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Childhood obesity and dental caries among paediatric dental clinic attenders

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Background. More than one-quarter of New Zealand children are overweight or obese. Research on the causes of obesity has found associations with high consumption of sweetened foods and beverages, which have also been shown to be risk factors for dental caries, but studies investigating a possible association between dental caries and obesity have had conflicting findings.

Aim. The aim of this study was to determine whether deciduous dental caries experience was associated with BMI among paediatric dental clinic attenders.

Design. This was a cross-sectional study of clinical records of 200 children aged eight and under (70% European) treated in the University of Otago undergraduate paediatric dentistry clinic between 2004 and 2006. Height and weight were measured and used to calculate BMI. Deciduous dental caries experience was recorded.

Results. The overall mean BMI was 16.0 (SD = 2.0). Pacific Island children had a higher mean BMI (at 17.0) than NZ European, Maori, and Asian/Other children (15.7, 16.8, and 15.9 respectively; $P < 0.05$). The dmft ranged from 0 to 15, with a mean of 6.1 (SD = 3.8); 24% had dmft <3, and 38% had dmft >8. No significant association was found between the BMI and caries experience (P-value = 0.932).

Conclusions. There was no association between BMI and dental caries experience in this convenient sample.

Introduction

Childhood obesity is a serious public health problem, and is currently defined as an excess amount of body fat in relation to lean body mass[1,2]. Over the past decade, childhood obesity rates have reached epidemic proportions in the United States and many other developed countries. In New Zealand, 25–30% of children are considered overweight or obese[3]. The simplest proposed explanation for obesity is energy imbalance, where energy intake far outweighs energy expenditure[4]. The condition , however, reflects a complex interaction of genetic, metabolic, cultural, environmental, socioeconomic and behavioural factors[5]. Childhood obesity is associated with cardiovascular and metabolic risk factors and is likely to continue into adulthood[6]. Adult obesity is associated with hypertension, cardiovascular disease, respiratory system disease, gastrointestinal disease, type II diabetes, depression and cancer[5,7].

Obesity in children is difficult to classify accurately, and no commonly accepted standard has yet emerged. Ideally, it should be measured using the percentage of body fat, measured using dual energy x-ray absorptiometry (DXA) scans. This is usually impractical for epidemiological studies. Hence, the body mass index (BMI) is widely used in such research. BMI in childhood is based on age and sex, and several charts have been derived to define cut-offs. BMI has been shown to correlate well to adiposity in children, along with the waist-to-hip ratio[8,9]. The Centers for Disease Control (CDC) 2000 charts (for BMI) are based primarily on data from children in the United States and use the 85th and 95th percentiles cutoffs (respectively) to

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identify overweight and obesity[10]. Internationally-pooled data was used to develop the International Obesity Task Force (IOTF) charts, that define overweight and obesity based on the commonly accepted adult cut-offs of 25 and 30 respectively[1].

Dental caries is the most common chronic illness in early childhood[11]. Caries prevalence has not changed since the 1970s, with 65% of 5-year-olds having experienced dental caries[11–13]. In New Zealand (NZ), ethnic inequalities are evident, with Māori and Pacific children having greater dental caries experience[14]. The School Dental Service and Ministry of Health report annually the number of children who are caries-free and the mean dmft for all 5-year-olds (http://www.moh.govt.nz/moh.nsf/indexmh/oralhealth-statistics/#schooldental). In 2008, 57% of all 5-year-olds were caries-free and the mean dmft was 1.98. Among Māori and Pacific Island 5-year-olds, 36% and 33% were caries-free and the mean dmft was 3.45 and 3.42 respectively. Cumulative caries experience is generally expressed as a DMFT or dmft value, representing the number of Decayed, Missing, or Filled Teeth in the permanent and primary dentitions respectively. Dental caries in early childhood has been shown to predict adolescent and adult caries experience[15].

Dietary shortcomings (with greater consumption of high fat, carbohydrate-rich foods) are associated with chronic diseases, such as obesity, cardiovascular disease, diabetes, and dental caries[16–18]. Poor dietary habits established in early childhood are carried through into adolescence and adulthood. The National Children's Nutritional Survey conducted in New Zealand in 2002 [3] showed that 50% of NZ European children – but only 45% of Māori and 40% of Pacific children – met the recommended dietary intake for the percentage of their daily energy requirements from fat. That survey also showed that food insecurity appears to be a contributing factor, with almost half of Pacific parents/caregivers and nearly one-third of Māori parents/caregivers eating less due to a lack of money[3]. Inadequate knowledge and the inability to access appropriate foods places a greater burden on low socio-economic status groups[19].

Dental caries and obesity share similar risk factors, most notably, diet and socio-economic status[17,19–21]. Poor dietary habits lead to a more rapid progression in obesity than in dental caries; hence, it has been suggested as a predictor for caries development and progression[22]. However, dental caries has a multifactorial aeitiology with genetic predisposition and early acquisition of mutans streptococci being suggested as more accurate predictors of caries.[23]. Currently, there is no consensus on the association between obesity and dental caries: Gerdin *et al.* (2008)[24], Hilgers *et al.* (2006)[7], Alm *et al.* (2008)[15] and Willershausen *et al.* (2004)[6] found an association between high BMI and high caries experience among children. Macek *et al.* (2006)[25], Chen *et al.* (1998) [26], Marshall *et al.* (2007)[19] and Tuomi *et al.* (1989)[22], however, found no such association.

The aim of this study was to determine whether deciduous dental caries experience was associated with BMI among paediatric dental clinic attenders.

Methods

This study was conducted in 2006 with patients in the paediatric dentistry clinics at the University of Otago School of Dentistry. Ethics approval was obtained from the University of Otago Ethics Committee. Using the School of Dentistry database system, we obtained patient records for 548 children between 3 and 8 years of age who were seen in the undergraduate paediatric dentistry clinics during the period 2004–2006. Of the 548 patient files, 200 (36.5%) had sufficient data to enable calculation of BMI and dmft. These were children primarily referred for management of dental caries and/or anxiety. Data on date of birth, gender, date seen, dmft, height, weight, and ethnicity were entered into an electronic database. Age, dmft, height, and weight at the date last seen were recorded. Age was recorded in years; height and weight were recorded in metres and kilogrammes respectively. Clinicians used a calibrated weighing scale and stadiometer to record weight and height. The dmft was recorded from the most recent clinical charting as the

total number of deciduous decayed, missing, and restored teeth. Each patient was classified as NZ European/Pakeha, Māori, Pacific Island or Asian/Other, based on the chart record. The data were statistically analysed using SPSS. Using their BMI values, children were categorised as 'normal', 'overweight' or 'obese' according to the age- and sex-specific standards published by Cole *et al.* (2000)[1] Associations were tested for statistical significance using chi-square tests and analysis of variance (where appropriate). Pearson's *r* was used to determine the correlation between dmft score and the continuous variables BMI and weight. The level of significance (alpha) was 0.05.

Results

Sociodemographic characteristics of the sample

Females comprised 55.4% of the 196 patients (Table 1). The mean age of the sample was 5.3 years (SD = 1.3; range 3–8). There were 139 NZ European (70.9%), 31 Māori (15.8%), 13 Pacific Island (6.6%), and 13 Asian/Other (6.6%).

Table 1. Sociodemographic characteristics of the sample (brackets contain row percentages unless otherwise indicated).

	Sex		
Ethnic group	**Female**	**Male**	**All combined[a]**
European/Pakeha	77 (55.4)	62 (44.6)	139 (70.9)
Māori	16 (51.6)	15 (48.4)	31 (15.8)
Pacific Island	6 (46.2)	7 (53.8)	13 (6.6)
Asian/Other	6 (46.2)	7 (53.8)	13 (6.6)
All combined	106 (53.0)	94 (47.0)	196 (100)

[a]Column percentages.

Table 2. BMI and caries experience by sociodemographic characteristics (brackets contain standard deviations).

	Mean BMI	**Mean dmft**	**No. overweight or obese (%)**	**No. obese (%)**
Sex				
Female	15.7 (2.1)	5.9 (4.0)	20 (19.0)	8 (7.6)[a]
Male	16.3 (1.8)	6.3 (3.5)	20 (22.0)	9 (9.9)
Ethnic group				
European/ Pakeha	15.7 (1.8)	5.8 (3.7)	24 (17.3)	7 (5.0)
Māori	16.9 (2.4)	6.8 (3.9)	10 (32.3)	5 (16.1)
Pacific Island	17.0 (2.7)	6.9 (4.5)	3 (23.1)	3 (23.1)
Asian/Other	15.9 (1.8)	7.2 (2.2)	3 (23.1)	2 (15.4)
All combined	16.0 (2.0)	6.1 (3.7)	40 (20.4)	17 (8.7)

[a]$P < 0.05$.

Weight, height, BMI characteristics by sex and ethnicity

Males had a higher mean BMI than females (Table 2). Among the ethnic groups, Pacific Island children had the highest mean BMI. Some 17 (8.5%) children met the inclusion criteria for being considered obese, and 23 (11.5%) were classified overweight. Therefore, the total number of children overweight or obese was 40 (20.0%).

Caries experience by sex and ethnicity

Summary data on deciduous dental caries experience are presented in Table 2. The mean dmft score among the sample was 6.1 (SD = 3.7), with a range of 0–15. Males had a slightly higher mean dmft than females (6.3 and 5.9 respectively, $P > 0.05$) and the Asian/Other group had a higher mean dmft than the other ethnic groups ($P > 0.05$). There was a higher proportion of obese children among the Pacific Island children. European children had the lowest prevalence of obesity.

The sample was divided into quartiles for dmft, with the lowest being ≤3, the second quartile 4–5, the third quartile 6–7, and the highest quartile being 8 or more dmft. Twenty-four percent of the obese children had a dmft score of 8 or more and 37.5% of the overweight children had a dmft of 8 or more. Of the children in the normal weight range, 35.4% had a dmft of 8 or more.

Overweight status and caries experience

Data on dental caries experience stratified by overweight/obese status are presented by sex and ethnicity in Table 3. Overall, the mean dmft scores of overweight and obese children did not differ from those of children in the normal weight range ($P > 0.05$). Among Māori, obese/overweight children had a

Table 3. BMI and caries experience (brackets contain standard deviations).

	Mean dmft (SD)	
	Not obese or overweight	Obese or overweight
Sex		
Female	6.3 (3.9)	4.4 (4.0)
Male	5.9 (3.3)	7.6 (3.8)
Ethnic group		
European	5.9 (3.6)	5.0 (4.2)
Māori	6.4 (3.9)	7.5 (4.0)
Pacific Island	6.9 (4.8)	6.7 (4.0)
Asian/Other	6.9 (1.7)	8.0 (4.0)
All combined	6.1 (3.6)	6.0 (4.2)

higher mean dmft than their slimmer counterparts, but this was not statistically significant.

Using the continuous (uncategorized) variables, there was no significant correlation between BMI and dmft score (Pearson's $r = -0.06$; $P = 0.41$) or between weight alone and dmft (Pearson's $r = -0.01$; $P = 0.87$) after adjusting for sex and ethnicity.

Discussion

This study set out to investigate the association between dental caries and obesity, since they share many common risk factors. The findings indicated no association between BMI and caries experience, at least in children seen in clinics at the University of Otago School of Dentistry.

Before discussing these findings further, it is appropriate to examine the limitations and strengths of the study. First, the findings are based on information obtained from patient files of children seen in the undergraduate paediatric dental clinic between 2004 and 2006. Only 36% had the height and weight information required to accurately assess BMI. This is because such information was added to examination charts only in mid-2004, and its routine collection was not enforced until the beginning of 2006. Although the potential sample was large, the findings of the study are perhaps compromised by only a minority of files having adequate data. Although all undergraduate students were trained under the same guidelines for caries detection, variations in the accuracy of the records appeared to be present, with incipient caries also recorded in some cases, but only cavitated lesions (or those seen on radiographs to involve dentine) were recorded in others. Some examinations did not include recent radiographs, as these were not indicated at the most recent examination. Cumulative caries experience was represented by dmft scores rather than by dmfs; this was for two reasons. First the data were routinely recorded in that form; second less variance is encountered when using dmft, and so the required N is correspondingly less. Turning to the N, it may be that the study's null finding resulted from type two error rather than the absence of an actual relationship between BMI and caries experience. The lack of any gradient in caries experience by BMI category (Table 3), however, strongly suggests that type two error was not a problem.

The lack of an association between BMI and dental caries experience in the primary dentition, found in this study, is consistent with the findings of Macek *et al.* (2006)[25], Chen *et al.* (1998)[26], Marshall *et al.* (2007)[19] and Tuomi *et al.* (1989)[22] Macek *et al.* (2006)[25] found an association between caries severity in the permanent dentition and high BMI. In this study, the lack of an association could be exacerbated by either the high caries experience of the sample, the under-recording of caries, or perhaps the small sample size (see above). One-third of the sample had high caries experience (dmft of 8 and above). The children seen in the undergraduate paediatric dentistry clinics were referred primarily because of severe early childhood caries and/or anxiety requiring comprehensive dental rehabilitation. Other referrals were because of medical conditions, trauma or dento-facial anomalies that preclude treatment within the School Dental Service. Children seen for trauma were likely to have had low caries experience and incomplete records for height, weight and caries experience, as these might not have been recorded at the examination visit, underestimating the caries experience of these children.

The one-fifth of the children in our sample who were overweight or obese is less than the most recent NZ estimate whereby approximately 30% of NZ children are overweight or obese[3]. The difference could be merely due to chance, or it could perhaps be due to the effects of severe caries on their diet. Acs *et al.* (1992) found that children with early childhood caries weighed significantly less than comparison children and were less than 80% of their ideal weight[27]. They also later suggested that the high carbohydrate intake that predisposed to early childhood caries initially, resulted in higher weights, but that this decreased as caries progressed and pain and infection altered eating and sleeping patterns[28]. The completion of comprehensive dental rehabilitation resulted in the phenomenon of catch-up growth[28]. Thomas *et al.* (2002) disagreed, as they found that children with rampant dental caries did not tend to weigh below the 50th percentile for their age, and the slight increase in weight after dental rehabilitation did not account for the catch-up growth phenomenon[29]. The BMIs recorded in this study followed national patterns in relation to ethnicity, with Pacific Island and Māori children having a greater BMI (on average) than European or Asian/Other children[3].

Dental caries and obesity have common risk factors that persist into adulthood and increase the risk of chronic diseases. Interventions that reduce the impact of these risk factors may decrease the prevalence of dental caries and obesity in childhood and prevent their persistence (and that of associated side – effects) into adulthood. Although no association has been found between BMI and caries experience in the deciduous dentition in this study, the long-term effects of early childhood caries on general health have not been confirmed. Regular monitoring of general health variables such as height and weight, if included into dental examinations might be indicators of current behaviours, as well as, short and long-term risks for other chronic diseases such as diabetes. Interventions aimed at improving dental health (such as diet advice) may also alter the risk factors for overweight and obesity.

What this paper adds

- This paper explores the association between dental caries experience and obesity in the primary dentition.

Why this paper is important to paediatric dentists

- Paediatric dentists might be in an optimal situation to identify children at a high-risk of developing chronic diseases.
- Appropriate interventions to improve oral health may also alter the risk factors for obesity.

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