Public Health England

Protecting and improving the nation's health

The relationship between dental caries and body mass index

Child level analysis

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Introduction

Childhood excess weight is a significant population health issue which has implications for children, their families and public health. Action to address obesity is a government and Public Health England priority and the ambition of this Government is to halve childhood obesity rates by 2030 and significantly reduce the health inequalities that persist[1]. All groups of the population, particularly children, are consuming too much sugar[2]. This increases the risk of excess calorie consumption and weight gain, which, over time, can lead to obesity. High sugar intakes are also associated with an increased risk of dental caries, the most common oral disease affecting children and young people in England, yet it is largely preventable. PHE's National Dental Epidemiology Programme for England (2017)[3] showed that almost a quarter (23.3%) of 5-year-olds had tooth decay and there were significant oral health inequalities. Almost 9 out of 10 hospital tooth extractions, among children aged 0 to 5 years, are due to preventable dental caries. Tooth extraction is still the most common hospital procedure in 6 to 10-year-olds, according to PHE data up to 2019[4].

Child oral health is a PHE priority as part of every child getting the best start in life and the government has recently stated that 'to give our children a good start in life, we need to do much better on oral health'[5].

In 2015 PHE published an evidence summary on the relationship between dental caries and obesity[6]. This involved a review of the literature and analyses of local authority level data from cross sectional surveys of dental caries from the National Dental Epidemiology Programme and obesity from the National Child Measurement Programme. The literature review found that children with obesity had higher dental caries levels than children of a healthy weight. Also, there was an emerging pattern of increasing prevalence or severity of dental caries in children with underweight and children with overweight. Analyses of the local authority level data found a weak to moderate positive correlation between dental caries prevalence and prevalence of obesity in 5-year-old children. Since this report, dental caries levels nationally have reduced from 28% to 23% in 2017[3] and obesity levels have remained largely unchanged[7].

Both dental caries and child obesity are strongly associated with deprivation. The National Child Measurement Programme[7] showed that obesity prevalence for children living in the most deprived areas was almost double that of those living in the least deprived areas for reception and year 6 children. PHE's National Dental Epidemiology Programme for England showed children from deprived areas had more than twice the level of decay (34%) than those from the least deprived areas (14%)[3].

The previous evidence summary had examined cross sectional data at local authority level to explore the associations between dental caries and body mass index. To further explore the relationship this document reports the findings from analyses of dental caries and body mass index data for individual 5-year-old children. This is the first time that such large national data sets on height, weight and dental caries have been linked at an individual child level. The findings from this study will be helpful for all dental and public health professionals supporting children and families with healthier lifestyle options.

Aim

These analyses aim to add to the evidence on the relationship between dental caries and body mass index in children using linked data from national programmes in England.

Method

Dental caries data from individual 5-year-old children, collected as part of the 2016/17 National Dental Epidemiology Programme[3], were linked to individual height and weight data, which had been collected as part of the 2016/17 National Child Measurement Programme[7]. The linked data set included 67,033 children. Dental caries data included dental caries prevalence and severity, that is the percentage of children with dental caries experience and the mean number of teeth with dental caries experience. Severity is described in all children and in children with any dental caries experience. It also included ethnic group, water fluoridation status of area of residence and area level of deprivation using the national deprivation quintiles from the Index on Multiple Deprivation 2015[8]. Data from the National Child Measurement Programme included weight, height and body mass index of children aged 4 to 5 years[9]. The children were grouped based on their body mass index as underweight, healthy weight, overweight or very overweight [9,10]. Four multivariable regression models were fitted to investigate the associations between body mass index and dental caries prevalence and severity while controlling for deprivation, ethnicity and water fluoridation.

Body mass index may be grouped using either a clinical or population threshold. In this study population thresholds were used to facilitate comparison with the population in the descriptive statistics, while clinical thresholds were used in the multivariable regression models where association on an individual level was being explored.

Results

Of the 96,005 5-year-old children for whom dental caries data were available, 67,033 were linked to their height and weight data. Of these children, 23.8% (n=15,949) were from the most deprived areas and 18.7% (n=12,521) were from the least deprived areas in England. Twenty-three percent (n=15,420) of the children had experienced dental caries and these children had an average of 3.3 teeth affected. The prevalence of dental caries varied by level of deprivation and 34.2% (n=5,458) of children living in the most deprived areas and 13.5% (n=1,695) of children living in the least deprived areas had experienced dental caries. These figures were similar to the findings of the National Dental Epidemiology Programme.

Less than one percent (n=593) of children were classified as underweight, 78.9% (n=51,983) were healthy weight, 12.5% (n=8,508) were overweight and 7.8% (n=5,949) were classified as very overweight (Table 1). These figures were similar to the findings of the National Child Measurement Programme, where 1.0% were underweight, 76.4% were healthy weight, 13.0% were overweight and 9.6% were very overweight.

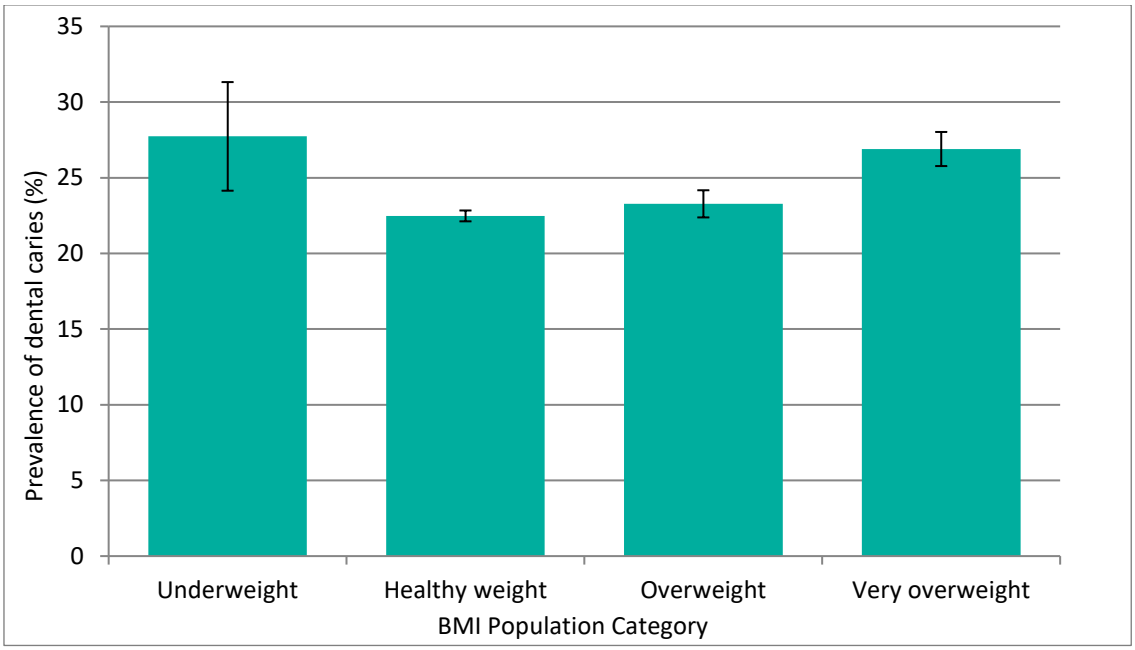
Table 1. Dental caries prevalence and severity by deprivation and body mass index population category

Characteristic	All children			Children with any dental caries experience					
	Number of children		Mean number of teeth with dental caries experience	Number of children		Number of teeth with dental caries experience			
	n	%	n	n	%	mean	25th percentile	median	75th percentile
England	67,033	100.0	0.8	15,420	23.0	3.3	1	2	4
IMD national quintile									
Most deprived 1	15,949	23.8	1.3	5,458	34.2	3.7	1	3	5
2	14,133	21.1	0.9	3,759	26.6	3.4	1	3	5
3	12,199	18.2	0.6	2,471	20.3	3	1	2	4
4	12,231	18.3	0.4	2,037	16.7	2.7	1	2	4
Least deprived 5	12,521	18.7	0.3	1,695	13.5	2.6	1	2	3
BMI population category[a]									
Underweight	593	0.8	1.2	163	27.5	4.5	2	4	6
Healthy weight	51,983	78.9	0.7	11,677	22.5	3.3	1	2	4
Overweight	8,508	12.5	0.8	1,980	23.2	3.3	1	2	4
Very overweight	5,949	7.8	0.9	1,600	26.8	3.2	1	2	4

[a]Underweight: below 2nd centile; Overweight: 85th to 94th centile; Very overweight: 95th centile and above[11]

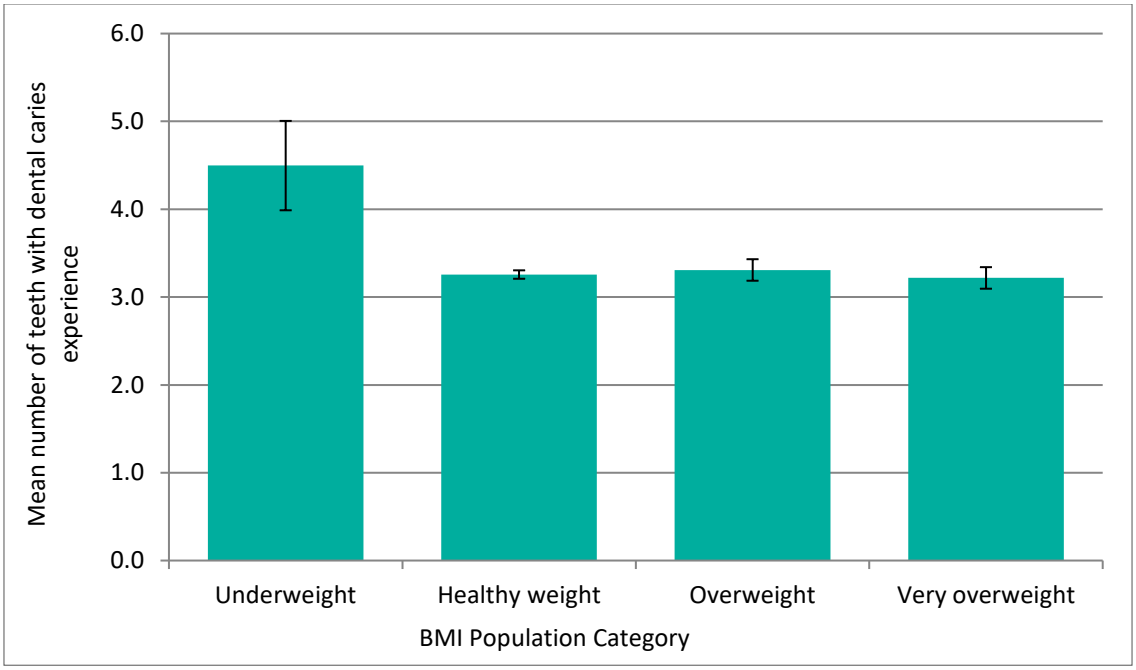
Dental caries prevalence was significantly higher among children with very overweight (26.8%, n=1,600) and with underweight (27.5%, n=163) (Table 1; Figure 1) than children with healthy weight (22.5%, n=11,677).

Figure 1. Prevalence of dental caries in 5-year-old children by body mass index population category, 2017



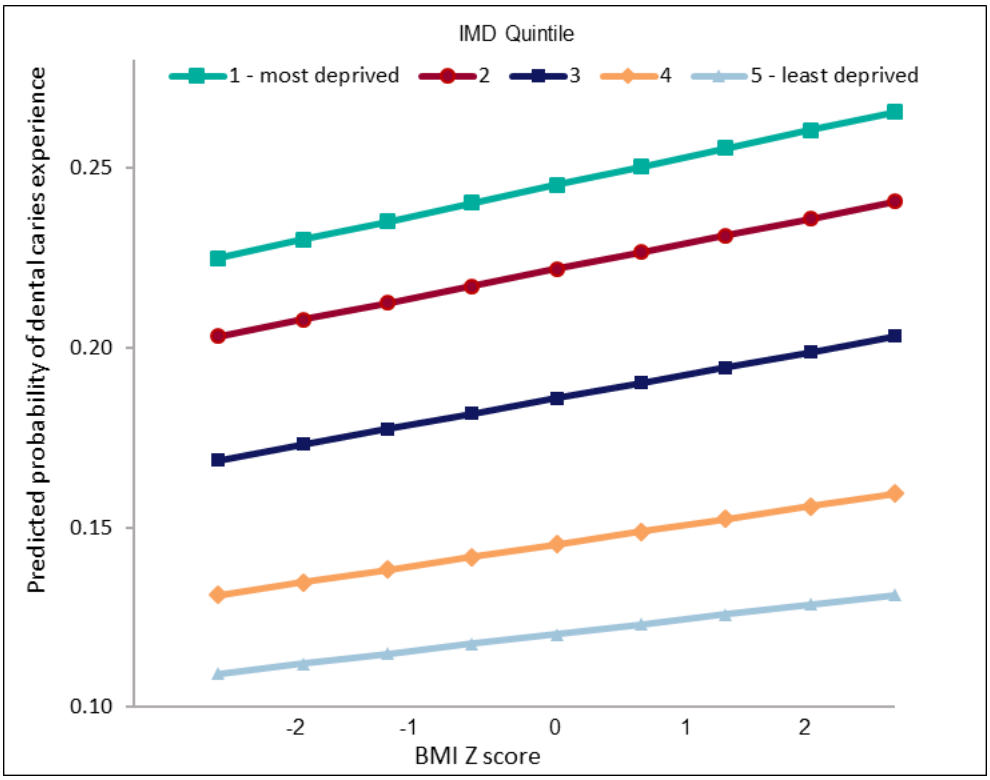
Children with underweight had significantly greater severity of dental caries experience (4.5 teeth) than other children (3.3 and 3.2 teeth) (Figure 2, Table 1).

Figure 2. Dental caries severity in 5-year-old children with any dental caries experience by body mass index population category, 2017



After adjustment for the other model covariates the prevalence of dental caries increased linearly with body mass index Z score[1] in all deprivation quintiles (Figure 3).

Figure 3 Caries prevalence by body mass index Z score and deprivation quintile



The odds ratios and the incidence rate ratios estimated by each of the 4 fitted multivariable models are given below (Table 2). The associations between dental caries and body mass index remained after controlling for deprivation, exposure to fluoridated water and ethnicity. The odds ratios showed that the likelihood of having dental caries was significantly higher for children with overweight and with very overweight. Among only those children with dental caries experience the likelihood of having more severe dental caries was greater for those children with underweight and lower for those with very overweight.

[1]Body mass index Z-score expresses the anthropometric value as a number of standard deviations or Z-scores below or above the reference mean or median value. A fixed Z-score interval implies a fixed height or weight difference for children of a given age.

Table 2. Odds ratios and incidence rate ratios of the 4 multivariable regression models

	Prevalence model using BMI Z score	Prevalence model using BMI categories	Severity model using BMI Z score	Severity model using BMI categories
	Prevalence (yes/no)	**Prevalence (yes/no)**	**Severity in children with any dental caries experience**	**Severity in children with any dental caries experience**
Variable	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Incidence Rate Ratio (95% CI)	Incidence Rate Ratio (95% CI)
BMI clinical category				
Underweight		1.01 (0.83-1.18)		1.24 (1.15-1.33)*
Healthy weight		Reference group		Reference group
Overweight		1.08 (1.02-1.15)*		1.02 (0.97-1.06)
Very overweight		1.14 (1.06-1.22)*		0.94 (0.89-0.99)*
IMD national quintile				
Most deprived 1	2.97 (2.90-3.03)*	2.97 (2.90-3.04)*	1.59 (1.54-1.64)*	1.58 (1.54-1.63)*
2	2.15 (2.08-2.22)*	2.15 (2.08-2.22)*	1.43 (1.38-1.48)*	1.43 (1.38-1.48)*
3	1.57 (1.50-1.64)*	1.57 (1.50-1.64)*	1.26 (1.21-1.32)*	1.26 (1.21-1.32)*
4	1.25 (1.17-1.32)*	1.25 (1.17-1.32)*	1.10 (1.05-1.16)*	1.10 (1.04-1.16)*
Least deprived 5	Reference group	Reference group	Reference group	Reference group
Number of observations	67,033	67,033	15,420	15,420

* Significant at 95% level

Discussion

A strength of this study is that this is the first analysis of child level linked data sets to explore the relationship between weight and dental caries experience whilst controlling for deprivation, which is strongly linked to both dental caries and overweight and very overweight. This relationship is mediated through dietary factors with those who regularly consume food and drinks high in sugar having an increased risk of both obesity and dental caries.

The findings from this study support the findings from previous work[6] that children with very overweight had a higher prevalence of dental caries than children with healthy weight. There was also a suggestion of a bimodal relationship between weight and prevalence of dental caries with more children with overweight and underweight experiencing the disease. Again, this pattern has been reported previously in the literature[12].

This work supports the role of dental public health and public health practice and affirms the need for sustained, evidence based action which includes consistent public health messages on how to reduce sugar consumption and encourage a balanced diet[13]. A growing body of evidence, including Tackling Obesities: Future Choices[14], suggests that a whole systems approach could help address complex problems like obesity. This approach is supported by PHE's Promoting healthy weight in children, young people and families[14]. All stakeholders have a role to play[16], one to one interventions are important to help individuals tackle their own weight, however this is not sufficient to tackle the issues at a population level. Policy level action is also required to support adoption of healthy behaviours, for example through sugar reduction and reformulation and the soft drinks industry levy.

This study showed that children who are above a healthy weight were more likely to have dental caries in all deprivation categories. This presents opportunities for dental and public health professionals to support families to engage in healthier behaviours, for example through use of PHE's healthier weight promotion: consistent messaging resources[17].

In addition these analyses identified the need for support for children with underweight who, although much fewer in number in this study, experienced significant levels of dental caries and may need specialist nutritional support.

Finally, overweight and very overweight in children may be an indicator of dental caries and public health practitioners and dental teams should provide appropriate interventions to promote good oral health in these children as well as interventions to support the adoption of healthy diets.

Conclusions

There was an association between children's weight and dental caries prevalence and severity, even when other potential influences such as deprivation were considered. Children with underweight or overweight and very overweight were more likely to have experienced dental caries than those of a healthy weight. However, when controlling for deprivation, ethnicity and water fluoridation status, the likelihood of having dental caries was significantly higher only for those children with overweight and very overweight.

These findings emphasise the importance of addressing the social determinants of health to reduce oral health inequalities while also tackling specific factors such as unhealthy diets though a proportionate universalism approach.

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