



## Exploring the association between body mass index and dental caries in 3–7-year-old children, living in Łódź, Poland

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**ABSTRACT:** Dental caries and childhood obesity are major problems affecting the health of children and preventing these conditions in children have been recognized as public health priorities (Hong et al. 2008; Odgien et al. 2010). The aim of the present study was to analyze the association between age-specific body mass index (BMI-for age) and dental caries in 3- to 7-year-olds. A cross-sectional study was conducted on 729 children from randomly chosen kindergartens and elementary schools in the urban area of Lodz, Poland. Anthropometric measurements were taken and the BMI-for-age was calculated for each child. Dental examinations were performed according to the WHO criteria. The sum of decayed, missing, filled primary/permanent teeth and surfaces – dmft/DMFT and dmft/DMFTS, and caries prevalence were computed. The percentage distribution of the BMI categories in the study group was: 72.7% normal weight, 8.92% underweight, 12.89% overweight and 5.49% obese. Caries prevalence in the primary dentition was significantly lower in underweight children than in those who were of normal weight ( $p=0.004$ ) or were overweight ( $p=0.039$ ). However, controlling for age and gender, no significant association was noted between BMI and caries prevalence in either dentition group. The Kruskal-Wallis test failed to reveal any significant differences in mean dmft across the four BMI groups in the whole population, nor within particular age groups, nor in DMFT in 5- to 7-year-olds. There was no association between BMI and dental caries either in the primary dentition or permanent teeth in the early period after eruption.

**KEY WORDS:** BMI-for age, dental caries, primary teeth, permanent teeth, childhood

## Introduction

Dental caries is a major problem affecting oral health in children all over the world (BSPD and IADPD 2003). Although the occurrence of caries has been observed to decline in developed countries, it remains high. The results of a national epidemiological survey of caries incidence conducted as part of the 2002 and 2012 Monitoring of Oral Health surveys in Poland, showed that 56.2% of children aged 3 and 85.6% of those aged 6 displayed caries-affected dentition (Dybizańska et al. 2003; Strużycka et al. 2014). Similarly, data from the UK National Diet and Nutrition Survey showed that 50% of children aged 3.5–4.5 years displayed obvious decay experience at dentine level (Jeeb et al. 2004). According to 1999–2002 data from the National Health and Nutrition Examination Survey (NHANES) 28% of 2 to 5-year-old children demonstrated a positive caries history in deciduous dentition (Macek and Mithola 2006), and 20.3% of 6–11-year-olds in permanent dentition (Kopycka-Kedzierawski et al. 2008).

Childhood obesity is also regarded as being of epidemic status in many parts of the world, although the proportion of overweight and obese children in populations varies considerably. North America, Europe, and parts of the Western Pacific have the highest proportion of overweight children. Parts of South East Asia and much of sub-Saharan Africa appear to have the lowest prevalence (Wang and Lobstein 2006). Childhood obesity rates are seen to be accelerating rapidly in the USA and in most European countries (International Obesity Task Force EU Platform Briefing Paper 2005). A decrease in physical activity and changes in dietary habits such as the increased consump-

tion of high-fat-food and refined carbohydrates are mentioned as initial factors for the rise in obesity (Diez 2001). In the USA, the percentage of 6- to 11-year-old children who are overweight (i.e. with BMI greater than the 95<sup>th</sup> percentile), has more than doubled – from 6.5% to 15.8% (Wilershausen et al. 2007), and in 2007–2008 almost 17% of children and adolescents aged 2–19 years were obese (Odgien et al. 2010).

A similar picture can be seen in Europe, where the estimates of the International Obesity Task Force (IOTF) – prepared for WHO show one in five children are overweight. An additional 400,000 children each year are becoming overweight, adding to the 14 million who are already overweight, including at least 3 million who are obese (International Obesity Task Force EU Platform Briefing Paper 2005). A study on Polish 3- to 6-year-old children from the Rzeszow region showed that 9.1% of girls and 9.9% of boys were overweight, diagnosed according to IOTF criteria, and the prevalence of obesity was 7.2% and 8.4%, respectively (Mazur et al. 2008). While the newest data concerning children aged 2–19 years, from nine countries (Australia, China, England, France, Netherlands, New Zealand, Sweden, Switzerland and USA), indicates a possible plateauing, the number of overweight and obese children is still unacceptably high, with significant consequences for health and well-being of those children (Olds et al. 2011). Excessive weight gain during early childhood increases the risk of obesity in later life and may contribute to many medical complications in adulthood, especially to coronary heart disease, hypertension, and type 2 diabetes (Jeeb et al. 2004; Ericson 2003). Also, overweight adolescents may experience health con-

sequences – such as glucose intolerance, early maturation or orthopedic problems (Dietz 1998).

However, malnutrition in children, which sits on the opposite extreme on the spectrum of adiposity, has also become a large public problem internationally (Cole et al. 2007). Malnutrition has been shown to be related to the risk of subsequent child mortality (mainly in children under 5 years) in developing countries – such as region of Sub-Saharan Africa as well as East, Pacific, and South Asia, while the lowest rate of child malnutrition is found in Europe (El-Ghannam 2003).

Some environmental risk factors, such as dietary habits and lifestyle seem to be shared by dental caries and deviation from normal BMI (Wang and Lobstein 2006). In particular, choosing foods high in carbohydrates seems to be causative for obesity, as well as for dental caries (Malic et al. 2006). However, when data from industrialised nations is analysed separately, no strong relationship can be seen between the amount of sugar consumed and caries occurrence (Woodward and Walker 1994). Even though Cinar et al. (2011) confirmed that obesity and dental caries share common lifestyle factors among adolescents, they found no associations between those two conditions. Evidence for an association between dental caries and deviation from normal BMI are equivocal, and some of those studies explore only the association between dental caries and excessive weight. In a systematic review investigating the association between BMI and dental caries, Hooley et al. (2012) showed that there is still significant disagreement – 49% of studies reviewed found no association between dental caries and BMI; 35% found a positive

association and 19% found an inverse association. Additionally, the review underlined that underweight children were significantly under-represented, what can be problematic for two reasons. First to assess the association between BMI and dental caries adequately, it should be tested across the full range of BMI scores, and second, if underweight children are not excluded but absorbed within the normal-weight group it may have influence potential differences in rates of caries between normal-weight and overweight groups. Paediatric dentists should be aware of the factors influencing the prevalence and severity of dental caries, as well as of potential links between oral health and general health, to be able to provide effective guidance to patients and their families. Variables as weight and height should be included, as part of routine dental history taking and examination, as these might be indicators of current child behaviours and short-or long-term risk for other chronic diseases. Appropriate interventions (including patient motivation to improve dietary habits) may not only reduce the risk of dental caries, but also alter the risk for childhood obesity or future disease (D’Mello et al. 2011).

The aim of the study was therefore to assess the relationship between BMI-for-age and caries in the primary and permanent dentition of 3- to 7-year-old children.

## Materials and methods

### Sample population

The study population consisted of 729 children (45.54% were boys and 54.46% girls), aged from 3- to 7-years (mean age

6.06  $\pm$  1.3); from randomly chosen public kindergartens and elementary schools in Lodz: the third-largest city in Poland, located in the central part of the country. Two kindergartens and 2 elementary schools were drawn from each of the 5 districts of Lodz. The inclusion criteria were as follows: the child being aged between 3- and 7-years-old, being generally healthy (without systemic diseases), informed written consent given by parents or guardians. Children who were absent from kindergarten or school on the day of dental examination or anthropometric measurements were excluded from the study. The chronological age of each child was calculated as the difference between examination date and birth date and expressed in the decimal system with an accuracy of 0.01 years. All children were Polish, and the group was homogenous with regard to race, Caucasian, and ethnicity. The study was performed with the consent of the Ethical Committee of the Medical University of Łódź. (No RNN/63/08/ KE).

### Dental examination

The clinical examinations were performed between 2009 and 2010, by pediatric dentists in a classroom setting with a standard dental mirror and blunt probe, under artificial light. The teeth were not routinely clean prior to the examination. However, if felt necessary, teeth were cleaned from plaque or dried with cotton rolls. When in doubt, a dental probe was used for plaque removal and careful examination of the surface. Deciduous and permanent dentition was clinically examined for caries, and caries diagnosis was based on the WHO recommendation (Oral Health Surveys. Basic Methods. WHO Geneva 1997). The caries intensity

in primary and permanent dentition, i.e. the sum of decayed, missing, filled primary/permanent teeth (dmft and DMFT, respectively) and surfaces (dmfts and DMFTS, respectively), as well as caries prevalence i.e. the proportion of children with positive dental caries history – dmft greater than 0 for primary dentition in 3-to 7-year-olds, and DMFT greater than 0 for permanent dentition in 5–7-year-olds were calculated (Macek and Mitola 2006).

### Anthropological measurements

Anthropometric measurements were performed by anthropologists using a standardized procedure, on lightly dressed children without shoes. Body height was measured in centimeters with the use of an anthropometer with a precision of 1mm, body mass was measured in kilos with the use of a medical scale with a precision of 100 g. The Body Mass Index (BMI) was calculated for each child according to the following formula:  $BMI = \text{body mass (kg)} / \text{height}^2 \text{ (m)}$ . The prevalence of particular BMI categories (underweight, overweight and obese children) according to the International Obesity Taskforce (IOTF) definition (Cole et al. 2007) was determined with the use of LMS Growth software (Pan and Cole 2011). The boundary BMI values for overweight and obese children stipulated by the IOTF based on centile curves of Body Mass Index depending on age and sex was established by Cole et al. (2007). These are numerically different from adult BMI cut-offs at 18 years of age, but divide children into categories corresponding to those used for adults. The cut-offs at 18 years and the corresponding categories are as follows: underweight (<18.5); normal weight (be-

tween 18.5 and <25); overweight (25 to <30); obesity ( $\geq 30$ ).

### Statistical evaluation

Statistically significant differences between the frequencies of each IOTF category in the groups were determined with the Chi-Square test and Yates-corrected Chi-Square test. As the distribution was not normal, the differences in caries intensity (dmft, dmfts) were tested with the Kruskal-Wallis ANOVA. Multiple logistic regression was used to examine BMI-for age as a predictor of dental caries. Controlling for age and gender, odds ratios (OR) and their 95% confidence intervals (CI) were calculated. The differences were considered significant if  $P < 0.05$ . All statistical analyses were performed with Statistica 10 for Windows.

### Results

The percentage distribution according to the BMI categories in whole study group was as follows: 72.7% normal weight, 8.92% underweight, 12.89% overweight and 5.49% obese. In total, 27.3% of children had BMI values that deviated from normal levels. Table 1 presents the number and percentage of children aged 3- to 7-years according to BMI categories and gender. No statistically significant differ-

ences were observed in the percentage of girls and boys within any particular BMI category. Figure 1 presents the percentage of children aged 3- to 7-years according to BMI category and to children age. The highest percentage of overweight and obese children was observed in 7-year-old children (16.97%), and those of underweight in 5-year-olds (16.28%).

Caries prevalence was high in examined children (Table 2). The overall prevalence of dental caries in primary and permanent teeth was 71.6% and 23.9%, respectively. Underweight children had the highest proportion of healthy dentition (38.8%). The analysis of caries prevalence in primary dentition revealed significant differences between underweight children and children with normal weight ( $p=0.004$ ), similarly, the percentage of children with dmft  $>0$  was lower in the group of underweight children than the group of overweight children ( $p=0.039$ ). However, when groups with overweight and obese children were combined, the differences in caries frequency between underweight children and those with a BMI above the norm were not significant ( $72.0 \pm 2.0$  vs.  $75.2 \pm 3.7$ ,  $p > 0.05$ ). Even though the percentage of overweight children affected with caries was the highest numerically, no significant differences in caries prevalence in primary dentition was found

Table 1. Number and percentage of children aged 3-to 7-years according to BMI categories (calculated using the cut-off points recommended by International Obesity Task Force) and gender

BMI categories IOTF	Boys	Girls	Pooled
	N (%)	N (%)	N (%)
Underweight	25 (7.53)	40 (10.08)	65 (8.92)
Normal weight	235 (70.78)	295 (74.31)	530 (72.7)
Overweight	50 (15.06)	44 (11.08)	94 (12.89)
Obesity	22 (6.63)	18 (4.53)	40 (5.49)
Pooled	332 (100)	397 (100)	729 (100)

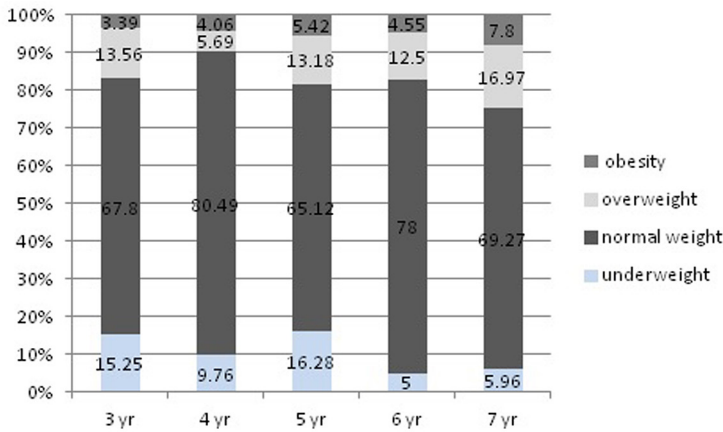


Fig. 1. Percentage of children aged 3 to 7-year according to BMI categories (calculated using the IOTF cut-off points) and age. Age classes were defined as follows: 3 year old (3.0–3.9 years), 4 year old (4.0–4.99 years) and 5 year old (5.0–5.99 years), 6 year old (6.0–6.99 years), 7 year old (7.0–7.99 years).

Table 2. Caries prevalence in examined children according to BMI categories and dentition type (primary/permanent)

BMI categories IOTF	Primary dentition (3–7-year-old children, N= 729)	Permanent dentition (5–7-year-old children, N=420)
	dmft>0	DMFT>0
	% ± SD	% ± SD
Underweight	61.2±6.0 <sup>1,2</sup>	11.5±6.3
Normal weight	72.0±2.0 <sup>1</sup>	24.3±2.5
Overweight	76.3±4.4 <sup>2</sup>	29.7±5.7
Obesity	72.5±7.0	20.0±7.3
Pooled	71.6±1.7	23.9±2.1

Chi squared test

<sup>1</sup>Significant differences between underweight children and children with normal weight,  $p=0.0404$

<sup>2</sup>Significant differences between underweight and overweight children,  $p=0.0391$

Table 3. Odds ratio (OR) of having dental caries among 3-to7-yr-old children, by selected characteristics (BMI categories) and dentition type

BMI categories IOTF	Primary dentition (3–7- year-old children, N=729)		Permanent dentition (5–7-year-old children, N=420)	
	dmft>0		DMFT>0	
	OR (95% CI)*	<i>p</i> -value	OR (95% CI)*	<i>p</i> -value
Underweight	0.80 (0.46–1.40)	NS	0.42 (0.12–1.51)	NS
Overweight	1.06 (0.62–1.83)	NS	1.26 (0.67–1.35)	NS
Obesity	0.82 (0.38–1.77)	NS	1.16 (0.72–1.87)	NS
Normal weight	1.0 Ref.		1.0 Ref.	

\*Controlling for age and gender, OR – odds ratio, CI – confidence interval

Table 4. Caries intensity in primary dentition (dmft) in examined children according to BMI categories and dentition type (primary/permanent)

BMI categories IOTF	dmft Mean±SD					Pooled 3-7 yr N=729
	3 yr N=59	4 yr N=124	5 yr N=129	6 yr N=198	7 yr N=218	
Underweight	1.0±1.0	1.25±2.3	4.24±3.87	3.5±3.03	3.92±3.93	3.06±3.4
Normal weight	1.61±2.88	1.93±2.98	4.21±3.87	4.26±3.31	4.2±2.94	3.59±3.33
Overweight	0	4.71±4.96	2.7±2.84	3.56±2.81	4.03±2.89	3.49±2.94
Obesity	5.5±7.77	1.8±1.79	2.86±2.41	3.44±3.47	3.0±2.74	3.05±3.2
Total	1.43±2.76	2.02±3.0	3.95±3.71	4.1±3.24	4.09±2.92	3.54±3.26

Kruskal-Wallis Anova  $p>0.05$  (for all comparisons across four BMI categories in whole group and in particular age groups).

Table 5. Caries intensity of primary dentition calculated per tooth surface (dmfts) in examined children according to BMI categories

BMI categories IOTF	dmfs Mean±SD					Pooled 3-7 yr N=729
	3 yr N=59	4 yr N=124	5 yr N=129	6 yr N=200	7 yr N=218	
Underweight	1.22±1.39	1.83±1.65	7.14±8.77	6.6±6.39	8.84±9.01	5.6±7.4
Normal weight	2.13±2.16	2.7±4.56	6.19±6.42	6.41±6.34	8.26±8.28	6.0±7.21
Overweight	0	6.14±6.59	3.41±3.97	6.16±9.76	7.73±7.91	5.65±6.97
Obesity	7.5±10.6	2.0±2.0	3.43±3.26	4.89±5.35	5.64±5.85	4.72±5.67
Total	1.88±4.67	2.78±4.5	5.83±6.56	6.32±7.08	7.93±8.11	5.85±7.11

Kruskal-Wallis Anova statistically non significant (for all comparisons across four BMI in whole group and in particular age groups).

Table 6. Caries intensity of permanent dentition calculated per tooth (DMFT) and per tooth surface (DMFSTS) in examined children according to BMI categories

BMI categories IOTF	Permanent dentition (5-7 year old children)	
	DMFT	DMFSTS
	Mean±SD	Mean±SD
Underweight	0.3±0.9	0.5±1.1
Normal weight	0.5±1.1	0.5±1.1
Overweight	0.6±1.1	0.6±1.1
Obesity	0.5±1.1	0.5±1.1
Total	0.5±1.1	0.5±1.1

between overweight children and those with normal weight, or between obese children and others (Table 2). Also the prevalence of caries in permanent dentition in 5-7-year-olds was not associated with any of the three categories of BMI ( $p>0.05$ ) (Table 2). Controlling for age and gender, multiple logistic regression models also showed that no statistically significant association was present between BMI-for-age and dental caries for either the primary or permanent dentitions (Table 3).

The Kruskal-Wallis test revealed no significant differences in caries intensity score for deciduous teeth (dmft and dmfts values) between four BMI groups in whole 3- to 7-year-old population, as well as in particular age groups (Tables 4, 5). Neither did the Kruskal-Wallis test reveal any significant differences in mean DMFT or DMFTS scores for permanent teeth across the four BMI groups in 5- to 7-year-olds (Table 6).

## Discussion

The findings show that in Polish children, as in other countries, there is the higher proportion of overweight and obese than underweight children (Lazzeri 2008; Rolland-Cachera 2002; Wang 2002). The percentage of children with BMI values below normal was higher than seen in a USA study, 4.2% of 2- to 6-year-olds (Hong et al. 2008). The percentage of underweight 7-year-old children (6%) was comparable with that of French children according to Must and the Center for Disease Control 2000 references (Rolland-Cachera 2002). In contrast the percentage of overweight and obese children together was lower than observed in the USA –22% vs. 18.38% (Hong et al. 2008), as well as overweight and obese 2- to 6-year-old Italian children: 16.6% and 8 % respectively (Maffei et al. 2006). However, the frequency of overweight was lower in German preschool children, 7.2%, (Kuepper-Nybelen et al. 2005), but similar in French children, 10.5% (Olds et al. 2011).

However, the observed differences in proportion of underweight, overweight and obese children between Polish children and reference populations can be due to the choice of cut-offs, the date of collection of the data on BMI, the coun-

try of origin and the study design. Different measures and criteria for defining obesity have been used across countries, with varying cut off points for overweight and obesity: the WHO reference, uses the 85th percentile of BMI to define overweight adolescents (10- to 19-year-old) and weight-for-height Z-scores for overweight children under 10; the USA reference, BMI 85th and 95th percentiles are used to classify overweight and obesity, respectively; 110% or 120% of ideal weight for height, and the Center for Disease Control 2000 references to define thinness, being overweight and obesity (5th, 85th and 95th percentiles respectively) (Wang and Lobstein 2006; Rolland-Cachera et al. 2002; Wang and Wang 2002). Recently the Childhood Obesity Working group of the International Obesity Task Force (IOTF) proposed a new international BMI reference to define overweight and obese children and adolescents aged 2 to 18 years. The IOTF classification uses age- and gender-specific BMI cut-off points for children based on BMI percentile curves (derived from large-scale surveys on childhood BMI from six countries, including Brazil, Britain, Hong Kong, The Netherlands, Singapore and the USA, which pass through the cut-off points of BMI 25 (overweight) and 30 (obesity) at age 18 (Cole et al. 2000; Cole et al. 2007). This approach has been recommended by the International Obesity Task Force (IOTF) for the comparison of child populations (Lobstein and Frelut 2003).

Testing the association between the lowered body weight and dental caries has been given less attention in literature comparing to the association between increased BMI and caries experience. The findings of Willerhausen et al. (2007) in-



sofar that underweight children have the highest proportion of healthy dentition, which was observed also in our study, but only for the primary dentition. However, the logistic regression analysis adjusted for age and gender did not confirm that underweight children are at lower risk of caries in primary dentition. Additionally, in our study the dmft did not differ significantly between children who were underweight and those in the other three BMI groups. In contrast Norberg et al. (2012) in a cohort of 5-year-old children from southern Sweden found that children with low BMI (below - 1 SD of national mean values for Swedish 5-year-olds) had statistically significantly higher number of decayed, extracted and filled teeth than children with normal BMI. The hypothesis proposed was that a chewing alteration is related to early childhood caries, especially severe early childhood caries (S-ECC), leading to dental pain and missing teeth, may be a favoring factor for growth impairment or decrease in body weight (Willershausen et al. 2007). Because the pain occurrence and pulp involvement were not investigated, what undoubtedly is the limitation of the present study, our results can neither prove nor deny that hypothesis. However, in the study of Sheller et al. (2009) in a sample of 2-6-year-old children with S-ECC, age- and gender-specific BMI percentile was not correlated with decayed, missing, or filled teeth or the number of pulp-involved teeth, even after adjusting for confounding factors.

It is difficult to explain the absence of an association between mean DMFT/DMFS and BMI category, despite lower caries prevalence in underweight children. Even though the proportion of children with dmft/DMFT=0 was highest in underweight children, the differences in

prevalence ceased to be significant once adjusted for age and gender. Additionally, the underweight group also include individuals with a very high dmft. These few outliers appear to have nullified the differences in caries severity between underweight children and the other BMI groups. As dental caries is a disease of multifactorial aetiology it is possible that different factors may have an influence on dental caries prevalence and severity. The examined sample was from an urban area in developed country, so it is also possible that improved access to public dental health and fluoride exposure may have reduced caries severity in overweight children.

Our study provides no evidence to suggest that overweight or obese children have higher caries experience or are at increased risk for dental caries compared to children with a normal BMI for age values. Chen et al. found no significant correlation between BMI and dental caries in 5133 Taiwan children aged 3 (Chen et al. 1998). Also, Sheller et al. note that BMI percentile does not correlate with dmft in 2- to 5-year-old children with severe early childhood caries, and no differences in number of decayed, extracted due caries and filled teeth of 5-year-old children with normal weight or overweight including obese were observed by Norberg et al. (2012). Other studies support our results, as they noted no association between dental caries and excessive weight, neither in the primary dentition of 2-to 5-year-old nor in the permanent dentition of 6- to 11-year-olds (data from the 1999-2002 National Health and Nutrition Examination Surveys) (Macek and Mitola 2006; Kopycka-Kedzierawski et al. 2008). However, in contrast to our results, using data from NHANES 1988-1994 Kopycka-Kedzierawski et al. found

that children aged 6- to 11-years at risk of being overweight and overweight were even less likely to have caries in deciduous and permanent dentition compared with children of normal weight (Kopycka-Kedzierawski et al. 2008). A study by Hong et al. (2008) based on data from the 1999–2002 National Health and Nutrition Examination Surveys of 2- to 6-year-olds revealed no significant association between childhood obesity and caries experience with the exception of the oldest group – comprising children 60 to 72 months of age. Hong et al. conclude that possible explanation for the positive association between dental caries and obesity is that both, caries and obesity are age-related cumulative conditions, and thus the older group is more likely to exhibit a stronger relationship. This is also supported by Gerdin et al. (2008) study, in Swedish children, in which the association between caries and obesity was weak, but it became significant when the children reached 12 years of age.

It is noteworthy, that some studies regarding the relationship between caries and overweight in preschool and primary school children present opposite results to ours (Vázquez-Nava et al. 2010; Granvile-Garcia et al. 2008; Tricaliotis et al. 2011). However, a meta-analysis of the results of a systematic search for papers between 1980 and 2010 addressing childhood obesity and dental caries conducted by Hayden et al. (2013) including analyses by dentition type (primary versus permanent), revealed a non-significant association between obesity and dental caries in primary and permanent dentitions. Yet, by accounting only for standardized definitions for assessment of child obesity using BMI, a strong significant relationship was evident with permanent dentitions (Hayden et al.

2013). This confirms our observations for primary but not permanent dentition, which may suggest that the influence on dentition status of overweight and obesity and related to those conditions behaviours is not relevant in the early period after eruption of permanent teeth.

### Study limitations

There are a number of limitations inherent to the study. Firstly, the use of dmft/DMFT index rather than the International Caries Detection and Assessment System (ICDAS), with higher diagnostic potential due to inclusion of noncavitated lesions, may have resulted in an underestimation of caries prevalence. Despite this limitation the dmft/DMFT index is still one of the most commonly used tool to assess caries experience in epidemiological studies. Secondly, a cross-sectional study design is less potent than a longitudinal design in establishing, whether there is a causal relationship between dental caries and weight status. Another limitation of the study is that the regression model used to examine BMI-for age as a predictor of dental caries, has not been controlled by socioeconomic status and diet, however lower socioeconomic status and diets high with refined carbonates were found to be associated with higher caries indices in some populations (Kopycka-Kedzierawski et al. 2008; Hayden et al. 2013). Additionally, a power calculation has not been provided.

### Conclusion

No association appears to exist in examined cohort between BMI categories and dental caries in either, primary or permanent teeth in the first period after eruption. However, further studies are need-

ed to better understand the relationship between deviation from normal BMI and caries in children at particular ages.

### Key message

Dental caries and increased body weight are a large health problem in children – more than 70% of children has positive history of caries, and the prevalence of overweight and obesity is high, exceeds 18%.

Although this study showed that no association seems to exist between increased body weight and increased prevalence or intensity of dental caries in 3-7-year-old children, because of possible general complications of both dental caries and childhood obesity, dentists and pediatricians should not forget about providing consistent education in child patients to protect them against those two health devastating conditions.

### Author contribution

AB-Z designed the study, acquired, analyzed and interpreted the data, and drafted the manuscript; BB-S acquired the data, analyzed and interpreted the data and is the co-author of the final version of the manuscript; MW-S designed and supervised the study and is the co-author of the final version of the manuscript; RF, BL-G, BS-W acquired the data; EŻ designed the study and is the co-author of the final version of the manuscript.

### Conflict of interest

The Authors declare that there is no conflict of interests regarding publication of this paper.

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