

Academic Achievement, School Absence and Self-Concept in Czech Prepubescent Children with Overweight and Obesity

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Abstract Problem. The paper offers findings about selected educational aspects of children's academic performance, examined here in terms of sociodemographic variables, BMI percentile values, cognitive test scores, weight bias internalization scale and self-concept scale with an aim to detect whether and to what extent these factors contribute to children's school results.

Methods. 557 fifth graders were administered *Vana's Intelligence Test*, the *Piers-Harris 2* self-concept questionnaire and other tools. Children's educational aspects were assessed in terms of school *Absence*, *Grade Point Average*, and *Czech* and *Mathematics* grades, with data obtained from their most recent report cards under the Informed consent of their legal representatives and in compliance with ethical standards.

Results. Prepubescent children from stronger socio-economic backgrounds suffer from overweight/obesity less often and perform slightly better at school. The present results suggest a link between weight bias internalization and overweight/obesity, and a somewhat weaker link between self-concept and overweight/obesity in the non-clinical population of prepubescent children. In these relationships of overweight/obese children, as in the cases of alarmingly high school absence, gender is an important variable. Multinomial logistic regression modelling the relationship between *Czech* and *Mathematics* grades and selected factors discovered that chances for a worse grade were significantly reduced by the results of *Vana's Intelligence Test* in both the subjects, while the *Self-concept* total score proved to be an insignificant factor. Conversely, pupils' *Czech* grades were negatively influenced by increased BMI (quartile), higher *Absence* rate, male *Gender*, *Presence*

of *only one parent* in the family and WBI, while in *Mathematics*, in addition to the above-discussed, significant regressors only included *Absence* and *Presence of only one parent*.

Discussions. The results of the *Self-concept total score*, the level of which is generally lower in girls than in boys in the population of Czech prepubescent children, agree with other authors' experience. The connection between the male sex and poorer performance in *Czech* can be partly explained by the fact that the development of speech, reading, writing and grammar is generally less complicated for school-age girls than boys. We can ask why a higher BMI quartile increases the chances of a worse grade only in the case of *Czech language*? So far, we can only speculate about the causes. In our opinion, it is possible that the impact of parents' education on the performance of children of this age is more pronounced in the *Czech language* (compared to *Mathematics*). The other possibility of the impact of the *BMI quartile* on the *Czech* grade is the significant predominance of boys in the o/o group. On the other hand, it should be noted that this argument would not explain the o/o children's poorer *Grade Point Average* score. However, we believe that the above reasons answer partially this question.

Conclusion. The vulnerability of o/o girls is pronounced in some domains of *Self-concept* and *Weight bias internalization*, while in boys it is reflected in the more frequent occurrence of high levels of *Absenteeism*, with the precise causes of this being still subject to speculation. In this regard, workers in the cooperating professions should pay continuous attention to strengthening the desirable aspects of education and healthy lifestyle among vulnerable groups of children. Educational aspects of overweight/obese children should therefore continue to receive increased attention.

Key words academic achievement, overweight/obesity, prepubescence, self-concept, weight bias internalization.

Introduction

The prevalence of overweight and obesity in Czech children has seen an upward trend in recent decades (Hamřík et al., 2017). The adverse effects of these phenomena on children's health and psychosocial relationships (Marinov et al., 2012) led to the implementation of remedial projects and programmes coordinated by the WHO in cooperation with the Ministry of Health of the Czech Republic (hereinafter "MH CZ") and the Ministry of Education, Youth and Sport CZ, such as the 2018 Health Behaviour in School-aged Children study (hereinafter "HBSC 2018"), (MH CZ, 2020), or Health Promoting Schools (hereinafter "HPS") (Nejedlá et al., 2015), etc.

When a school is involved in the HPS programme, all its activities (including the nature and focus of teaching or impact of assessment) are planned in terms of their consequences which may either promote or threaten health. For this reason, we became interested in studies conducted abroad that draw attention to the specifics of academic achievement (Datar & Sturm, 2006), cognitive skills (Black et al., 2015), and self-concept in overweight/obese children (Hill, 2017). Their findings are rather heterogenous, and opinions differ, for instance, when it comes to the impact of certain sociocultural conditions or the socio-economic status of the family on the overweight/obese child's school results (Black et al., 2015). Our study aims to contribute to this discussion with findings from a country with a socialist past.

Overweight and obesity can lead to more or less serious kinds of health problems already in prepubescence. These health problems then negatively affect various skills or performances (Marinov et al., 2012), and are also associated with particular neurocognitive outcomes. Miller et al. (2015) confirmed these in executive functions such as inhibitory control and working memory, and in other cognitive functions that are important for academic success. Recent findings have shown that obesity biomarkers like adipokines or inflammatory cytokines are associated with learning, attention, and other cognitive functions (Gallotta et al., 2015). As for academic outcomes, similar conclusions were reached by Ryabov (2018), who found that higher weight status in childhood is directly associated with lower academic performance in young adulthood.

Given the focus of the present study, it is also important to point out here that deviations from the socio-cultural appearance standards can inhibit success in the social and performance areas for several reasons (Marinov et al., 2012). In recent decades, there has been an ongoing professional debate on the self-concept of children with o/o. Poorer self-esteem can be observed as early as in five-year-old obese girls (Fraňková, 2006). Sarkar et al. (2010) found that low self-concept has serious consequences especially for overweight adolescent girls. For boys, obesity is either criticized or associated with strength by their male peers.

Some studies provide evidence of overall self-concept impairment (Latzler & Stein, 2013), while other have found more pronounced problems only in some of its domains or only in overweight/obese clinical patients (Schwartz & Brownell, 2004), or discovered the same or normal self-concept levels between children with and without obesity

(Wadden et al., 1984). Hill (2017) even postulates the “myth of psychological maladjustment” in the given part of the population.

Our research addresses the question of whether and to what extent higher body mass index (i.e. overweight, obesity) contributes to academic performance (including school absence), and how cognitive abilities, weight bias internalization (WBI) and children’s self-concept contribute to these relationships.

The formulation of the research goal was preceded by the study of both the aforementioned quantitative and other, qualitative studies (Kenney et al., 2017).

Material and Methods

Sociodemographic indicators were selected based on studies of the characteristics of Czech population with overweight/obesity (Kobzová et al., 2003) and on foreign studies of academic achievement and self-concept in overweight/obese children (Datar & Sturm, 2006; Black et al., 2015).

Children’s academic performance was assessed according to their *Grade Point Average*, grades from *Czech, Mathematics* and *Behaviour*, and the number of *Absences*. These data were obtained from the children’s most recent report cards under the parents’ Informed consent and while adhering to the ethical principles and the principle of anonymity.

Vana’s Intelligence Test was created at the turn of the 1920s and 1930s and is intended for prepubescent children (Svoboda et al., 2015).

Since the norms of *Vana’s Intelligence Test* emerged in 1975 (Svoboda et al., 2015) are no longer suitable today, individual subtest gross scores were converted to intelligence quotient (hereinafter “IQ”) scores following norms generated ad hoc from the results. During non-linear transformation, the gross scores were converted to percentiles and then to z-scores using quantiles of normal distribution. Subsequently, gender and age factors were removed from the results so as not to over-assess older children, or boys or girls, depending on the subtest. The individual subtest scores were summed within the same weights into a total IQ with a mean of 100 and a standard deviation of 15.

The Czech version of the *Piers-Harris Children’s Self-Concept Scale* (Obereignerů et al., 2015) is intended for children and adolescents from 9 to 18 years old.

In the original (American) *Piers-Harris Children’s Self-Concept Scale* version (Piers & Herzberg, 2002), the gross scores of the individual scales are converted to normalized t-scores: the gross scores, which are strongly negatively skewed, are converted to t-scores with normal distribution by means of non-linear transformation. This step was most likely omitted in the Czech version, where the t-scores still show a negative skew. Dostál therefore applied the same procedure as in the case of the *Vana’s Intelligence Test* for the conversion of the gross scores into t-scores, with the mean of the resulting scores set to 50 and the standard deviation to 10.

The *WBI scale* was compiled from selected *Piers-Harris Children’s Self-Concept Scale* statements. Each respondent received a point for answering “yes” in the following items: “My looks bother me”, “I give up easily”, “I am dumb about most things”, and for answer-

ing “No” in: “I like being the way I am”, and “I am good-looking”. We were inspired to include the *WBI scale* by the authors Zuba and Warschburger (2017), who found that *WBI* mediates the relationship between *BMI* and psychosocial problems, such as eating and emotional problems, or behavioural issues.

Data and Respondents

The study deals with “common child overweight/obesity” (Marinov et al., 2012) in 5th-grade primary school pupils in the Zlín Region, CZ. The schools were drawn mechanically via simple random sampling. Special and otherwise exceptional classes/schools were not included. The research was conducted at 13 primary schools in the region, with one school visited twice – during the 2017/18 school year (two fifth grades), and in September of the 2018/19 school year (two other fifth grades). Most of the schools were involved in the Health Promoting Schools project (Nejedlá et al., 2015), and we also gained cooperation with many primary schools thanks to the support of MUDr. Marie Nejedlá, head of the Public Health Promotion Centre of the National Institute of Public Health in Prague. The research concerned urban population (about 75,000 inhabitants), and the preliminary study was carried out in two primary schools in municipalities with up to 5,000 inhabitants. The Zlín Region is considered as a location with a relatively healthy economy with a high proportion of small and medium-sized enterprises. There is a strong emphasis on a healthy environment and plenty of greenery in the cities, which contributes to the positive atmosphere of the area (<https://www.kr-zlinsky.cz/hospodarstvi-zlinskeho-kraje-cl-164.html>).

A sample of 557 children was obtained ($n = 557$; 269 boys, i.e. 48 %) with the age of the respondents defined as follows: $M = 11.26$, $SD = 0.45$, $Min = 10.08$, $Max = 12.17$.

All respondents’ body parameters were taken by a single expert with the use of the same devices (Zemková, 2016). The underrepresented groups were integrated in 4 broader categories: low weight (65 children with BMI percentile 1–9), normal weight – below also abbreviated as “nor” (319 children with BMI percentile 10–75), robust to overweight (84 children with BMI percentile 76–89), and overweight to obese – below also abbreviated as “o/o” (89 children with BMI percentile 90–99). The results of o/o children are predominantly described as in common, i.e. as one and not as two sets in the following text.

Data Processing

Methods for examining the relationships between *weight bands (categories)* and *individual sociodemographic variables* were chosen with regard to whether we worked with a nominal variable (where we used the chi-square test), or with a metric variable (where we compared the averages of the given variable within the four weight groups).

We performed the comparisons in psychological tests (i.e. *Vana’s Intelligence Test* and *Piers-Harris Children’s Self-Concept Scale*) simultaneously for all subscales using MANOVA (test statistics were derived from the Wilks Lambda). In addition, we calculated

ANOVA for each test scale, and where statistically significant differences were found, we marked the given group of averages with asterisks.

The relationship between children's academic performance and selected factors was evaluated using multinomial logistic regression.

Results

Relationships between BMI bands and sociodemographic data

The relationships between BMI bands and sociodemographic data were evaluated from the perspective of all four weight categories and were confirmed only for the variables outlined below.

As for *Gender*, the number of overweight or obese boys was found to be almost twice the number of girls in the same weight category ($\chi^2_{(3)} = 10.66$, $p = 0.013 < 0.05$).

A less expected result was an insignificant relationship between *Presence of both parents* in the family and BMI ($\chi^2_{(3)} = 1.24$, $p = 0.75$).

A significant relationship was observed between BMI and *Living Conditions* ($\chi^2_{(3)} = 10.15$, $p = 0.017 < 0.05$), with the most striking difference found in the o/o category – children living in blocks of flats are almost twice as likely to fall in this group.

The results were similar for the relationship between *Parent Education* and BMI – the lower the parents' education, the higher the chance of the child falling in the o/o group; the effect was statistically significant for *Father's Education* ($\chi^2_{(6)} = 12.82$, $p = 0.045 < 0.05$), and at trend level for *Mother's Education* ($\chi^2_{(6)} = 10.86$, $p = 0.091 > 0.05$).

A strong relationship was also observed between BMI and *Eating Habits* ($\chi^2_{(3)} = 15.07$, $p = 0.002 < 0.05$). There is an over 31 % chance of a child using an alternative way of eating (two snacks, lunch at home, etc.) to show a BMI percentile higher than 90. For children who eat in the school canteen, the probability is only less than 14 %.

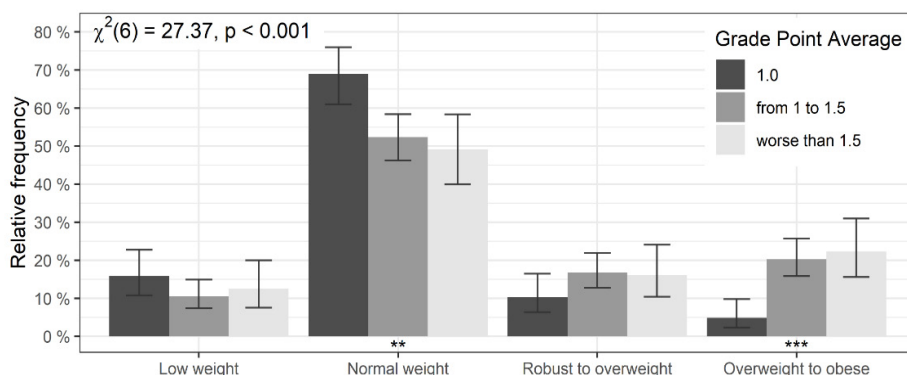
Relationships between BMI bands and various educational aspects in prepubescent children

As far as *Behaviour* is concerned, it was surprising to note that none of the 557 fifth-grade pupils were assessed below *Excellent* on their most recent report card.

As seen from *Graph 1* depicting the relationships between BMI and *Grade Point Average*, children with excellent average are much less likely to fall in the o/o group.

Graph 1

Relationships between BMI and Grade Point Average in prepubescent children



Two-sample analyses showed that when *Grade Point Average* was only compared in children whose both parents had completed high school education, the differences were less prominent. The comparison between the nor and the o/o children yielded the following ($t_{(118)} = 0.047$, $m_{(nor)} = 1.30$, $m_{(o/o)} = 1.44$). There were no significant differences between boys (subscript “b”) and girls (subscript “g”) with nor ($t_{(286)} = 0.55$, $m_{(b)} = 1.28$, $m_{(g)} = 1.31$) or with o/o ($t_{(82)} = 0.08$, $m_{(b)} = 1.45$, $m_{(g)} = 1.33$).

Significant results were found also for the relationship between *BMI* and *Czech grades* ($\chi^2_{(6)} = 22.62$, $p < 0.001$). Two-sample analyses indicated differences in *Czech grades* between boys and girls with nor ($t_{(314)} = 0.03$, Cohen $d = 0.04$, $m_{(g)} = 1.64$, $m_{(b)} = 1.81$), and similarly between o/o boys and girls ($t_{(86)} = 0.02$, Cohen $d = 0.03$, $m_{(g)} = 1.81$, $m_{(b)} = 2.16$).

As with *Grade Point Average* and *Czech grades*, when adjusted according to parents’ education (i.e. only high-school educated parents’ children were compared), the two weight categories evinced less contrast ($t_{(127)} = 0.04$, $m_{(nor)} = 1.79$, $m_{(o/o)} = 2.09$).

The trend in the relationships between *Mathematics grades* and *BMI* was similar to the cases where the p-value did not exceed the given significance level, here precisely ($\chi^2_{(6)} = 12.14$, $p = 0.06 > 0.05$).

Two-sample comparison of *Mathematics grades* revealed no differences between nor and o/o children ($t_{(401)} = 0.08$, $m_{(o/o)} = 1.73$, $m_{(nor)} = 1.59$), or between boys and girls with nor ($t_{(314)} = 0.25$, $m_{(g)} = 1.63$, $m_{(b)} = 1.53$), or between o/o boys and girls ($t_{(87)} = 0.17$, $m_{(g)} = 1.65$, $m_{(b)} = 1.87$).

The relationships between *BMI* and school *Absence* were more complex. To begin with, it can be stated that there was no significant relationship between *BMI* and the number of missed hours ($\chi^2_{(6)} = 3.18$, $p = 0.788 > 0.05$) in any of the weight categories, and the findings were similar for two-sample comparisons ($t_{(404)} = 0.21$, $m_{(nor)} = 33.43$, $m_{(o/o)} = 38.33$).

However, when we applied the criterion of *Absence over 100 hours*, which corresponds to approximately 4 weeks per term (5 months), o/o boys had significantly higher numbers of absences than boys with normal body weight ($\chi^2_{(0.05)}(1) = 7.14 > 3.841$), and at the same time, the frequency of *Absence over 100 hours* in obese boys almost significantly exceeded the frequency of *Absence over 100 hours* in overweight boys ($\chi^2_{(0.05)}(1) = 3.60 < 3.841$).

In contrast to o/o boys, none of the girls in the same weight category reached the *Absence over 100 hours* level. The mean values of school absences in o/o boys and girls appeared to be the same ($t_{(87)} = 0.08$, $m_{(g)} = 30.1$, $m_{(b)} = 42.9$).

There was no significant difference between boys and girls with nor in terms of *Absence over 100 hours* ($\chi^2_{(0.05)}(1) = 0.918 < 3.841$), but *Absence over 50 hours* was more frequent in boys ($\chi^2_{(0.05)}(1) = 32.8 > 3.841$). However, the mean values of school absence were higher in girls with nor ($t_{(316)} = 0.04$, Cohen $d = 0.06$, $m_{(g)} = 36.5$, $m_{(b)} = 29.3$).

Relationships between results of Vana’s intelligence test and BMI

The test did not find a statistically significant difference across the four weight categories. The comparison of the *Vana’s intelligence test* total scores $F(3, 169.7) = 2.21$, $p = 0.089$ also yielded a negative result, where children with nor reached an insignificantly highest level, followed by children in the robust to overweight category, children with low weight, and o/o children.

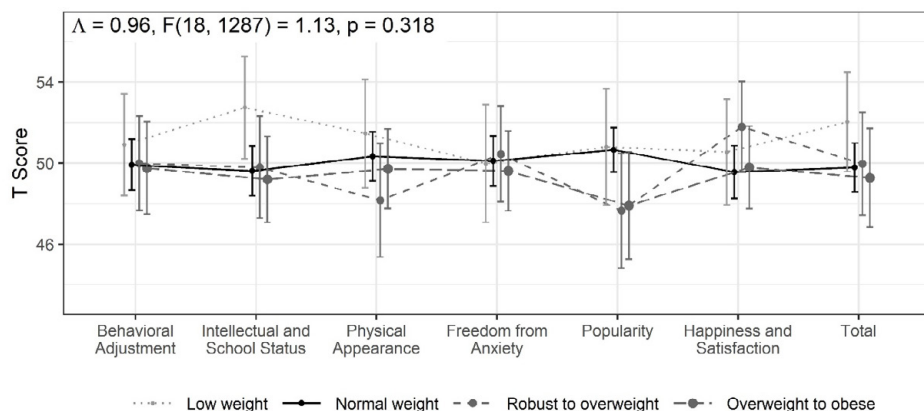
Similarly, no differences were found in two-sample comparisons between weight categories (nor and o/o) ($t_{(407)} = 0.05$, $m_{(nor)} = 73.9$, $m_{(o/o)} = 81$) or genders ($t_{(nor)} = 0.97$, $m_{(b)} = 100.71$, $m_{(g)} = 100.76$, $t_{(o/o)} = 0.71$, $m_{(b)} = 99.87$, $m_{(g)} = 96.82$).

Relationships between BMI weight bands and results of the Self-concept questionnaire

The comparison of individual self-concept domains between children of different weight categories is shown in *Graph 2*. As may be observed, the test did not find a significant difference. The ANOVA of the total scale led to the same result $F(3, 154.1) = 0.31$, $p = 0.816$. The greatest difference is observed in the *Popularity* subscale, where the o/o groups scored lower, however, even there it is not statistically significant $F(3, 147.4) = 2.191$, $p = 0.09$.

Graph 2

Relationships between results of Piers-Harris Children’s Self-Concept Scale and BMI weight bands



When we compared the gross score averages in nor and o/o children, we discovered statistically significant differences in the *Total score* as well as in all the subscales except

for *Behavioural Adjustment*, where the children's results were the same in both weight categories:

Total score ($t_{(389)} = 0.000$, Cohen $d = 0.00034$, $m_{(nor)} = 41.73$, $m_{(n/o)} = 36.87$), *Intellectual and School Status* ($t_{(342)} = 0.004$, Cohen $d = 0.006$, $m_{(n/o)} = 8.89$, $m_{(nor)} = 0.15$), *Physical Appearance and Attributes* ($t_{(331)} = 0.000$, Cohen $d = 0.003$, $m_{(n/o)} = 9.18$, $m_{(nor)} = 11.65$), *Freedom from Anxiety* ($t_{(341)} = 0.000$, Cohen $d = 0.0005$, $m_{(n/o)} = 8.40$, $m_{(nor)} = 9.89$), *Popularity* ($t_{(335)} = 0.000$, Cohen $d = 0.001$, $m_{(n/o)} = 7.17$, $m_{(nor)} = 8.27$), *Happiness and Satisfaction* ($t_{(337)} = 0.002$, Cohen $d = 0.003$, $m_{(n/o)} = 7.13$, $m_{(nor)} = 8.09$).

Statistically significant differences between boys and girls with nor were found only for the *Total score* ($t_{(262)} = 0.04$, Cohen $d = 0.06$, $m_{(g)} = 40.65$, $m_{(b)} = 43.08$).

As for o/o boys and girls, the significant differences were found in the *Intellectual and School Status* ($t_{(75)} = 0.04$, $m_{(g)} = 7.93$, $m_{(b)} = 8.89$, Cohen $d = 0.06$), *Physical Appearance and Attributes* ($t_{(75)} = 0.01$, Cohen $d = 0.02$, $m_{(g)} = 7.51$, $m_{(b)} = 10.18$), and *Freedom from Anxiety* ($t_{(75)} = 0.002$, Cohen $d = 0.003$, $m_{(g)} = 7.36$, $m_{(b)} = 9.1$) scales.

For the *WBI* scale, where (as opposed to the *Physical Appearance and Attributes* subscale) a higher number of points indicated unfavourable self-concept due to body weight, a difference was found between the two weight categories ($t_{(388)} = 0.000$, Cohen $d = 0.0008$; $m_{(n/o)} = 1.5$, $m_{(nor)} = 0.85$). There was a significant difference between o/o boys and girls ($t_{(85)} = 0.031$, Cohen $d = 0.045$, $m_{(g)} = 1.9$, $m_{(b)} = 1.2$), but not between boys and girls with nor ($t_{(300)} = 0.179$).

Relationships between grades and selected variables

Table 1 illustrates the outcomes of multinomial logistic regression (proportional odds model) modelling the relationship between children's *Czech grades* and the given factors. More precisely, we modelled the chance that an individual will receive a higher (i.e., worse) grade. The results indicate a significant impact of all the included regressors except for the *Physical Appearance and Attributes* scale and the *Overall Self-concept scale*.

Table 1

Degree of impact of selected variables on children's Czech grades

	Odds ratio	Lower limit	Upper limit	p-value
BMI (quartile)	1.21	1.04	1.41	.016
Absence (10 to 49 hours)	2.33	1.41	3.85	<.001
Absence (50 or more hours)	2.05	1.17	3.59	.012
WBI (z-score)	1.36	1.12	1.65	.002
Phys. appear. (z-score)	1.02	0.85	1.23	.826
Self-concept (z-score)	0.91	0.75	1.10	.333
IQ (z-score)	0.41	0.33	0.51	<.001
Gender (girl)	0.47	0.32	0.69	<.001
Only one parent	2.45	1.54	3.91	<.001

Note. The 'absence' regressor reference group is 0 to 9 hours. The effect of BMI was calculated using percentiles, and the resulting odds ratios were converted to quartiles in order to increase comprehensibility.

When *BMI* increases by one quartile, the chances of getting a worse grade grow about 20 % higher. Worse performance in the given subject is also associated with a higher degree of *Absence*, however, whether the pupil missed 10 to 49 hours or 50 or more hours makes no difference with the chances being approximately double in both cases. For each *WBI* standard deviation, the chance of getting a worse grade rises by about 40 %, while it decreases by about 60 % for each *IQ* standard deviation. Boys are more than twice likely to obtain a worse grade than girls, while the probability is about 2.45 times greater for children growing up with only one parent as opposed to children from complete families.

Table 2 shows the results of multinomial logistic regression modelling the relationship between *Mathematics grades* and the given factors.

Table 2

Degree of impact of selected variables on children's Mathematics grades

	Odds ratio	Lower limit	Upper limit	p-value
BMI (quartile)	1.15	0.98	1.36	.082
Absence (10 to 49 hours)	2.33	1.35	4.02	<.002
Absence (50 or more hours)	2.01	1.11	3.66	.022
WBI (z-score)	1.16	0.95	1.41	.149
Phys. Appear. (z-score)	1.14	0.94	1.38	.186
Self-concept (z-score)	0.88	0.72	1.07	.196
IQ (z-score)	0.30	0.24	0.39	<.001
Gender (girl)	0.96	0.65	1.44	.859
Only one parent	1.96	1.22	3.15	.005

Note. The 'absence' regressor reference group is 0 to 9 hours. The effect of *BMI* was calculated using percentiles, and the resulting odds ratios were converted to quartiles in order to increase comprehensibility.

Here, there is no significant impact of the *BMI*, *WBI*, *Gender*, *Physical Appearance* subscale and *Overall Self-concept scale* regressors. The degree of *Absence* has a similar impact in *Mathematics* as in *Czech*, that is, the chance of obtaining a worse grade is more than twice as high if the pupil is absent for 10 or more hours. Similarly, the presence of only *One parent* in the household has approximately the same effect. The most striking is the relationship between the *Mathematics* grade and the result of the *Vana's intelligence test* – for every 15 IQ points (i.e. one standard deviation) the chance of getting a worse grade is reduced by 70 %.

Discussion

The connection between family background and children's social behaviour, position or school performance is a known fact (Berk, 2018).

Psychosocial factors, especially in conjunction with particular family or other social group constellations, may play a significant role in the development and maintenance of childhood obesity (Martin et al., 2017), but also in the development of internalized or externalized psychological problems that affect the self-concept of prepubescent chil-

dren (Rohr, 2018; Sobotkova, 2012; Steinberg et al., 2011). Parents' objectivity in assessing their children's weight may vary depending on the child's age (Carnell et al., 2005), but is generally unrelated to parents' education or socioeconomic status. It is also known that parents of overweight children often express concern about their children's future social lives (Towns & D'Auria, 2009; West et al., 2008). Edmunds (2009) interviewed parents of overweight 4–15-year-olds and found that mothers reported experiences of accusatory or belittling communication when consulting with professionals. In contrast, they highly valued relationships with experts who supported the family throughout the therapy.

Blanco et al. (2017) found clinical levels of depression and higher levels of anxiety in mothers of overweight children. These mothers used more maladaptive strategies when dealing with their children than mothers of children with normal weight. The mothers' adverse mental state was related to their child's excess BMI and to more intense expression of emotions and maladaptive strategies on their part (alcohol use, higher frequency of critical comments, etc.).

It is also known that childhood overweight/obesity and the associated physical competence and appearance can lead to resignation to shared (e.g. physical) activities with peers. Many authors report pronounced fluctuations in girls' self-concept in relation to body transformation between the ages of 11 and 12 (Langmeier & Krejčířová, 2006; Thorová, 2015; Orel et al., 2015).

According to Berk (2018), the dimensions of academic achievement, social competence, physical competence, and physical appearance form a substantial part of the overall self-concept of the Euro-American prepubescent population, thus, she lists almost identical dimensions to the *Piers-Harris 2* self-concept questionnaire, while other questionnaires (e.g. Harter, 2012) also list additional domains.

The different self-concept findings of child respondents with o/o in studies have been explained by sociocultural differences, the inclusion of clinical or non-clinical populations with o/o, the use of different self-concept methods, etc.

In the prepubescent period, enduring friendships are formed based on mutual selection in terms of academic performance, interests, sociability (shyness/sociality), popularity, ethnicity, inattention, hyperactivity, aggression, depression, and socioeconomic status (Berk, 2018; Steinberg et al., 2011; Thorová, 2015). Prepubescent peer groups tend to consist of 3 to 9 children of the same age and ethnicity. By the age of 11, many children confirm that they belong to such a group and most of their peer interactions take place within this group (Steinberg et al., 2017). Loneliness, loss of a friend, or peer rejection may predict academic problems, grade retention, truancy, victimization, etc. (Steinberg et al., 2011).

Himmelstein and Puhl (2019) found that adolescents with o/o reported relatively frequent experiences of various forms of victimization. The most common sources of weight-related victimization were peers, followed by friends, family members (in the form of various teasing), and teachers. All adolescents with obesity admitted to a high degree of internalizing preconceptions and experiencing negative emotions in such moments. They also expressed a need for more support from parents in coping with these stressful experiences. Adolescents with o/o felt it was important to learn practical strategies that

would help them respond to bullying at school. Similar experiences of bullying from the perspective of adolescents with obesity are described by Reiter-Purtill and colleagues (2017) or by the Czech authors Balharová and Jurčová (2006).

An alternative view is offered by Hill (2017), who acknowledges that children with o/o (as well as some children with normal weight) may be peer-bullied more often. Some of them eventually begin to bully other children (usually in adolescence). The author takes this as evidence that these bullying victims have retained at least some vestiges of self-respect. According to Hill (2017), only a relatively small proportion of youth with obesity have low self-esteem. He argues that weight loss is only weakly associated with improved self-esteem in studies. A common counter-argument to this view of Hill's is that the transformation of self-concept may be rather complex and may not occur as visibly as is the case with physical appearance.

We now return to socio-demographic characteristics. In agreement with domestic as well as foreign studies (Berk, 2018; Kobzová et al., 2003) the present paper confirms that the characteristics of variables associated with a family's lower socio-economic status are more common in o/o prepubescent children, and at the same time that these children tend to be less successful in terms of certain academic criteria.

Compared to the *HBSC 2018* study (Hamřík et al., 2017; MH CZ, 2020), there was a slightly lower percentage of overweight (about 11 %; *HBSC* 15 %) and obese (about 5 %; *HBSC* 6 %) children in our set of respondents. This may stem from differences in respondent numbers, geographical locations, or the ways of obtaining data on children's physical characteristics, as the latter might have prevented some parents from granting Inform Consent when their children found the idea of being measured and weighed uncomfortable. Data on physical characteristics for the *HBSC 2018* study were obtained based on children's references.

Correspondent with the *HBSC 2018* study is our finding of a significant prevalence of overweight boys over girls in the given age group, which also includes prepubescence.

Sociodemographic data collected for the present research also included the *Presence of both parents* in a common household. The item was formulated in this way during preliminary research steps, where we encountered uncertainty on the part of some children as to whether their parents were married, divorced, etc. However, the analysis did not discover differences for this factor between children in the individual weight categories. Compared to some previous studies (e.g. Kobzová et al., 2003), this is a less usual finding.

As for children's performance in *Czech* and *Mathematics*, multinomial logistic regression revealed that pupils growing up with only *One parent* tend to have worse grades. Similar to *Presence of both parents*, the *Number of siblings* factor did not seem to make a difference across the weight categories, neither did the *Number of siblings sharing a room*. Most children with nor and o/o reported having their own room, with the rest most often sharing with one sibling.

The finding suggesting that lower *Parents' education* heightens the probability of a child suffering from o/o is consistent with existing research in this country and abroad (Berk, 2018; Vignerová et al., 2000).

The results for the *Living Conditions: flat or house* item indicate an overall lower socio-economic status of families with o/o children, which corresponds to other studies from the Czech environment (MH CZ, 2020). The *Presence of a car* in the family was reported by most children regardless of weight category. As far as *Eating Habits* are concerned, the present research shows a connection between o/o and a higher tendency towards alternative ways of eating (other than using the school canteen), which is also reported in other professional texts (Marinov et al., 2012).

According to Vignerová and Bláha (In Pařízková & Lisá, 2007), children with o/o are more likely to skip breakfast, snacks and/or lunch, and rarely eat anything other than main meals. The fact that there are individually different motives towards the need to eat is elaborated by Cakirpaloglu (2012). A dietary pattern that leads to a reduction in unhealthy fats, increased consumption of fruits and vegetables or proper distribution and dosage of food during the day is presented in many publications (Fraňková & Dvořáková-Janů, 2003). Experts also agree on the significance of risk periods for the development of obesity in relation to children's diets – as mentioned, for example, by Hainer and Bendlová (In Hainer et al., 2011).

Children's *Behaviour* outcomes, that is, the fact that all respondents' behaviour and effort at school was graded as *Excellent*, may be explained by the fact that teachers and other pedagogical staff are nowadays resorting to more creative ways of resolving disciplinary problems than lowering a child's grade. Alternatively, this might be the impact of different primary prevention mechanisms being put into effect (Miovský, 2015; Nejedlá et al., 2015).

The possibility of concomitant health (psychosomatic) complications that may occur in overweight/obese children during their school years and thus either directly (e.g. sleep apnoe, asthma, ADHD) or indirectly (e.g. school absence) affect their school performance has been pointed out by Kaestner and Grossman (2009). We believe that our research supports the aforementioned authors' observation.

Regardless of the weight factor, absenteeism in prepubescence is often caused by a combination of actual health problems and occasional avoidance of demanding tasks, other children, or certain teachers. Our research has shown that *Absence over 100 hours* is more common among o/o boys compared to those with nor, and at the same time that it is almost significantly more common in obese boys than in overweight boys. We can only speculate as to the main cause of excessive absenteeism in o/o boys, since the exclusively health-related aspect is called into question by the fact that none of the o/o girls exceeded the 100-hour limit.

Multinomial logistic regression has shown that *Absence of 10 to 49 hours* in one term contributes to the chance of obtaining a worse grade in *Czech* and in *Mathematics*, as does *Absence of 50 or more hours*. It would seem logical to expect that *Absence over 100 hours*, especially if continuous, will have a devastating effect on children's psychosocial or cognitive development in general, or on the development of their relationships with classmates etc. A possible protective effect for adolescent children with extreme obesity has been noted by authors who found that the rate of victimization of these children is the same as that

of children with normal weight, but at the same time that most children with extreme obesity are home-schooled (Reiter-Purtill et al., 2017).

It is without doubt that educational results are related to the level of cognitive abilities, evaluated for the purposes of this research with *Vana's Intelligence Test*, which discovered similar results in children across the given weight categories. Insignificantly highest Overall score of *Vana's Intelligence Test* was achieved by children with nor, which is considered the most favourable for health, followed in descending order by less optimal (according to the health point of view) categories: i.e. robust to overweight – low weight – o/o).

Recent studies (Gallotta et al., 2015; Miller et al., 2015) provide evidence for connections between lower levels of mental performance in o/o children and certain specifics in their mental or physical functions, which may affect their performance at certain times and under certain conditions, e.g. frequent fatigue or drowsiness, less resistance to demanding physical activity, temperature changes, etc. Repeated failure is thought to create vicious circles that lead to unfavourable mental setting for future performance (Marinov et al., 2012). The interaction of socio-cultural factors and cognitive performance seems probable; paradoxically our position in this issue is also supported by the results of a study that rather negates the sociodemographic or socio-cultural influences (Black et al., 2015).

We found *Gender* to be an important variable in terms of children's responses in the *Self-concept questionnaire* and the *WBI scale*. The results of the *Self-concept total score*, the level of which is generally lower in girls than in boys in the population of Czech prepubescent children, agree with other authors' experience (Obereignerů et al., 2015).

As for *Gender* differences among o/o children in the *Intellectual and School Status*, *Physical Appearance and Attributes* and *Freedom from Anxiety* subscales of the *Self-concept questionnaire*, it can be concluded that o/o girls always scored significantly lower than o/o boys, who, in turn, scored significantly lower than nor girls, and, finally, nor girls had insignificantly lower levels than nor boys. We explain the lower values of the Cohen effects in the above comparisons by lower numbers of respondents included in the partial analyses. This way, the results of our research contribute to hypotheses about no or only very weak association between o/o and *Self-concept* or its individual domains (Hill, 2017). At the same time, it cannot be ruled out with certainty that we would come to different conclusions with a larger number of respondents.

The *Physical Appearance and Attributes* subscale is not only related to perceived physical attractiveness, but also includes items such as “I am smart”, “I am popular with boys”, etc. and thereby bears certain resemblance to the *WBI scale* (“My looks bother me”, “I am dumb about most things” etc.). Both tools thus partially pursue a similar goal, but evaluate it differently. We included both scales with an aim to draw a clearer distinction between the impact of the *perception of physical appearance/weight* and the impact of the *broken self-concept of children in different areas of life precisely due to the negatively perceived body weight*.

Therefore, it is perhaps no coincidence that the comparison of the *Physical Appearance and Attributes* and *WBI scales* results revealed less favourable responses in the o/o category, and in terms of gender differences in o/o girls. Using multinomial regression, we

further found that each standard deviation of the *WBI* (similarly to *BMI*) contributes to the chance of obtaining a worse grade from *Czech*, while the *Physical Appearance and Attributes* scale proved to be an insignificant regressor in these relationships. The existence of a subjective perception of one's body weight is also confirmed by *HBSC 2018* results (MH CZ, 2020), where a relatively high percentage of boys and a slightly lower percentage of overweight or obese girls aged 11–15 did not seem aware of having weight problems, while a relatively balanced percentage of boys and girls with nor did. In the same vein, a study by German authors (Meier et al., 2010) found that obese children who perceived their body weight as 'normal' had fewer mental and social problems and used healthier coping strategies.

It comes naturally that children's references to the subjective perception of their weight in the above-mentioned studies may have been influenced by item wording or other methodological peculiarities. Future research could certainly benefit from exploring these relationships further and learning how to deal with them effectively in practice.

Multinomial logistic regression modelling the relationship between *Czech* and *Mathematics* grades and selected factors discovered that chances for a worse grade were significantly reduced by the results of *Vana's Intelligence Test* in both the subjects, while the *Self-concept* total score proved to be an insignificant factor. Conversely, pupils' *Czech* grades were negatively influenced by increased *BMI* (quartile), higher *Absence* rate, male *Gender*, *Presence of only one parent* in the family and *WBI*, while in *Mathematics*, in addition to the above-discussed, significant regressors only included *Absence* and *Presence of only one parent*. The connection between the male sex and poorer performance in *Czech* can be partly explained by the fact that the development of speech, reading, writing and grammar is generally less complicated for school-age girls than boys (Svoboda et al., 2015).

In conclusion, it can be stated that the results of our study are consistent with current similarly focused foreign research which involves prepubescent children and finds lower academic achievement in o/o pupils, as well as evidence of a connection between this phenomenon and children's health and physical condition (Cadenas-Sanchez et al., 2020).

We are aware that there remain some unanswered questions concerning the differences in connection with o/o children's school results. We can ask, for example, why a higher *BMI quartile* increases the chances of a worse grade only in the case of *Czech language*. So far, we can only speculate about the causes. In our opinion, it is possible that the impact of parents' education on the performance of children of this age is more pronounced in the *Czech language* (compared to *Mathematics*). In our opinion, this assumption is also supported by the fact that the performances among children of all weight categories in *Vana's Intelligence Test* were only insignificantly different. The other possibility of the impact of the *BMI quartile* on the *Czech* grade is the significant predominance of boys in the o/o group. On the other hand, it should be noted that this argument would not explain the children's poorer *Grade Point Average* score. However, we believe that the above reasons provide at least part of the answer to this question.

All in all, we presume that if social science professionals learn to deal with the above-mentioned educational aspects of overweight/obese children, it could be another step

towards alleviating the unfavourable sociodemographic characteristics of this part of the population.

Conclusion

Based on the above-described research and references of children with o/o, it is suggested here that families in the given part of the population are disadvantaged (parents' education, living arrangements, diet). The causes may be related to lifestyle characteristics as well as to the continuing stratification of the Czech society after 1989. Equally, it cannot be excluded that some of the lifestyle characteristics observed are a consequence rather than the original cause of disadvantage. For children with o/o, high frequency of alternative way of eating may be particularly threatening.

The research further yielded results which point to a connection between the body weight of a part of Zlín prepubescent children in the o/o band and lower academic achievement in *Czech* and *Grade Point Average* performance, with the same level of cognitive abilities in children of all the weight categories. Boys with obesity were found to have a higher frequency of the highest absenteeism rates over the study period compared to overweight and normal weight ones. The results in the self-concept test reflect the above differences, evident not only with respect to weight but also to gender categories.

As far as research limitations are concerned, we must mention the uneven numbers of respondents in different weight categories, stemming from the difficulty to obtain relevant data – not all schools and/or parents were willing to cooperate in this respect.

Further research in the area should concern educational circumstances (knowledge testing conditions, teachers' attitude towards children with o/o, support for constructive motivation of children with o/o towards learning, etc.).

To conclude, we would like to express our respect to all Czech experts in the field of overweight and obesity in Czech children and adolescents. Many names are listed, though space precludes mentioning each. Acknowledgement is also due to all Czech (and Slovak) psychologists, psychotherapists, and nutritional psychologists, who have made significant contributions both through theoretical studies and practical work in clinical facilities, outpatient clinics and counselling centres, or as educational and school counsellors.

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