of regions has shown significant differences. Children from less affluent families in 21 of 24 Western and 5 of 10 Central European countries were at a higher risk of becoming overweight (Due et al. 2009).

Currently, childhood overweight and obesity are more frequently analysed than malnutrition, not only in Poland but in other developed countries as well (Gupta et al. 2012, Ng et al. 2014). However, the data analysis of age-standardised mean BMI for children and adolescents from 200 countries reveals that underweight significantly exceeds obesity. The pooled study shows that in 2016 75 million girls and 117 million boys worldwide were moderately and severely underweight. In the same period, 50 million girls and 74 million boys worldwide were obese (NCD Risk Factor Collaboration 2017). The health and social consequences of both of these conditions are significant. Overfeeding and the excessive growth of adipose tissue in young children burden their bodies and lead to a variety of health problems that can manifest themselves during adolescence or many years later (Gei et al. 2001, Brouwer et al. 2013). Body fat is strongly associated with total cholesterol and high-density lipoprotein (HDL) cholesterol (Rush 2009). Importantly, excess body weight predicts not only medical problems in children but also social and educational ones (Janssen et al. 2004). Additional factors such as school stress and low self-esteem can contribute to the development of obesity among children and adolescents (Kark et al. 2014).

Genetic factors, maternal obesity during pregnancy (Taylor et al. 2014) and weight gain in early infancy (Wijlaars et al. 2011, Labayen et al. 2012) only partially explain the development and emergence of overweight and obesity among children. The neighbourhood environment (Sherburne et. al. 2009), lifestyle aspects, including diet (Lin et al. 2007, Henneberg and Grantham 2014, Horsch et al. 2015), physical activity level (Janssen et al. 2005, Ara et al. 2007, Lioret et al. 2007, Matton et al. 2007, Cleland et al. 2008, Boles et al. 2013, Lee et al. 2015), and sedentary behaviours (Jargo et al. 2005, de Jong et al. 2011) are of greater importance. However, these elements depend heavily on the social, economic and cultural conditions in which the family lives (Albertini et al. 2008, Lämmle et al. 2012). The diets and other behave connected to the health of young children are almost entirely decided by their parents (Campbell et al. 2006, Cullinan and Cawley 2017). Thus, it is important to determine the scale of the problems of overweight and obesity among the youth based on the disparate social and family groups in which children develop.

This study aimed to evaluate the rates of overweight and obesity occurrence among 6- and 7-year-olds living in Poland with regard to selected socio-economic (parents' level of education, number of children in the family) and demographic factors (place of residence).

Methodology

The study material was obtained from research conducted within the frame-

work of a national project entitled, "The six-year-old at the beginning of school education", which was governed by the Research Group of the University of Jan Kochanowski in Kielce. This project includes diagnoses of physical, motor, mental, social and emotional development, as well as indices of the health, family and school environments in which children were born in 1999 and 2000. Our research used data collected in 2006, and the procedure consisted of two stages. In the first stage (April to May), 34 225 children and their parents were examined, by teachers of physical education or school nurses. In the second stage (September to October), 35 339 children and their parents were examined. In each stage, the investigation targeted approximately 10% of all children of this age group in Poland. The sample selection was randomized, taking into account the distribution of the populations in various regions of the country, types of facilities (kindergarten – schools) and the environment – urban vs. rural (Cieśla et al. 2007).

Within the project, parents completed a survey that contained numerous questions concerning the overall socio-economic status of the family, self-esteem related to social status, living conditions, parental aspirations, the child's health and physical activity. To evaluate the rates of overweight and obesity in children in relation to family socio-economic status and the demographic factor, information about parental level of education, the number of children in the family, and the place of residence were used. In accordance with the education level of parents four groups of children have been differentiated: primary education (eight to nine years of schooling), vocational (eleven years of schooling), secondary (twelve years of schooling and

Table 1. Demographic characteristics of participants

Demographic characteristic	All boys		All girls	
	N	%	N	%
Place of residence				
City	19,420	58.76	18,339	58.23
Village	13,631	41.24	13,154	41.77
Maternal level of education				
Primary	2,340	8.37	2,219	8.29
Vocational	9,711	34.75	9,287	34.68
Secondary	10,908	39.04	10,593	39.56
Higher	4,983	17.84	4,680	17.47
Paternal level of education				
Primary	2,302	8.38	2,176	8.27
Vocational	13,613	49.58	13,206	50.20
Secondary	8,119	29.58	7,752	29.46
Higher	3,422	12.46	3,175	12.07
Number of children in family				
1	7,717	25.39	7,391	25.39
2	13,586	44.70	12,993	44.65
3	5,458	17.96	5,210	17.90
4 or more	3,633	11.95	3,511	12.06

secondary school-leaving examination) and higher – university education (more that fifteen years of schooling). The place of residence was differentiated between rural and urban areas, according to the regional administration division of Poland. Statistics of the size of the studied groups are shown in Table 1.

The calendar age of the respondents was determined according to the date of birth and the date of examination. Height and weight were measured using an anthropometer and a scale in accordance with accepted guidelines. Overweight and obesity were determined for children in a given age group by calculating body mass index (BMI) using cut-off points of the International Obesity Task Force standards (IOTF) (Cole et al. 2000). These international cut-off points are defined by values of BMI >25 (overweight), and > 30 (obesity) at the age of 18. There are based on representative data from six countries and are defined by values of BMI at the age 18 (Li et al. 2016). Because no differences were found in the percentages of those overweight and obese between 6-year-olds and 7-year-olds, both age groups were considered together to assess the rates of these conditions in relation to family socio-economic status.

The analyses and our associated inferences were based on the data of 64 544 children (33 051 boys and 31 493 girls) who completed both the questionnaire and the anthropometric measurements (Table 1).

The significance of intergroup differences regarding the rates of overweight and obesity occurrence was assessed using the chi-square test, adopting a significance level of 0.05.

The relationship between predictors (factor's level) and BMI was evaluated by linear regression analysis. To verify whether the relationship between the predictors and the dependent variable is the same (of the same magnitude) in the sample of boys and girls, analyses of moderation (interaction) were performed, with sex as the moderating variable. This method allows for checking whether a given predictor differs in the magnitude of its impact between girls and boys. The analyses of moderation were performed by means of the PROCESS software (Hayes 2013).

Results

Overweight and obesity were significant among 6- and 7-year-olds. These problems affected more than 15% of children in this age group. Overweight occurred slightly more frequently in girls (12.39% of all examined girls) than boys (11.62%), whereas the opposite result was observed for obesity. Over 5% of all boys studied were obese compared to 4.52% of all girls ($\chi^2=18.85$, $p<0.001$) (Table 2).

Place of residence was an important determinant with regards to childhood obesity. Overweight and obesity occurred more often among children living in cities than those living in rural areas. As many as 11.90% of boys and 12.98% of girls from cities qualified as overweight, with 11.12% and 11.58% respectively for those from rural homes. These differences were significant in the case of girls ($\chi^2=15.33$, $p<0.001$) and boys ($\chi^2=7.84$, $p=0.02$).

Maternal education level was an important indicator of the risks of overweight and obesity amongst 6- and 7-year-olds. The differences in this variable were significant for both girls ($\chi^2=27.10$, $p<0.001$) and boys

Table 2. The rates of childhood overweight and obesity in relation to socioeconomic factors

Demographic characteristic	Boys					Girls				
	Overweight		Obesity			Overweight		Obesity		
	n	%	n	%		n	%	n	%	
Sex	3,842	11.61	1,682	5.08		3,907	12.39	1,426	4.52	χ^2=18.85 p<0.001
Place of residence										
City	2,323	11.90	1,012	5.21	χ^2=7.84	2,380	12.98	846	4.61	χ^2=15.33
Village	1,516	11.12	666	4.89	p=0.020	1,523	11.58	578	4.39	p<0.001
Maternal level of education										
Primary	222	9.49	102	4.36		229	10.32	93	4.19	
Vocational	1,121	11.54	472	4.86	χ^2= 25.32	1,094	11.78	438	4.72	χ^2= 27.10
Secondary	1,308	11.99	615	5.64	p<0,001	1,387	13.09	500	4.72	p<0.001
Higher	603	12.10	273	5.48		635	13.57	189	4.04	
Paternal level of education										
Primary	229	9.95	111	4.82		244	11.21	75	3.45	
Vocational	1,558	11.44	723	5.31	χ^2=15.26	1,599	12,11	644	4.88	χ^2=26.11
Secondary	972	11.97	450	5.54	p=0.018	1,049	13.53	358	4.62	p<0.001
Higher	420	12.27	155	4.53		395	12.44	123	3.87	
Number of children in the family										
1	1,027	13.31	495	6.41		1,066	14.42	414	5.60	
2	1,637	12.05	703	5.17	χ^2=126,35	1,645	12.66	619	4.76	χ^2=133.86
3	559	10.24	250	4.58	p<0.001	536	10.29	197	3.78	p<0.001
4 or more	304	8.37	133	3.66		362	10.31	90	2.56	

(χ^2=25.32, p<0.001). Both percentages of overweight boys and overweight girls increased as maternal education level increased. Mothers with primary level education had the fewest overweight children (9.49% boys and 10.32% girls), whereas mothers with higher levels of education had the most (12.10% and 13.57% respectively) (Table 2). Likewise, maternal education predicted an increase in the fraction of boys with obesity from 4.36% to 5.48%. Mothers with a higher level of education had the fewest obese girls (4.04%), in contrast to groups with primary (4.19%) or vocational or secondary education (4.72%) (Table 2).

Fathers with higher levels of education were more likely to have overweight sons (12.27%) than those with only primary education (9.95%) (χ^2=15.26, p=0.018). Paternal level of education had a similar relationship to overweight among girls (χ^2=26.11, p<0.001). However, fathers with either primary or the highest level of education had a lower prevalence of obesity among daughters (3.45%, 3.87%) and also sons (4.82%, 4.53%).

The frequency of overweight and obesity occurrence showed a high variation in regards to the number of offspring in a family. "Only sons" (6.41%) and "only daughters" (5.60%) were twice as likely to be obese as their peers living in families with 4 or more children (3.66%, 2.56% respectively). The results of the chi-square test indicate that this factor is associated with the risk of developing childhood overweight or obesity (girls: χ^2=133.86, p<0.001; boys: χ^2=126.35, p<0.001).

Table 3. Multiple linear regression analysis of sex, socioeconomic, demographic factors and BMI

Predictor	F=32.103, p<0.001, R^2=0.055				
	B	Beta	St. Error	t	p-value
Sex	0.026	0.016	0.007	3.748	<0.001
Place of residence	–0.004	–0.002	0.007	–0.510	0.610
Maternal level of education	0.020	0.022	0.005	4.016	<0.001
Paternal level of education	–0.008	–0.009	0.005	–1.581	0.114
Number of children in family	–0.062	–0.045	0.006	–10.006	<0.001

B – unstandardized regression coefficient; Beta – regression coefficient; St. Error – Standard Error of regression coefficient; t – Student t statistic; p – probability level; R^2 – coefficient determination (square of multiple correlation); F – Fisher statistic for ANOVA.

Table 4. Moderation analyses for sex

Predictor	B	St. Error	Lower 95 CI	Higher 95 CI
Place of residence	0.029	0.013	0.004	0.053
Maternal level of education	–0.002	0.008	–0.018	0.013
Paternal level of education	–0.001	0.008	–0.017	0.016
Number of children in family	0.004	0.011	–0.017	0.026

B – unstandardized regression coefficient for the interaction effect; St. Error – Standard Error of regression coefficient for interaction; Lowe/Higher 95% CI: 95% confidence for the interaction effect.

A multiple regression analysis was used to show which combination of socio-economic variables is associated with the greatest risks of overweight and obesity. Table 3 presents the results of the multiple linear regression analysis of sex, same socio-economic and demographic factors and BMI. The prediction was statistically significant (F=32.103. p<0.001). The level of the mother's education was significantly and positively related to BMI, while the "number of children in family" factor related negatively to BMI. The following relationship is arranged in accordance with the gradient: the higher the mother's level of education, the more frequent the occurrence of excessive body weight amongst her offspring; whereas, overweight and obesity occur significantly less often in families with a large number of children than in those with single children. The Beta standardized regression coefficient for each predictor was very small but the largest occurred in the "number of children in the family" predictor (–0.045), followed by "maternal level of education" (0.022). The analysis of moderation was used to test for sex differences. The results indicated that the interaction was significant in the "place of residence" predictor (the CIs did not include zero), which means that the impact of place of residence on BMI was different in boys vs. girls (Table 4). Table 5 shows this relationship, calculated separately for boys and girls. The impact of place of residence on BMI was significantly nega-

Table 5. Analyses of impact of place of residence on BMI separately for boys and girls

Sex	B	St. Error	Lower 95 CI	Higher 95 CI
Girls	–0.044	0.009	–0.062	–0.027
Boys	–0.016	0.009	–0.033	0.002

B – unstandardized regression coefficient for the interaction effect; St. Error – Standard Error of regression coefficient for interaction; Lowe/Higher 95% CI: 95% confidence for the interaction effect.

tive for girls, but not for boys. It means that the BMI was higher for girls living in a city than in a village; however in the group of boys there was no significant relationship between place of residence and BMI.

Discussion

The analysis of the rates of overweight and obesity in relation to family socio-economic and demographic factors enables us to ascertain which of the variables are associated with proper body weight among children. Significant associations were identified between parental education level and the rates of overweight and obesity among children. The maternal and paternal levels of education should be considered in the following two ways: on the one hand, completing a stage of education is associated with the type of work and related earnings but on the other hand, a higher educational level is likely associated with a greater awareness of the developmental needs of a child, and pro-health/pro-overweight attitudes are adopted at the same time. Mothers and fathers with higher levels of education were more likely to have overweight children. Being overweight is not as badly received as obesity among young children. In Polish families, snacking between meals is common; in addition, the practice of controlling and limiting the intake of sweets for children and young people is absent (Suliga 2008). Mothers and fathers with higher levels of education had the fewest obese boys and girls. Importantly, however, the results slightly differed by sex. The prevalence of obesity clearly differed with regard to how excessive body weight was approached in daughters and sons. Many obese boys in families with higher social statuses might indicate over-protection and spoiling, especially by mothers. Affluent women attach a greater importance to being slim, thereby resulting in the much more serious treatment of obesity among their daughters, emphasizing that girls should look slender at an early age. The study of the secular trends in body mass index and the prevalence of overweight and obesity among Polish schoolchildren between the years 1966–2012 has revealed the sex differences, especially in the last survey. Considering three periods of development: childhood, early and late adolescence in boys the prevalence of overweight (from 19.19% to 19.64%) and obesity (from 5.56% to 4.87%) was similar, but in corresponding girls' groups prevalence of overweight (from 17.53% to 9.88%) and obesity (from 6.30% to 1.91%) has decreased in older age groups (Gomuła et al.2015). A few studies have observed the following trend: families with higher socio-economic statuses had the most obese boys and the fewest obese girls (Jopkiewicz et al. 2011, Gurzkowska et al. 2014, Mladenova and Andreenko 2015). Brisbois et al. (2011) 15 of the reviewed studies have found an association between fathers with low levels of education or employment status and adulthood obesity in their sons or daughters.

The effects of family size on growth and child development are different in many factors. The studies into Polish youth conducted by Przewęda and Dobosz (2003) showed that although only children are taller, they are less physically fit. The lower fitness of only children relative to their peers with siblings is explained by their lack of natural stimulation, such as the stimulation of movement through play with a brother or sister. However, the results of other studies have indi-

cated that only children show advanced motor development (Półtorak 2009). With respect to excessive body weight, only children are the most likely to be overweight or obese. Similar data was reported by Mladenova and Andreenko (2015) between Bulgarian children aged from 8 to 15. The number of children in the family most strongly differentiated the study in this respect. Thus, "only children" might be more likely to develop overweight or obesity than their peers with siblings. Focusing attention on "only children" can lead to overfeeding and reduce their natural activity through constant control and excessive concern. It is easier for parents who have two or more children to observe the differences in the dietary needs of siblings and adapt to them. This task is more difficult for the parents of only children because they often determine portion size, the amount of food, and the quality of the food based on their own ideas rather than the real needs of the child.

Overweight and obesity more often occurred among boys and girls living in cities. Findings from the Health Behaviour in School-aged Children (HBSC) study of 2009–2010 conduct by the Institute of Mother and Child in Warsaw has shown similarly that overweight and obesity is observed more often in Polish boys and girls from cities than villages (Mazur and Małkowska-Szkutnik 2011). In addition, Suliga (2009) observed a low BMI among boys living in rural areas versus their peers in the city, and an associated vitamin-deficient diet and a lower intake of calories. An additional study in Bulgaria found that children were less likely to be obese if they lived in rural area (Mladenova and Andreenko 2015). In contrast to our study, in the US or Canada more frequent childhood overweight and obesity occurrences were observed among individuals living in rural areas than among those living in cities (Bruner et al. 2008, Berlin et al. 2013) and no significant differences were reported by Wolnicka et al. (2016) in the prevalence of excessive body mass in children from the rural and urban regions of Poland.

From the linear regression analysis for all the group, we found that the main predictors of overweight and obesity among 6- and 7- year-old children were the number of children in the family, the mother's level of education and sex. Moderation analysis for boys and girls has shown that the interaction was significant only in the "place of residence" factor. This result indicated that overweight and obesity were more common among urban girls than rural ones. The family and its socio-economic status are important determinants in the risks for childhood overweight and obesity. A higher level of parental education was not always associated with a more conscious and consistent approach to maintaining a proper body weight in one's offspring. Polish society, which is still developing, considers the purchase of large quantities of food as a sign of prosperity and higher status. Thus, disparate living conditions and family models create a unique system of variables that are characteristic of the region. Therefore, we should observe inter-population differences and changes in the importance of social modifiers over the coming decades.

In conclusion, the family model and the socio-economic conditions in which a population operates are important determinates of the frequency of childhood overweight and obesity occurrence. Currently, the most significant modifiers in Poland seem to be the number of children in the family and the educational

level of the mother. These variables are associated with family functioning and the acceptance of specific health and anti-health behaviours.

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Authors' contributions

MM conceived and designed the paper, was principal investigator for the research project. AP analyzed and interpreted the data presented here. GN-S supported data analysis and interpretation. Statistical analysis of the data was executed by AP and EC. All authors were involved in drafting the paper and in approval of the final manuscript.

Conflicts of interest

The authors have no conflicts of interest to declare.

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