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Birth Order and BMI in Teenage Girls

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ABSTRACT

The goal of this study was to investigate the relation of birth order to relative weight and prevalence of obesity in a group of 13–15 years old girls. In 1997, 1458 girls were examined. The height and weight measured by trained staff were recorded. Family size and birth order were obtained by a questionnaire. For the purpose of the present study, 776 and 250 girls coming from two- and three-child full families, respectively, were selected from the total sample on the basis of complete information. The Body Mass Index (kg/m²) was adjusted to reference US population (NCHS) by means of the LMS parameters. Prevalence of overweight and obesity was defined according to recommendation of the International Obesity Task Force. The effect of birth order on BMI was tested by one-way analysis of variance. Prevalence of obesity was tested by the means of Pearson chi-square. First and second born girls from two-sibling families did not show significant differences in average standardized BMI. Relative weight significantly differs among girls coming from three sibling families, decreasing along with the birth order. The first-born girls were 1.5 times at higher risk of obesity in comparison to later- born girls. Differences in the proportion of overweight girls among birth order groups showed a high significance within three sibling families.

Introduction

Studies of obesity among children, without regard to the relationship to the socio-economic status of their parents, have demonstrated a strong association with family size. It has been shown that not only the mean weight of children declines, but also the frequency of overweight and obesity decreases with an increasing number of siblings[1–4].

In spite of recently growing concern for the health consequences of overweight and/or obesity, the prevalence of overweight and obesity has increased considerably in both child and adolescent segments of the populations in North America and Europe[5,6]. Thus, studies identifying risk factors in the development of obesity and monitoring of prevalence of excessive fatness could provide the relevant reasons to prevent such risk.

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Few data are available on the effect of birth order on the prevalence of obesity among siblings. Howells[7] described divergent findings in several examinations, but the number of siblings investigated was low and did not produce conclusive results. In the more recent study of 19-year-old Dutch men, no association between obesity and birth order was reported[8]. In an examination of risk factors associated with childhood obesity in Northern Italian elementary schools one of the factors which has been suggested as relevant to obesity was the birth rank of the child. It was not found that birth order influences the frequency of obese children in a given sibship size. The significant excess of obese subjects was observed only in the third-born girls from three-child families[9]. Dissimilar results were found in the study of 3–5 year-old Kuwaiti children[10]. It turned out that overweight and obesity were significantly associated with birth order in both sexes.

In the present study we investigate the relation of birth order to relative weight and prevalence of overweight and obesity in a group of 13–15 year-old girls.

Material and Methods

1458 girls attending 7th grade of randomly selected primary schools of the city of Wroclaw were examined in the Lower Silesian Center for Medical Diagnostics in Wroclaw between January and December 1997. On this occasion, height with stadiometer to nearest millimeter and weight with digital meter to nearest 100 grams were measured by trained staff. Family size and birth order and social background were obtained by questionnaires, which were distributed, prior to the survey, among parents and collected by the schoolteachers. During the examination, the girls were also asked whether they had menstruated yet. The answers were recorded in two categories – »yes« or »no«. This procedure permitted to divide the sample into two groups – menarchal and pre-menarchal girls.

The present study includes 776 and 250 girls from two- and three-child full families selected from the total sample on the basis of complete information (birth order). Data for larger sibship size were too small to consider in the material. The Body Mass Index (kg/m^2) for all samples was adjusted for age using LMS parameters for a reference population of United States published by National Center for Health Statistics (NCHS) [11]. This method allows an estimation, for each tabulated age and sex, L, M and S smooth curves, which represent respectively a power of the Box-Cox conversion to normality, the mean and the coefficient of variation. Then, given the values of L, M and S for the reference population at each age the conversion of actual BMI of each individual girl into SD scores Z was used. The use of SD scores (SDS) removes the effect of age on BMI and mostly avoids the problem of increasing variance due to variability of maturation rate[12,13]. The BMI (after adjusting for age) of girls included in the study (N = 1026), on average did not differ significantly from the excluded girls ($t = 0.70$; $p = 0.482$).

The estimation of prevalence of overweight and obesity, according to recommendation of International Obesity Task Force[14], was based on data of 190,000 children from six development and developing countries. The cut off points were defined in body mass index units in young adulthood, accounting for 25 kg/m^2 for overweight and 30 kg/m^2 for obesity and extrapolated to the appropriate age in childhood[14].

Several statistical methods were applied to collected data. The effect of birth order on BMI was tested by one-way analysis of variance. The analysis was carried out in the two groups of girls: coming from two- and three-child families. Pearson Chi-square test was used to test the prevalence of overweight and obesity in these two groups depending on birth order. Then, logistic regression was used to test the relative risk for overweight and obesity for first-born versus later-born, regardless of family size.

Results

Table 1 shows the descriptive statistic of raw values of relative weight in relation to birth order and sibship size. The average age of all the girls was 13.7 (SD = 0.37) years. Among the analyzed 1026 girls, 79.7% have already menstruated whereas the remaining 20.3% of subjects were before menarche. There were no significant differences in the number of post-menarchal and pre-menarchal girls between first and second born girls in two-child families (Pearson $^{2} = 0.57$; $p = 0.450$); and between first, second and third born girls in three-child families (Pearson $^{2} = 1.07$; $p = 0.587$). Additionally, significant differences have not been found in proportion to parental education level relative to birth order within two and three sibling families.

The results of the analysis of variance are listed in Table 2. First and second born girls from two sibling families did not show significant differences in average standardized BMI. Standardized relative weight significantly differs among girls coming from three sibling families, decreasing along with the birth order. The same analysis repeated for all subject but regardless of family size did not show any effect of birth order on relative weight ($F = 2.26$; $p = 0.105$; not showed). It seems that first-born girls are at higher risk of obesity, but only in comparison to subsequent girls coming from three sibling families.

According to assumed definition 128 (12.47%) girls were overweight in their age class. Figure 1 and 2 present the prevalence of girls recognized as overweight in relation to birth order and, two- and three-child family size, respectively. Differences in the proportion of overweight girls among birth order groups show a high significance within three sibling families (Pearson $^{2} = 9.03$; $p = 0.011$). However, the difference in proportion between first-born girls from two- and three-child families turned to be insignificant ($p = 0.063$). The used cut off point to define the obesity separated from total sample only 9 girls (0.88%), and calculating the prevalence depending on

TABLE 1
MEANS, MEDIANS AND STANDARD DEVIATIONS OF BMI IN RELATION TO BIRTH ORDER IN GIRLS FROM TWO AND THREE-CHILD FAMILIES

Birth order	N	Mean	Median	SD
		Two siblings		
First	294	19.65	19.10	3.17
Second	442	19.53	19.14	2.85
Total	736	19.58	19.12	2.98
		Three siblings		
First	62	20.79	19.96	3.34
Second	80	19.72	19.66	2.52
Third	108	19.22	18.92	2.86
Total	250	19.77	19.51	2.94

TABLE 2
MEANS OF STANDARDISED BMI AND STANDARD DEVIATIONS BY BIRTH ORDER AND FAMILY SIZE, AND RESULT OF ANALYSIS OF VARIANCE

Birth order	Mean (SDS scores)	SD	F-ratio	p-value
		Two siblings		
First	–0.05	0.99	0.01	0.924
Second	–0.06	0.88		
Total	–0.06	0.93		
		Three siblings		
First	0.27	0.93	4.96	0.008
Second	0.02	0.84		
Third	–0.19	1.00		
Total	0.00	0.95		

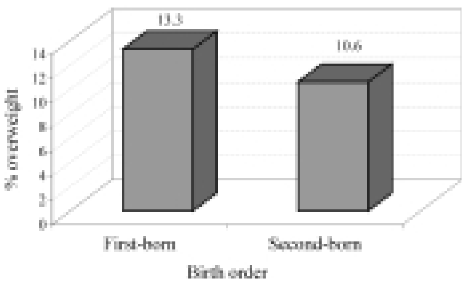

Fig. 1. Prevalence of overweight for the girls from two-child familes by birth order.

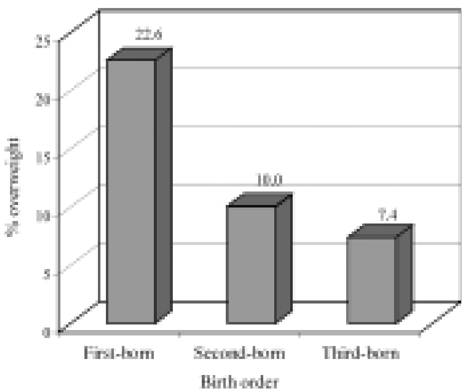

Fig. 2. Prevalence of overweight for the girls from three-child families by birth order.

birth order was ceased. The relative risk for obesity for first-born in comparison to later-born girls, regardless of family size accounting for 1.53 (Wald ^{2} = 5.03; p = 0.025; 95% CI – 1.05 – 2.23; not shown).

Discussion

Findings of the present study identified the early risk factor for increased relative weight among adolescent Polish girls. Birth order showed the significant positive relationship between both the relative weight and prevalence of overweight. However, the association becomes only significant in comparison of birth order status in girls from three-child families and between first-born and later-born girls, regardless family size.

There are many researches showing the importance of sibship size affecting variation in relative weight (weight-to-height or BMI) or fatness level among school children[2–4]. It seems that family size can be a critical risk factor for obesity development in children, regardless of the economical level and social class of the family[3,10]. Whitelaw[2] argued that quantity and quality of nutrition might mediate between the association in the number of children in a family and relative weight or fatness.

Reports on the effect of birth order on relative weight and fatness are less consistent. There are some studies, which have been done on different populations and covered different age range that reported contradictory results[7,15,16]. Quoted observations did not confirm the association between birth order and BMI and/or fatness though explored a reasonable number of subjects and allowed for simultaneous controlling the contribution of other factors. Ravelli and Belmont[7], using the massive data of nineteen-year-old men from the Dutch military service, found no consistent and reliable association between obesity and birth order despite significant family size effect.

Another group of authors reported the similar results obtained in the present study, however some of them focused the association between birth order and risk of obesity[17], the others analyzed only the effect of being first-born *versus* later-born[18] or being an only child versus having sibs[19]. Petterson et al.[17] observed that the risk of obesity in 10-year-old US girls decreased as the number of siblings increased. More recently, Stettler *et al.* [18] pointed out that first-born status was independently associated with increased adiposity in the young African American adults. These findings partly confirmed our results. The first-born Polish girls were 1.5 times more likely to developed overweight in adolescence.

Contrary to the previous reports the present study examined the association between birth order and risk of obesity in the groups stratified by family size. Such analysis design allowed estimating the net effect of birth order i.e. not confounded by family size. It can be linked only with the findings of Zonta Sgaramella et al.[9], which showed a significant excess of obese third-born girls aged 7–11 years in three-child families, so the relationship was inverse as obtained in the present study. It seems that the used definition of obesity and very scant sample size made difficult the comparison of two studies.

From such contradictory evidence for the effect of birth order on fatness and prevalence of obesity no firm conclusion could be made. It is necessary to confirm three distinctive effects: birth order by family size, being first born and being the only child. There are also some factors, which could have confounded the observed associations and could have been partly responsible for differences in obtained results. Among others, it should be mentioned: environmental and behavioral factors present between birth and the date of examination, distribution of family size, duration of birth intervals between subsequent children, and the average socio-economic level of examined population. One may suppose that: 1) the birth order factor show the greater impact on obesity in the childhood where patterns of diet much more depends on parental resources than in the adulthood or adolescent state, 2) it is possible that the birth order effect could be observed only in these populations where the economic situation of families apparently deteriorate when the next child appears. In this case, every one later-born child, compared to early-born could suffer from nutritional or parental care attenuation.

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REDOSLIJED ROĐENJA I BMI U ADOLESCENTNIH DJEVOJAKA

S A Ž E T A K

Cilj ove studije bio je ispitati povezanost redoslijeda rođenja i relativne težine te prevalencije prekomjerne težine u skupini djevojaka dobi od 13–15 godina. U 1997. godini ispitano je 1458 djevojaka. Težina i visina su izmjerene, dok su podaci o veličini obitelji i redoslijedu rođenja dobiveni putem upitnika. U cilju ovog istraživanja iz ukupnog uzorka odabrano je, po kriteriju potpunosti informacija, 776 i 250 djevojaka iz obitelji s dvoje, odnosno, troje djece. BMI (kg/m^2) je poravnan prema referentnoj populaciji SAD-a (NCHS) putem LMS parametara. Prevalencija prekomjerne težine i pretilosti definirana je prema preporukama *International Obesity Task Force.* Učinak redoslijeda rođenja na BMI testiran je jednosmjernom analizom varijance. Prevalencija pretilosti testirana je Pearsonovim ^{2} testom. Prvo- i drugorođene djevojke iz obitelji s dvoje djece nisu pokazale značajnu razliku u prosječnim standardiziranim vrijednostima BMI. Relativna težina značajno se razlikovala među djevojkama koje dolaze iz obitelji s troje djece, uz pad vrijednosti s redoslijedom rođenja. Prvorođene djevojke imale su 1.5 veći rizik pretilosti u usporedbi s kasnije rođenim djevojkama. Razlike u proporciji pretilih djevojaka među skupinama po redoslijedu rođenja, pokazale su visoku značajnost unutar obitelji koje imaju troje djece.