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Parental weight status, birth weight and depression signs influence on child's z-BMI

Dana Apela[ab], Olga Ļubina[ac], Karīna Agadžanjana[a], Ilze Napituhina[a], Iveta Dzīvīte-Krišāne[ad], Jurgita Gailite[ae], Dace Gardovska[af]

Objectives: Overweight and obesity has become an important worldwide health issue, that is why the risk factors for gaining excess weight are being studied a lot. Big birth weight and parental overweight are known risk factors for childhood overweight. The association between psychological issues and excess weight is bidirectional. Aim of our research was assessing if there was any association between parental weight status, birth weight or signs of depression and the exact value of already overweight child's standardized body mass index (z-BMI). *Study design:* Cross-sectional study. **Materials and Methods:** All 303 respondents included were six to seventeen years old patients of the first weight correction programme in Baltic states. Their first day data were gathered from Children's Clinical University Hospital electronic databases *Andromeda* and *Saule*, as well as from outpatient medical records. Height and weight data were turned into z-BMI. Depression signs had been assessed using Children Depression Inventory (by M. Kovacs, 1992). Parental weight status and child's birth weight had also been documented. **Results:** From all 303 respondents 141 (47%) were boys. Median age 12 (IQR 10-15) years. The median z-BMI was significantly higher in boys than in girls (2.97 (IQR 2.59-3.37) vs. 2.59 (IQR 2.13-2.90), p<0.001). Parental weight status correlated significantly with z-BMI value in boys (r=0.17, p=0.043) and in girls (r=0.18, p=0.026). The correlation became stronger when controlled by birth weight and signs of depression: r=0.87, p=0.005 for boys; r=0.96, p<0.001 for girls. There was no significant correlation between z-BMI and either birth weight or signs of depression. **Conclusions:** The parental excess weight correlated significantly with the z-BMI of their son or daughter. The signs of depression and birth weight had no significant association with z-BMI.

Keywords: children; z-BMI; birth weight; parental weight status; Children Depression Inventory

There are different overweight and obesity definitions for at least five years old children, but the most popular is the WHO definition: overweight is standardized body mass index (z-BMI) above the 1st standard deviation, but obesity – z-BMI above the 2nd standard deviation (WHO, 2017).

Childhood overweight and obesity is not only a paediatric problem. Higher childhood body mass index (BMI) is associated with higher risk of adulthood obesity as well as metabolic syndrome and impairment of glucose metabolism (Petkeviciene et al., 2015).

There are lots of evidence about the risk factors for becoming overweight during childhood: gender (Steur et al., 2011), big birth weight (Pereira-Freire, Lemos, de Sousa, Meneses, & Rondo, 2015; Sacco, de Castro, Euclydes, Souza, & Rondo, 2013; Suchomlinov & Tutkuviene, 2014; Woo Baidal et al., 2016), relationship with parents (Blewitt, Bergmeier, Macdonald, Olsson, & Skouteris, 2016), parental excess weight and education level (Parikka et al., 2015; Smetanina et al., 2015), passive smoking (Steur et al., 2011), the number and gender of siblings (Mosli et al., 2016), breakfast skipping and lower meals frequency (Smetanina et al., 2015). Depression can be the reason as well as the consequences of the excess weight (Russell-Mayhew, McVey, Bardick, & Ireland, 2012). However, the results may be different if the whole study sample consists of overweight children and risk factors for higher z-BMI value are being explored.

The Weight Correction Program that takes place at Children's Clinical University Hospital (CCUH) in Riga is the first such multidisciplinary paediatric weight correction programme in Baltic states. During the period of almost three years about 300 overweight and obese children have entered this programme. We used first day data to explore the characteristics of this population of overweight children and adolescents. The aim of this study was to assess the association between the z-BMI and each of these: birth weight, parental weight status, signs of depression. The probable differences between female and male respondents in these variables were also explored.

Materials and Methods

Statistical analysis

The first day data from 303 at least six years old patients that had entered the CCUH Weight correction programme by 13th June 2017 were gathered and analysed during this retrospective research.

Variables

All the respondents had been weighed and measured by CCUH stuff. The weight and height data were gathered from medical records during this study. The weight and height data were then transformed into the z-BMI by using WHO programme AnthroPlus (WHO, 2013).

[a] Children's Clinical University Hospital, Riga, Latvia, LV-1004
[b] Student of The Residency Section of The Faculty of Continuing Education, Riga Stradiņš University, Riga, LV-1007, Latvia
[c] Student at The Department of Doctoral Studies of Rīga Stradiņš University, Riga, LV-1007, Latvia
[d] Assoc. Prof., The Department of Pediatrics, The Faculty of Medicine, Riga Stradiņš University, Riga, LV-1007, Latvia
[e] Assist., The Department of Pediatrics, The Faculty of Medicine, Riga Stradiņš University, Riga, LV-1007, Latvia
[f] Prof. Dr. Habil. med., Head of The Department of Pediatrics, The Faculty of Medicine, Riga Stradiņš University, Riga, LV-1007, Latvia
Correspondence: Dana Apela, 005972@rsu.edu.lv

The signs of depression were defined as at least 13 points in Children Depression Inventory (CDI by M. Kovacs, 1992). Children's Depression Inventory by Kovacs consists of 27 items. The respondent is asked to choose the most appropriate statement from three provided options on each item. The patient gets 0 – 2 points for each item. Thus, the maximal score of CDI is 54 points. Those who score less than 13 points are considered to have no depression signs, but as soon as the result is 13 points or more, there are significant signs of depression. The more points received, the more severe depression. The main aspects that the CDI targets are (considering previous two weeks): negative mood, physical symptoms (anhedonia, sleep disorders, anorexia), negative self-esteem, the feeling of ineffectiveness, interpersonal problems. Thus, the depression signs were used as a dichotomous variable: 0 = no signs; 1= has signs of depression. The parental weight status was classified into following categories: none of parents with excess weight, only mother overweight, only father overweight, both parents overweight. The birth weight was included in statistical tests as a dichotomous variable: 0 = less than 4 kg; 1 = at least 4 kg.

Statistical analysis

The statistical analysis of data was performed with IBM SPSS Statistics 25.0. The normality of distribution was assessed by Shapiro-Wilk test. Descriptive data were reported as percentages, medians and interquartile ranges (IQR). The Spearman's rho correlation test was used to assess the association between z-BMI and each of the following: birth weight, parental weight status, depression symptoms. Moreover, the nonparametric partial correlation ("IBM Partial rank correlations in SPSS - United States," 2016) was performed with each of the three factors, while controlling for the rest two factors. All the correlation tests were carried out for each gender separately. Nonparametric tests – Chi square test, Mann-Whitney test – were used to compare the female and male data. The results with p<0.05 (two-tailed) were considered significant.

Results

The whole sample

303 respondents were included. 141 (47%) were boys. Median age 12 (IQR 10-15) years. Median z-BMI 2.75 (IQR 2.30-3.23) units. Most of the respondents – 260 (86%) – were obese, but the rest – overweight. The frequency of every considered risk factor among all respondents is shown in the Table 1.

Table 1. The frequency of every considered risk factor among all respondents, as well as among each gender group separately.

		All	Boys	Girls
Parental weight		300[a]	139[a]	161[a]
	No parents overweight	93 (31%)	43 (31%)	50 (31%)
	Only mother overweight	60 (20%)	25 (18%)	35 (22%)
	Only father overweight	63 (21%)	29 (21%)	34 (21%)
	Both parents overweight	84 (28%)	42 (30%)	42 (26%)
Birth weight		292[a]	136[a]	156[a]
	< 4 kg	219 (75%)	88 (65%)	131 (84%)
	≥ 4 kg	73 (25%)	48 (35%)	25 (16%)
Signs of depression[b]		162[a]	70[a]	92[a]
	Absent[c]	109 (67%)	51 (73%)	58 (63%)
	Present[d]	53 (33%)	19 (27%)	34 (37%)

[a] – number of respondents that had the data about the relevant risk factor available
[b] – according to CDI (Children Depression Inventory) score
[c] – less than 13 points
[d] – at least 13 points

Boys

The median age of boys was 12 (IQR 10-14) years. The median z-BMI was 2.97 (IQR 2.59-3.37). Almost all (141; 93%) were obese, but only 10 (7%) boys were overweight on the first day of their participation in Weight Correction Program. The frequency of every considered risk factor among all boys is shown in the Table 1.

The results of correlation tests are shown in the Table 2. The correlation between the parental weight status and child's z-BMI stays significant even while controlling by signs of depression and birth weight. Moreover, this correlation becomes much stronger when controlled by depression sign groups and birth weight.

Table 2. The correlations between z-BMI and each of the three factors in boys.

	Spearman's rho		Partial correlation - controlled by the rest two factors	
		z-BMI		z-BMI
Parental excess weight	Correlation Coefficient	0.17	Correlation Coefficient	0.87
	Sig. (2-tailed)	0.043	Sig. (2-tailed)	0.005
	N	139	df	6
Signs of depression	Correlation Coefficient	0.21	Correlation Coefficient	0.25
	Sig. (2-tailed)	0.086	Sig. (2-tailed)	0.545
	N	70	df	6
Birth weight	Correlation Coefficient	0.083	Correlation Coefficient	0.147
	Sig. (2-tailed)	0.335	Sig. (2-tailed)	0.729
	N	136	df	6

z-BMI – standardized value of body mass index

Girls

The median age of girls was 12 (IQR 10-15) years. The median z-BMI was 2.59 (IQR 2.13-2.90). There were 129 (80%) girls with obesity. The frequency of every considered risk factor among all girls is shown in the Table 1.

The results of correlation tests are shown in the Table 3. The only significant correlation is found between parental weight status and child's z-BMI. This correlation remains significant and even grows stronger when controlled by the presence of signs of depression and the birth weight class.

Table 3. The correlations between z-BMI and each of the three factors in girls.

	Spearman's rho		Partial correlation - controlled by the rest two factors	
		z-BMI		z-BMI
Parental excess weight	Correlation Coefficient	0.18	Correlation Coefficient	0.96
	Sig. (2-tailed)	0.026	Sig. (2-tailed)	<0.001
	N	161	df	6
Signs of depression	Correlation Coefficient	-0.02	Correlation Coefficient	0.40
	Sig. (2-tailed)	0.841	Sig. (2-tailed)	0.332
	N	92	df	6
Birth weight	Correlation Coefficient	0.058	Correlation Coefficient	-0.232
	Sig. (2-tailed)	0.473	Sig. (2-tailed)	0.580
	N	156	df	6

z-BMI – standardized value of body mass index

Gender differences

There was no difference in age between the two gender groups (p=0.143). The median z-BMI was significantly higher in boys than in girls (p<0.001). The z-BMI is already adjusted by gender and age. Thus, the difference between boys and girls in our study means more severe excess weight in boys than in girls and cannot be explained by physiological gender difference.

There was no significant difference in the distribution among the parental weight status groups between the gender groups (p=0.806). The median values of z-BMI in the parental weight status groups for each gender are shown in

Figure 1. For girls there is a tendency that the maternal excess weight is associated with higher median z-BMI than paternal excess weight, but vice-versa association for boys. Nevertheless, the difference in z-BMI between these two parental groups is not significant either for girls or boys.

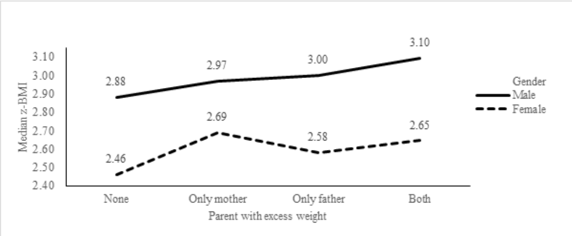

Figure 1. The median child's z-BMI in groups according to parental weight status.

The percentage of respondents with high birth weight was significantly higher in boys than in girls (p<0.001). There was no significant difference in number of respondents with depression signs between girls and boys.

Discussion

The Weight Correction Program at Children's Clinical University Hospital in Riga is the first such paediatric multidisciplinary programme in Baltic states. This is the first survey to assess the characteristics of participants of CCUH Weight Correction Program.

Male respondents had significantly higher z-BMI upon entering the CCUH Weight Correction Program than girls. The possible reason for this could be the parental perception of child's weight. According to Pedroso et al., mothers of boys are more likely to want a larger silhouette for their child, but mothers of girls are more likely to want a thinner silhouette for their daughters (Pedroso, Toral, & Bauermann Gubert, 2018). Nemecek et al. have also noticed that the weight of overweight boys is more often underestimated by parents than the weight of overweight girls (Nemecek, Sebelefsky, Woditschka, & Voitl, 2017). Wang et al. showed that the weight of adolescent boys is more likely to be underestimated by boys themselves and their mothers (Wang et al., 2018). In addition, the weight of girls was more likely to be perceived correctly or even overestimated by girls and their mothers. On the contrary, Gomes et al. correlation results showed that parents of overweight boys were more concerned about the child's weight than parents of overweight girls (Gomes, Barros, & Pereira, 2017). Nevertheless, the gender was not a significant predictor of parental concerns after adjustment by other confounding factors. Moreover, Gomes et al. had included 2 – 6 years old children in their study, but our sample consists of at least six years old children and adolescents.

Both genders had a significant association between their z-BMI and parental excess weight groups. This correlation remained significant and even grew stronger when was controlled by the presence of depression signs and the child's birth weight. Thus, we can confirm the association between the number of overweight parents per family (0, 1 or 2) and child's z-BMI. This finding is consistent with those described by Parikka et al. (Parikka et al., 2015). Njuieyon et al. have described the maternal excess weight as a predictor of metabolically abnormal obesity (Njuieyon et al., 2018). On the other hand, all of our respondents are participants of the Weight Correction Program and their data were gathered on the first day of programme. Thus, we may hypothesize that overweight parents notice their child being overweight later (when the excess weight of the offspring is much more severe) than normal weight parents. Christofaro et al. have proven an analogical hypothesis in their study – overweight parents are about twice as likely to underestimate their offspring's weight (Christofaro et al., 2016). Moreover, this misperception was dose-dependent – the risk of underestimating offspring's weight was higher in families with both parents overweight than in those with only one parent overweight. Though Parikka et al. have showed that the parental education can influence the child's BMI directly or indirectly (Parikka et al., 2015), this predictor has no significant effect in Christofaro's study (Christofaro et al., 2016). Sylvetsky-Meni et al. found that the overweight parents more often than normal weight parents consider providing healthy diet for their children very time- and effort-consuming (Sylvetsky-Meni, Gillepsie, Hardy, & Welsh, 2015).

Our study shows a tendency that the excess weight of the same-gender-parent is associated with higher offspring's z-BMI. But this trend did not reach statistical significance. Fujita at el. have explored the influence of maternal BMI at the beginning of pregnancy and the offspring's BMI – it turns out that the association grows stronger as the years go by; moreover, there is a significant association for girls since their birth, but for boys – only at the age of 13 (Fujita, Kouda, Nakamura, & Iki, 2018).

Lots of publications describe big birth weight (at least 4 kg) as a risk factor for obesity in pre-schoolers (Sacco et al., 2013). There was no significant association found between the birth weight and z-BMI in any gender group in our study. This could be explained by the characteristics of sample. All the included respondents were overweight or even obese. Thus, there were no normal weight respondents included to compare with. So, we cannot contradict higher birth weight being a risk factor for becoming overweight. Our results only show that the exact z-BMI cannot be predicted by the birth weight value. Mitchell et al. described linear connection between child's birth weight and BMI at the age of 6 – 7, but not in adolescence (Mitchell et al., 2018). Most of our sample were adolescents – that could be the reason for no association between the birth weight and z-BMI value in our study. Moreover, we did not include, for example, breastfeeding data in our analysis. Reuter et al., as well as Mitchell et al. proved breastfeeding to be a protective factor against obesity (Mitchell et al., 2018; Reuter et al., 2018). It should be emphasized, that Mitchell at al. used offspring's BMI, but we used z-BMI – this methodological difference may be the main reason for inconsistent findings.

The signs of depression also did not show significant association with z-BMI either in boys, or girls in this study. So, in this sample it does not matter how much excess weight one has for the depression signs to occur. The prevalence of signs of depression in our sample is slightly higher than in the sample described by Moharei et al. (Moharei, Noroozíasl, Behdani, & Ghaemi, 2018). They also found a significantly higher prevalence of depression among overweight girls than boys, but there was no such a difference in our study. Nevertheless, it is not easy to compare our results with the Moharei's because they have not described the mean z-BMI of their overweight group, moreover there is not even a precise CDI score cut-off value mentioned in the article. Pirgon et al. have used the mean scores of CDI, not a specific cut-off values (Pirgon, Sandal, Gokcen, Bilgin, & Dundar, 2015). Their mean CDI value is slightly higher than ours. This difference may be due to the age – they included only adolescents, but we have younger respondents as well. Furthermore, Pirgon et al. included only obese participants, but there are some non-obese overweight respondents in our sample. Esposito et al. have also described higher mean CDI score in a sample of obese prepubertal children than in our sample (Esposito et al., 2014). Moreover, they even found a significant positive relationship between z-BMI and CDI score. Nevertheless, it is not clear from the article if the data of whole sample or only the group of obese respondents were included in correlation analysis.

Limitations

Because of the retrospective design we had to use already documented data. Unfortunately, some patients had missing data. We had no access to the variables describing socioeconomic status of each family. The birth order and number of siblings were not available as well. Parental weight was used as a dichotomous variable – is overweight or is not overweight. If we had information about every parent's exact BMI, maybe we could explore better the gender differences of the association between child's z-BMI and parental weight.

The fat free mass index (FFMI) and fat mass index (FMI) are considered to be better markers of excess weight than BMI (Karklina et al., 2011). Because of the study design, we had no access to FFMI or FMI. As the patients of the Weight Correction Program are not usually athletes with high muscle mass, we considered using BMI acceptable. Moreover, we used z-BMI instead of simple BMI to avoid the physiological influence of age upon the anthropometric measurements.

5. Conclusions

We explored the factors influencing z-BMI value in a sample of patients of the first paediatric Weight Correction Program in Baltic states. The parental excess weight correlated significantly with the z-BMI of their son or daughter. The signs of depression and birth weight had no significant association with z-BMI.

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Ethical approval: The investigations were carried out following the rules of the Declaration of Helsinki of 1975 (https://www.wma.net/what-we-do/medical-ethics/declaration-of-helsinki/), revised in 2008. The research was permitted by Children's Clinical University Hospital and approved by the Ethics Committee of Riga Stradiņš University on 30th November 2017. Number of approval pronouncement: 42.

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