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RISK FACTORS FOR OBESITY DEVELOPMENT IN SCHOOL CHILDREN FROM SOUTH-EASTERN POLAND

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Abstract: The aim of the study was to determine socio-economic and parental factors affecting odds for development of obesity in school-age children from south-eastern Poland (SEP). 2,182 boys and 2,066 girls from randomly selected elementary schools in SEP were involved in this study. The mean age of the girls was 10.4 years (SD 2.4, range 6.7–14.9). The mean age of the boys was 10.5 years (SD 2.3, range 6.9–14.9). 167 boys (7.7%, 95% CI: 6.6–8.8%) and 208 girls (10.1%, 95% CI: 8.8–11.4%) were obese. The difference in prevalence of obesity between genders was statistically significant. Socio-economic risk factors (RF) were different from those in Western Europe or the United States. A small number of siblings was RF for obesity. Intact family had a protective effect. No correlation was found between child's obesity and parental education, income *per capita* or mother working outside the home. Parental obesity was RF for the obesity in children. High BMI at birth was an RF for obesity. A distinct pattern of socio-economic RF underlines the importance of population specific epidemiological studies. Defining RF in a specific region provides information to design specific preventive strategies.

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INTRODUCTION

Obesity is one of the most common pathologic conditions in developed countries. Constant increase in the prevalence of obesity has been observed during the last few decades [12, 13]. This problem is also seen among children and adolescents [11, 12, 25]. Environmental factors play a significant role in the development of obesity [1, 2, 8, 10, 11, 14, 21]. The role of genetic factors was confirmed by studies on pairs of twins and adopted children [17, 18]. Data regarding family structure and social conditions needs to be taken into consideration in the development of public health interventions. Every society has comes with unique combinations of issues that determine socio-economic risk factors for the development of obesity. This makes it difficult to extrapolate data collected within other societies. The aim of this study was to discover the socio-economic risk factors for the development of obesity in south-eastern Poland.

SUBJECTS AND METHODS

Data was collected in randomly selected elementary schools in south-eastern Poland. The Ethical Committee of the Regional Chamber of Medicine in Rzeszów approved the study. Power analysis determined that 1,500 + patients

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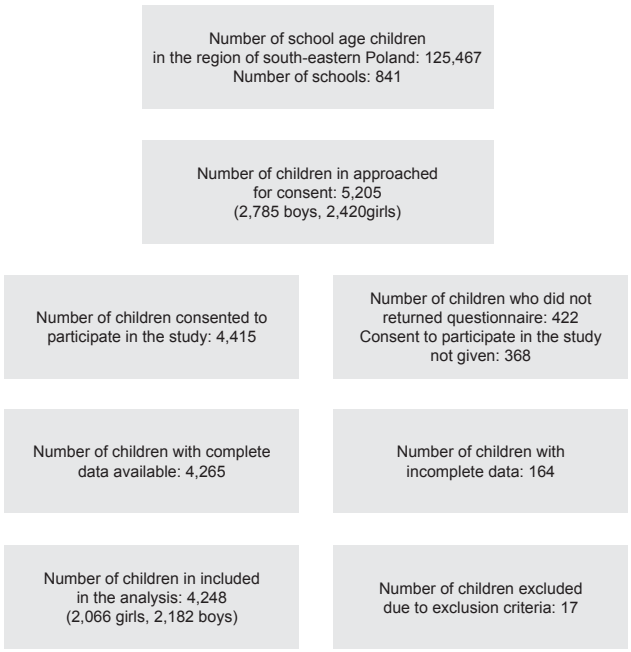

Figure 1. Demographics of the studied population.

enrolled in the study was sufficient to detect the odds ratio of >1.5 when comparing prevalence of obesity in the study groups with >95% confidence.

The population was defined as 146,000 school-age children of the Podkarpacie province in south-eastern Poland. In order to select the sample we used block randomization method, and 14 schools from a total of 841 schools were selected randomly. Upon obtaining consent, a questionnaire was distributed among all the parents of children attending the selected schools. The questionnaire contained questions regarding potential risk factors for obesity in the families. Families of 5,205 children (2,785 boys and 2,420 girls) were asked to participate in the study from 1998–2000. We obtained consent from the families of 4,415 children. Complete data was collected form families of 4,265. Children with chronic or genetic diseases that could impair their growth or require prolonged drug therapy, especially steroid therapy, were also excluded. Also, children wearing casts or orthopaedic appliances were excluded from the study. A total of 7 children were excluded, based on exclusion criteria. Data from 4,248 children (2,066 girls and 2,182 boys) was analysed in our study (Fig. 1).

The mean age of the girls was 10.4 years (SD 2.4, range 6.7–14.9). The mean age of the boys was 10.5 years (SD 2.3, range 6.9–14.9).

The children were weighed and measured without shoes, only in underwear, at the school hygienist's room. Weight was obtained in the standing position with a standardized scale RADWAG WPT 60/150 with an accuracy of 100 g. Height was measured in the standing position with a fixed stadiometer with an accuracy of 1 cm. Three separate measurements were obtained for both weight and height. From the 3 measurements, the mean weight and height were calculated. Body mass index (BMI) was calculated according to standard formula.

Additionally, parents' weight, birth weight of the child, mother's age at the time of the child's delivery, parents' education, economic status, number of family members, martial status, mother's work outside the home were recorded, based on the data from the questionnaire. BMI of the parents was calculated on the basis of their weight and height data from the questionnaires.

Obesity was determined according to the criteria of the International Obesity Task Force (IOTF) [4]. Parental obesity was defined as BMI exceeding 30 [4]. We identified the children whose birth weight was higher than 97 percentile based on the percentile curves of birth weight for both sexes, developed by Lubchenco *et al.* [19].

In order to examine the impact of the risk factors on the occurrence of obesity, we calculated odds ratios (OR) for each of the factors separately. The 95% confidence intervals were calculated, using the standard formula. In analysis of the data, we used student t-test and χ^2 test. We also performed multivariate analysis of the data. Significance of the differences was set at the level of $p < 0.05$. The statistical analysis was carried out, using STATISTICA v. 5.0 and EXCEL software.

RESULTS

167 boys (7.7%, 95% CI: 6.6–8.8%) and 208 girls (10.1%, 95% CI: 8.8–11.4%) were obese. The difference in the prevalence of obesity between genders was statistically significant. Tables 1 and 2 show the analysis of the biological risk factors of obesity development in boys and in girls. Mother's age at the time of the child's delivery did not have a significant influence on further development of obesity in either group of children. Obesity in the mother, father or both parents correlated highly ($p < 0.001$) with the occurrence of obesity in school girls and boys. The presence of obesity in children correlated highly with the mother's obesity. The correlation with father's obesity was also significant. The highest risk of obesity occurred in children with two obese parents.

Table 1. Biological risk factors of obesity in boys (N = 2182).

	Odds ratio	95% CI	p
Birth-weight (≥3800 g *vs.* <3800 g)	1.44	1.01–2.06	0.04
Mother's age at delivery (≥30 *vs.* <30)	0.99	0.96–1.02	NS
Obese father *vs.* non-obese father	8.38	6.01–11.68	<0.001
Obese mother *vs.* non-obese mother	16.75	11.78–23.82	<0.001
Obesity in both parents *vs.*:			
obese father and non-obese mother	4.13	2.32–7.35	<0.001
non-obese father, obese mother	8.98	5.07–15.62	<0.001
both parents non-obese	66.87	39.15–114.23	<0.001

Table 2. Biological risk factors of obesity in girls (N = 2,066).

	Odds ratio	95%CI	p
Birth-weight (≥3800 g *vs.* <3800 g)	3.22	2.34–4.43	<0.001
Mother's age at delivery (≥30 *vs.* <30)	0.98	0.95–1.01	NS
Obese father *vs.* non-obese father	9.38	6.12–12.92	<0.001
Obese mother *vs.* non-obese mother	14.28	10.31–19.79	<0.001
Obesity in both parents *vs.*:			
obese father and non-obese mother	4.24	2.42–7.45	<0.001
non-obese father, obese mother	6.89	4.12–11.53	<0.001
both parents non-obese	51.98	32.00–84.45	<0.001

Table 3. Social risk factors of obesity in boys (N = 2,182)

	Odds ratio	95% CI	p
Number of family members			0.003
1–2 children *vs.* 3–4 children	1.63	1.15–2.30	0.006
1–2 children *vs.* 5 or more children	2.13	1.09–4.15	0.02
Financial status			NS
<500 PLZ *vs.* >500 PLZ per person	1.36	0.94–1.82	NS
Father's education			NS
elementary *vs.* vocational	1.06	0.72–1.55	NS
elementary *vs.* secondary	1.52	1.01–2.33	NS
elementary *vs.* university	0.93	0.37–2.31	NS
Mother's education			NS
elementary *vs.* vocational	1.10	0.74–1.64	NS
elementary *vs.* secondary	1.21	0.81–1.83	NS
elementary *vs.* university	1.49	0.77–2.86	NS
Mother's employment outside home			NS
unemployed *vs.* employed	1.35	0.73–2.22	NS

We found a statistically significant correlation between obesity and high birth weight, both in girls and boys. High birth weight in girls significantly increased the risk of subsequent obesity (OR-3.22, confidence interval: 2.34–4.43). In boys with a high birth weight, the odds ratio of the obesity was lower (OR-1.44 confidence interval 1.01–2.06), but still statistically significant.

Analysis of the social risk factors of obesity for boys and girls is shown in Table 3 and 4. A small number of children living in the same house significantly increased the risk of obesity prevalence in both girls and boys. Low income, low level of parent's education or the mother's work outside the house, did not increase the risk of subsequent obesity in girls or boys. In our population, intact family structure had a significant protective impact on the prevalence of obesity (Tab. 5).

Table 4. Social risk factors of obesity girls (N = 2,066).

	Odds ratio	95%CI	p
Number of family members			0.001
1–2 children *vs.* 3–4 children	1.60	1.17–2.27	0.003
1–2 children *vs.* 5 or more children	2.34	1.27–4.31	NS
Financial status			NS
<500 PLZ *vs.* >500 PLZ per person	1.63	0.92–1.56	NS
Father's education			0.02
elementary *vs.* vocational	1.21	0.86–1.70	NS
elementary *vs.* secondary	1.60	1.10–2.32	0.01
elementary *vs.* university	1.61	0.89–2.93	NS
Mother's education			NS
elementary *vs.* vocational	0.90	0.52–1.30	NS
elementary *vs.* secondary	1.00	0.70–1.44	NS
elementary *vs.* university	1.07	0.60–1.89	NS
Mother's employment outside home			
unemployed *vs.* employed	1.30	0.96–1.76	NS

Table 5. Family structure and prevalence of the obesity.

	City		Rural areas	
	Two parent family	Single parent family	Two parent family	Single parent family
Obese (%)	8,2	22	8,7	18
Non-obese (%)	91,8	78	91,3	82
Number of subjects	1,796	109	2,298	61
p	<0.001		<0.05	

DISCUSSION

Biologic risk factors of the obesity. Our analysis of the biological determinants of obesity did not show significant differences in comparison with previous studies. Many authors point to a significant statistical relationship between obesity in children and the parents' BMI [3, 10, 15, 16, 29]. Our study confirms the existence of this relationship in our population.

Previous studies emphasized a particular role of mothers [1, 22, 24]. Our study confirms the stronger relationship of the child's obesity with the mother's rather than the father's obesity. Maternal impact was confirmed by the experiment showing the eating behaviours of obese children differed significantly from that of non-obese only when the mother was present [17]. A statistically significant correlation between obesity and high birth weight, both in girls and boys, was found. The scientific literature is ambiguous on this matter [22, 26, 28]. Probably there is no single mechanism, not a single risk factor, in the intrauterine environment that could determine the odds of the obesity. Mother's age at the time of child delivery did not have a statistically

relevant impact on the development of obesity in the tested groups of girls and boys. In this matter, our study is in accordance with that of De Vito *et al.* [7].

Socio-economic risk factors in child obesity. We found an increase in the occurrence of obesity in children from families with 2 or less children. This is consistent with other Polish studies showing that the children's obesity appeared most frequently in families with few children [27]. In contrast to this, De Vito *et al.* did not find any correlation between the small number of family members and occurrence obesity in children [7]. A potential explanation could be that in families with fewer children, there are fewer opportunities for modelling physical activity during play with siblings [5]. In more affluent countries, this effect can be neutralized by families being able to enrol children into extracurricular sport activities.

Our study did not find a statistically significant relation between parents employment status and obesity. In this respect, our population is different from that of Anderson *et al.* [2]. In Poland, unemployment is high and is present across all levels of education. Unemployment has a significant impact on family finances.

Managing on a very limited budget, families often give up buying new clothes, snack food and toilet items; they limit spending on education, cultural and leisure pursuits. Basic nutrition, however, is one of last items affected [15, 16]. Most likely, the negative effect of increased family stress in unemployed families is balanced by the positive effect of reduced snacking and decreased television time. In the study of De Spiegalaere *et al.* children living in poor families have a higher chance of developing obesity [6]. In our population, we did not find a statistically significant correlation between low income and the prevalence of obesity. A potential explanation could be that in Poland, the correlation between poverty and nutritional habits is different than that reported in the US and Western Europe. A study comparing Warsaw (high income) with low income rural areas showed that nutritional habits were better in rural areas [24]. Strauss *et al.* noticed more frequent obesity prevalence in families of less-educated parents [23]. Similar findings come from developing countries [30]. A Polish study on adult population found a relationship between low education and obesity [9]. Our study is in agreement with these findings. We found a difference between fathers' education and obesity, but the correlation between maternal education and the prevalence of obesity did not reach statistical significance.

In our study, intact family structure had a significant protective effect on the development of obesity in children. Despite recent economic growth, Poland remains one of the poorest countries in the European Union. A possible explanation is that in the prevention of the impact of poverty on children, support from the immediate and extended family is more important than family income in a poor but closely knit population [25, 29, 30].

SUMMARY

Our study confirms previously described biological factors affecting the development of paediatric obesity. A pattern of socio-economic risk factors is different than that described in the US or Western Europe. The underlying causes of the differences need to be investigated in detail in future studies. It is important to note that each society has a unique economic and cultural arrangement which prevents easy predictions based on studies from other populations. In order to provide decision makers with the data specific to the population of interest, there is no substitute for an epidemiological study of that population.

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