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Childhood growth and dental caries

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Objectives: The aim of the study was to examine whether the removal of carious teeth affected children's growth relative to that of a standard population. ***Design:*** Longitudinal prospective observational study. ***Setting:*** Manchester Dental Hospital (MDH), UK. ***Participants:*** Five and six year- old children who attended for extraction of carious teeth under general anaesthesia. ***Main outcome measure:*** Change in height, weight and BMI standard deviation scores during the six months after extraction of carious teeth. **Methods and materials:** The children's dental caries levels, weight and height were measured prior to extraction using standard criteria and a single trained examiner and they were then re-measured six months later. The body mass index of the children was calculated and all measurements were converted to standard deviation scores (SDS) using the UK 1990 growth reference. Changes in growth SDS during the six months subsequent to the extractions were then calculated. ***Results:*** Two hundred and eighteen children, mean (range) age 5.9 (5-6) were examined initially, of whom 131 were successfully followed up a mean 7.1 (0.13) months later. The participants had a mean dmft of 7.18 (SD 3.27) at baseline and were not shorter than expected (8.3% <10^{th} percentile), or more underweight (6.9% <10^{th} percentile for weight). At follow up children showed a statistically significant gain in BMI SDS (mean (SD) 0.26 (37) p<0.001) and a small gain in height SDS (0.05 (0.38) p=0.05). ***Conclusion:*** This study suggests that the extraction of carious teeth in five and six year old children promotes weight gain and possibly growth.

Key Words: childhood, dental caries, growth.

Introduction

Abnormal growth/ weight gain in young children is a substantial public health problem which causes much concern among parents and health professionals. It would seem entirely consistent with current knowledge to assume that recent changes in dietary intake may also impact upon dental caries in the child population. It has also been suggested that dentists may be ideally placed to recognise children at risk of poor growth and development (Acs 1999).

The concept that dental disease and child's body weight may be related was raised as early as 1982, when a retrospective case-note study examined the body weights of children attending for tooth extractions under general anaesthetic (GA) were compared to children attending for routine dental care (Miller et al 1982) and subsequent studies have suggested that treatment of caries may lead to improvement in weight gain (Acs et al, 1998, 1999), at least in children whose growth is below average.

Therefore the main aim of this study was to examine growth in children with dental disease subsequent to the removal of their carious teeth. By comparing the relative height, weight and BMI of the study children to a reference population, the research investigated the following:

- Whether children with high levels of caries are prone to low or high growth indices (BMI, height, weight).
- Whether growth indices amongst children with high levels of caries increase after the removal of carious teeth.
- Whether growth indices in low-weight children increase after the removal of carious teeth.

Method

All children of ages five and six who had an appointment for dental extractions under GA were invited to participate in the study. Two hundred and eighteen children joined the study with their parents/guardians consent.

Ethical approval for the study was obtained from the Local Research Ethics Committee (LREC).

All parents filled in a short medical questionnaire regarding the general health of their children. Details of any medical problem, either current or in the child's past, which might affect growth or weight were gathered and a drug history was also taken. Any child who had a medical condition, which would affect normal growth, was excluded from the study.

After recruitment, basic demographic information was collected, plus details of the child's family structure and birth details, including prematurity.

Each child was then weighed using calibrated Seca digital scales, and their height measured in a standardised fashion using a rigid scale (Seca portable height Rod). Children were measured in indoor clothing and shoes.

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Each participating child was then dentally examined by a trained and calibrated examiner (intra-observer Kappa = 0.80) according to the British Association for the Study of Community Dentistry (BASCD) criteria (Mitropoulos *et al*, 1992.). The examinations were performed under standardised condition using a dental unit, a plane mouth mirror, and a CPITN probe (which was used solely to remove debris). Numbers of decayed, missing and filled deciduous teeth surfaces were recorded.

The children then had their carious teeth extracted which rendered them caries-free(it is a policy of MDH to remove all carious teeth in children going for GA).

At a recall visit six months after the GA the child's height and weight were measured again. Growth data (height and weight) were collected as previously and in the same environment. All participants were coded and the examiner was blind to the base-line body mass index and dental status.

The frequency distribution, mean and standard deviation and range of dmft, dt (decayed teeth), mt (missing teeth due to caries) and ft (filled) in the study population, at baseline prior to extraction were determined.

After subtraction of standard constants for shoes and clothing Body Mass Index (BMI) of the children was calculated [weight (kg)/height (m^2)] and weight, height and body mass index were converted to percentiles and Standard Deviation Scores (SDS) to allow comparison of the study subjects to a standard population using Lgrow software version 2.0. Using the current British reference standards as recommended in The Children's Society's "Recommendations for best practice for weight and growth faltering in young children" allowed comparison of the study group to population norms of children of the appropriate age and gender (The Children's Society, 2002). Frequency distribution of the study population in percentile categories for weight, height and BMI at baseline and follow up were plotted. Differences in SD score for weight, height and BMI at baseline and follow up were calculated.

Results

One thousand two hundred children aged 2-12 year-old were admitted to MDH for extraction of carious teeth under general anesthesia during the study period which was from October 2002 to December 2003. Of these, 218 five and six year old children participated in the study. The main reason for non participation was difficulties in attending the follow up examination.

A total of 119 boys and 99 girls with a mean age of 5.9 years were included in the study and most of them were the first child and came from the family with two children. Fourteen percent of them had a history of being born premature.

Most of the children recruited to the study had a high caries rate, as expected. The mean (SD) dmft was 7.18 (3.27). Table 1 shows the mean, standard deviation and other descriptive dental data. Fifty-eight per cent of children had dmft >6. Ninety-six (44%) children had signs of dental abscesses or oral fistula when they were examined.

The children as a group were of average height, weight and BMI. The proportion of the study population who weighed below the standards tenth percentile and above ninetieth percentile at baseline was 6.9% (15) and 14.7% respectively, whilst 8.3% (18) were below the standard's 10^{th} percentile for height and 13% were above ninetieth percentile at base line. Table 2 shows growth data for the study population at baseline.

One way ANOVA analysis of height, weight and BMI SDS in relation to caries levels showed no significant differences in the mean SDS of these growth indicators in children with different caries levels. Table 3 shows the relationship between BMI and caries levels.

A total of 131 (60.1%) study population children attended for the follow-up visit at a mean period of 7.1(0.13) months.

Frequency distribution of the study population's weight, height and BMI at baseline and follow up indicated a decrease in the proportion of children in the lower percentiles for BMI, six months after extraction of carious teeth (Figures 1 and 2).

On average the children showed a clear gain in weight and BMI SDS at follow up and a slight gain in height (Table 4). The 15 children with low weight (<10^{th} percentile) at baseline also had significant increases in SD scores for weight and BMI at follow up.

Discussion

The data presented in this study did not reveal any evidence of either underweight or shortness in children with higher caries levels, unlike earlier studies (Miller 1982, Acs 1992, Thomas and Primosch 2002). However the results clearly indicate faster weight gain in the study children in the six months after their tooth extractions and this acceleration in weight gain is beyond that which would be expected in normal population of this age. Whilst the dropout rate was high (as had been expected for a disease prone, low socio-economic status population such as the one studied) the follow up sample size of 131 gave 95% power for detecting the shifts in SD scores shown. The study population is not representative of the population at large but the effect of this bias in the sample does not diminish the importance of changes in weight and BMI. The children's age was measured in months, thereby enabling growth over the six month follow up period in the reference and study population to be compared. There would naturally be a difference between height and weight indexes over six months due to natural growth, but individual's and population's SD scores for weight and height stay constant over time unless growth acceleration or deceleration has taken place. The significant difference in SD scores therefore implies that the children's weight gain increased subsequent to the extraction of their carious teeth, beyond that which would be seen in reference population during this time period. An SD score measures the distance of an individual measurement is from the population (reference group) mean. If weight is being gained steadily (i.e. an individual's difference from the population mean remains constant they grow) the S.D. score will stay the same. If weight is gained more rapidly than would normally happen to a person in that percentile over the time period examined, the person's S.D. score (distance of the individual from the population mean) would go up.

Table 1. Distribution of decayed (d) missing (m) and filled (f) teeth and surfaces in the study population at baseline (n = 218)

	Mean (SD)	*Range*
dmft	7.18 (3.3)	1-16
dt	6.87 (3.3)	1-16
mt	0.18 (0.5)	0-3
ft	0.17 (0.6)	0-4
dmfs	21.5 (11.2)	2-53

Table 2. Mean, Standard Deviation and distribution of study population in <10th and >90th percentile of weight, height and BMI SD Scores at baseline (n = 218)

	Mean (SD)	*% (number) <10th percentile*	*% (number) >90th percentile*
Weight SDS	-0.01(1.18)	11.0(24)	11.9(27)
Height SDS	-0.15(1.03)	11.0(24)	7.8(18)
BMI SDS	0.10(1.20)	10.6(23)	14.2(32)

Table 3. One-way ANOVA analysis of BMI SD Score with dmft in the study population

	Sum of squares	*df*	*Mean square*	*F*	*Sig*
Between Groups	0.11	2	0.05	0.14	0.86
Within groups	86.65	215	0.40		
Total	86.6	217			

Table 4. Paired samples test for SD scores of weight, height and body mass index at baseline and follow up for whole study population (131 matched cases) and also for children below 10th percentile (9 matched cases)

	All children n=131			*Weight <10th percentile at baseline (n=9)*		
	Mean (SD)	*CI*	*P*	*Mean (SD)*	*CI*	*P*
Weight SDS	0.26 (0.37)	0.32,0.19	<0.001	0.57 (0.32)	0.82,0.32	<0.001
Height SDS	0.05 0.38	0.12,0.00	0.08	0.00 0.27	0.21, 0.20	0.90
BMI SDS	0.32 0.54	0.42,0.23	<0.001	0.82 0.59	1.27,0.36	<0.001

The results would therefore appear to indicate that the children's ability to gain weight was negatively affected by the presence of carious teeth in their mouths.

Other studies have examined the effect of caries on body weight in paediatric populations (Lee et al, 1997, ACS et al, 1992). These studies reported that children with caries weighed significantly less than control groups. A recent study reported that, following complete dental treatment in children with early childhood caries, there was no difference in their age-adjusted weight when they were compared to a non-caries control group (Acs et al 1999). Children who weighed less than 80% of their ideal weight for their age, have also been previously shown to experience an acceleration in growth to a higher percentile of growth after dental rehabilitation (Lee et al, 1997). Again, the current study provides confirmation for those findings, as the low weight (<10th weight percentile) children underwent significant growth acceleration after tooth extraction.

The baseline measures in the study reported in the current paper would confirm a lack of 'difference' between children with and without caries, but the follow-up findings of both studies strongly suggest an association between the eradication of dental caries and weight gain. It is of note though that these children were not as a group underweight, and at follow up 20% of children had BMI above the 90% percentile, which suggests that some had actually become at risk of becoming obese since their

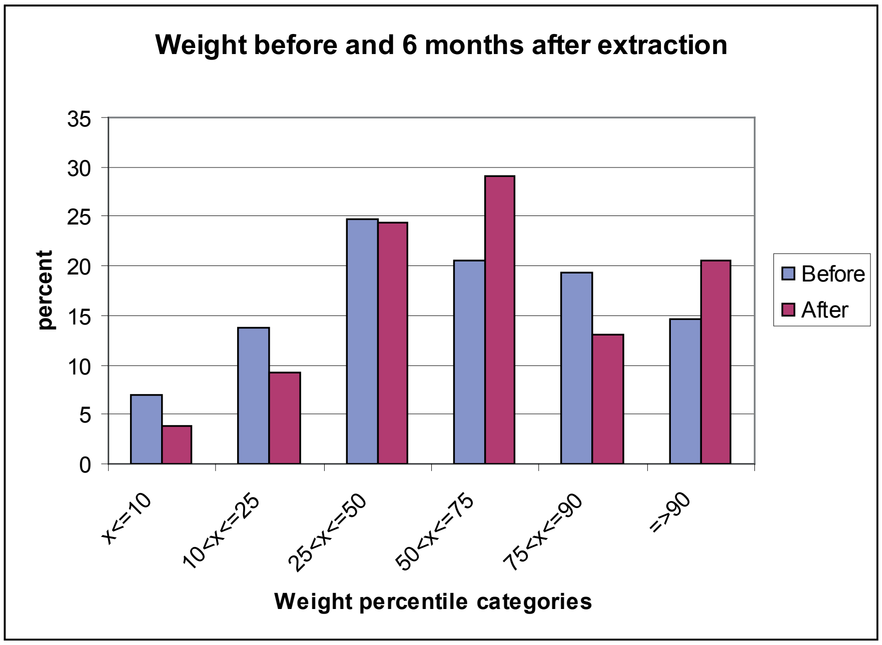

Figure 1. *Percent of study population in reference population weight percentile categories before and six months after extraction of carious teeth*

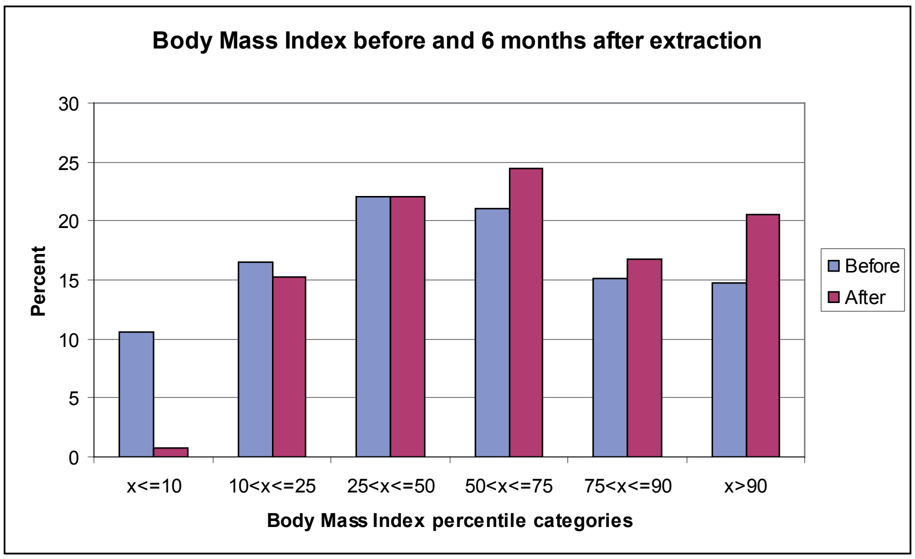

Figure 2. *Percent of study population in reference population BMI percentile categories before and six months after extraction of carious teeth*

dental extraction. The high sugar, low residue diet most associated with dental caries would be expected to also be obesogenic, and recent evidence has associated high consumption of sugary drinks in particular with obesity (Matthiessen at el, 2003; Berkey at el, 2004).

If dietary intake had altered as a result of their caries this could have resulted in an alteration of established growth patterns which are then re-established once the carious teeth are removed.

The potential for increased glucocorticoid production in response to pain, decreased growth hormone secretion in response to disturbed sleep pattern, and overall increased metabolic rate during the course of infection are all possible explanations of the observed association between growth and caries. An alternative explanation for the observation would be that pain and infection alter eating habits e.g. if carious teeth become pulpitic, the eating of refined carbohydrates will cause pain and children may avoid such foods resulting in reduced calorific intake (Boyd *et al*, 1998). Whichever explanation is accepted for the observed association, the hypothesis that dental disease and growth are related through the common factor of diet are supported by the data presented and also seem plausible, both biologically, and behaviourally.

The study would have been enhanced by the use of an untreated control group, so that a direct comparison could be made. However it was not deemed ethical to examine and weigh children known to have caries unless treatment was then made available. A group of dental attenders as a control was deemed highly unsuitable as they would have been too different from the study group with regard to a number of important parameters such as socioeconomic group and dental care habits. Therefore the alternative of a reference population was used in place of a control group. A problem with this is that it is known that the upper limits for UK reference values for weight and BMI are already set substantially below their true value, with various studies suggesting that 50% more than the expected number of children now have BMI values above the 91st or 98th percentiles at this age (Reilly at el 1999). However the Royal College of Paediatrics and Child Health Expert Consensus Group in 2000 stated that "the UK 90 reference is superior and in many settings the only usable reference, which can be recommended". Because the UK references values for weight and BMI are set below their actual current value, had a 'modern' reference population been available, the children in the study might have proven thinner before extraction than what is now the norm. An alternative explanation of the findings is that the results reflect a faster increase in weight of the study children, when compared to the reference population than would have been expected. The children were also measured fully clad (as still tend to be the case in dental practice) which, without adjustment, would have introduced a substantial bias. However subtracting a correction factor for clothes and shoes should have prevented this, though the precision of the individual estimates will inevitably have been reduced.

This paper presents evidence which strongly suggests that children's growth is affected by the state of their dental health. This relatively simple observation is very important, as it provides yet another reason for policy makers and Governments to invest time, resources and expertise in improving both children's diets, and their dental health. It is essential to remember that dental caries is one of the only very few common childhood diseases which cause large numbers of the child population to undergo general anaesthesia. Children who are allowed to develop dental decay therefore suffer, not only in terms of potential effects on their growth and development, but also directly, as the treatment, if it is carried out using general anaesthesia, also poses a serious health risk to the children involved.

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