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Effect of Dental Caries on Children Growth

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1. Introduction

Abnormal growth/ weight gain in young children is a substantial public health problem which causes much concern among parents and health professionals.

Recent reports suggest that in many established market economies changes in dietary practices have resulted in a change in children and adolescents' body mass index. Among the reported dietary changes are alterations in the pattern of intake of carbohydrates. It would seem entirely consistent with current knowledge to assume that such changes may also impact upon dental caries in the child population.

Dental caries is a disease which attacks the dental hard tissues by demineralising the enamel. If oral conditions are favourable then this demineralisation can progress from the outer enamel layer of the tooth into the softer underlying dentine, resulting in decay. Dental decay is more common in individuals who have frequent intakes of dietary sugars (fermentable carbohydrates). Frequency of intake of carbohydrate is more predictive of the decay process than the absolute amount. Dental caries is also an extremely widespread childhood disease. It is particularly prevalent among deprived populations (Wright, 2000).

Dental caries is the most common reason for children undergoing general anaesthesia and thereby is therefore a major cause of exposure of small children to the medical risks associated with general anaesthesia (Whittle, 2000).

A number of nutritional factors, which may be factors in growth and development such as Vitamins A and D, water hardness and protein, have been hypothesised as potentially linked to dental caries (Mellanby & Pattison, 1928; East, 1941; Aptone-Merced & Navia, 1980). However, there is little evidence to substantiate that the systemic effects of poor nutrition increase the risk of dental decay, and it is generally accepted that while diet can have a profound local effect on erupted teeth, it has much less effect while the teeth are forming(Rugg-Gunn, 2000).

It has been demonstrated that low birth weight children more frequently have hypo plastic defects in the enamel of their teeth than normal weight babies, but that dental caries is also less frequent (Fearne et al, 1990).

An association between physical problems affecting the mouth, and childhood growth, has been hypothesized and it has been suggested that dentists may be ideally placed to recognize children at risk of poor growth and development (Boyd, 1998).

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 general anaesthetic tooth extractions, 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; Malek Mohammadi et al, 2009) at least in children whose growth is below average.

This chapter presents evidence which strongly suggests that children's growth is affected by the state of their dental health. These relatively simple observations are very important, as they 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 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 poses a serious health risk to the children involved.

2. Principles of normal growth

Growth is a critical indicator of child health and its importance is recognized by the World Health Organization, which identifies growth assessment as the best single measure for defining the nutritional status and health of children, as well as being an indicator of quality of life in whole populations (Hall, 1996).

Normal growth is a sign of good health, and ill children often grow slowly. Growth in children is not simply an increase in height and weight, but is a complex process involving increases in both the size and number of cells. It is influenced by genetic factors, but a number of other factors are also relevant, including nutrition, and these may act to prevent the individual achieving his or her genetic potential. Measurement of growth indicators, such as weight, height and head circumference can give valuable information about a child's nutritional well-being and growth pattern.

3. Growth monitoring

Health professionals accept that routine growth monitoring in children is a standard component of community child health services (Department of Health and Social Security,UK, (HMSO), 1974). In both developing and developed countries, health workers monitor growth in order to detect problems, and where possible, intervene if there is evidence of malnutrition and growth problem. Health workers and mothers spend considerable time on this activity, because early detection of growth failure depends on effective monitoring (Reid, 1984). Monitoring requires accurate, regular measurements, accurate transcription of data to a growth chart and appropriate action if poor growth is identified. It is also important to ensure that measurements are performed consistently, using appropriate equipment and also using trained staff (Garner et al 2000). Inconsistencies

can occur at a number of stages, including in the setting up and calibration of equipment, the measuring techniques used, and the recording of data.

Growth monitoring may be done through height and weight measurements but a variety of other indices such as supine length, standing height, height velocity, weight velocity, weight for height, height for weight, Body Mass Index(BMI) and many more other measurements are also considered relevant.

In order to interpret biological variables such as height and weight, it is important to compare them with normal data for children of the same age and, where appropriate, sex. Accurate measurement and the use of standard growth charts are important tools for monitoring a child's growth.

4. Growth problems

Assessment of growth and nutrition is important, both in the diagnosis of primary nutritional and growth disorders and also in the diagnosis of chronic disorders. Because of some background disturbances, sometimes a child may be abnormally short or tall and light or heavy from infancy onwards, whereas in others initial normal growth is followed by growth failure or acceleration.

5. Nutrition and growth

Food consumption has a tremendous influence on human lives and is essential to life itself. Eating appropriate amounts of a wide variety of foods helps to maintain optimal health. Prolonged periods of poor food choices may cause impaired health. People need approximately 50 nutrients for growth and maintenance of health. These nutrients are present in a wide variety of different types of foods. Carbohydrates, lipids and proteins are energy nutrients which give the human body the energy it needs for moving and doing work, as well as for such vital activity as breathing and pumping blood. Minerals, a category made up of more than 20 nutrients perform a variety of functions, although they are not sources of energy. Vitamins are regulatory substances needed in even smaller amounts than minerals. At present, 13 vitamins are recognized as essential nutrients. Every person, (whether a child or mature adult), needs good nutrition in order to maintain good health and this can be supplied by a well-balanced healthy diet taken in regular meals and in appropriate surroundings (Wright, 2000).

The evidence in the World Health Organization (WHO) Global Database on Child Growth (De Onis et al, 2000) and Malnutrition gives a description of the magnitude and geographical distribution of childhood under- and over-nutrition worldwide. Analyses based on the database's information confirm that child under-nutrition remains a major public health problem in many countries, and can hamper children's physical growth and mental development. Indeed, it may even be a major threat to their survival. Despite an overall decrease in poor growth in developing countries, in some, poor growth is increasing in prevalence and in many others the incidence of growth faltering remains disturbingly high(De Onis et al, 2000, 1993). An important observation which has been made, is that the pattern of growth faltering in developing countries, not only within a region but also globally, are remarkably similar even though different instruments and measuring methods were used in the surveys. This suggests that interventions during the earliest periods of life

are likely to have the greatest impact in promoting good nutrition and preventing poor growth and development in children.

6. Healthy eating habits in preschool children

Good preschool eating patterns are important because they influence both energy and nutrient intake, and dental health. An optimum eating pattern would be regular meals and nutritious, low fat, low sugar snacks. Young children have small appetites but large nutrient needs relative to their body size, therefore regular refueling is required. An eating pattern based on distinct meals is generally beneficial and also promotes dental health. Dental caries is prevalent in preschool children and it is directly related to the amount and frequency of consumption of non-milk extrinsic sugars in the diet (Holt, 1991). Family meal patterns are inevitably affected by family routines, parents working hours and the child's appetite at different times of day. Regular meals allow opportunities for socializing and for parents to set a good example with respect to food choices and eating behavior (Graham, 1972).

A suitable snack should provide nutrients other than calories and should be low in non-milk extrinsic sugar and not interfere with the child's appetite for meals (Sims & Morris, 1974). Snacks high in non-milk extrinsic sugars greatly increase the risk of dental caries and an excessive intake of high fat, high sugar snacks will lead to an energy intake in excess of need (Splett & Strory, 1991). Many snacks will reduce the appetite for meals, often to the detriment of total nutrient intake (Beaton & Chery, 1988). The best snacks are bread and cereals, or fruit and vegetables. They need to be readily available, affordable and appealing to a child (Ministry of Agriculture, Food and Farming, (MAFF), 1997).

7. Feeding problems in pre-school children

Feeding problems are remarkably common in pre-school children. The incidence of feeding problems has been estimated to vary from 16% to 75 %(Eppright et al, 1969; Minde & Minde, 1986). This is a time of growing individuality for children, a time when a child's personality and temperament is demonstrated. Most cases of food refusal and feeding problems are minor and have no effect on growth or the child's weight gain but occasionally the problems can be very severe. Feeding problems may relate to the choosing of foods, or to eating behaviors. Both of these may be accompanied with food refusal or food fads which have psychological and other underlying causes (Harrise & Booth, 1992).

Medical conditions must always be considered and excluded as a reason for a child failing to eat. In the absence of underlying disease, psychological problems should be considered. Many young children pass through a phase of being faddy about food and refusing to eat certain foods. Food faddiness tends to reflect the extremes of young children's food likes and dislikes and often has a psychological cause. Food like and dislikes are influenced by taste, familiarity, parents attitudes to food, and food appeal. In this respect, refusal to eat meat and vegetables and also refusal to drink milk have been reported in young children. Poor appetite, limited food appeal, emotional upset and manipulative behavior are said to be the most common reasons for food refusal in young children(Harrise & Booth, 1992).

Excessive intake of snacks, milk and drinks, particularly squash, may be a reason for poor appetite in young children (Houlihane & Rolls 1995). Snacks close to mealtimes may also suppress appetite (Sims & Morris, 1974). Irregular frequent meals are a common feeding

pattern in young children. This behavior may influence both the appetite and dental health of children. In a study in 1991 Holt showed that between-meal snacking was prevalent in 4 year-old children (Holt, 1991). Small children may be over-whelmed by a large plate of food. Small portions, of colorful, attractively presented food are more tempting (Harrise & Booth, 1992).

Toddler behavior is strongly influenced by past experience. Any negative experience with food might result in future food refusal. Transient food refusal may occur after birth of a sibling or other event, in an attempt to redirect attention to themselves (Harrise & Booth, 1992). Refusal to chew due to failure to introduce texture and lumps before 6-7 months of age can result in children rejecting lumpy food later (K & R Minde, 1986).

8. Assessment of diet, nutrition and feeding problems

One of the most important indicators of suitable and adequate nutrition is normal growth. Therefore, prolonged food refusal, even due to non-organic causes can result in impaired growth. Regular weight and height measurement is therefore necessary. Taking a detailed diet history is also an important part of growth assessment (HMSO, 1992). Diet questions should include a food diary describing all food and drink consumed, with details of meal pattern, location of eating time and supervision received(HMSO, 1992). There are different types of diaries available. Food frequency tables are one type which includes information about frequency of consumption as well as the type of foods usually eaten. Details of nutrient intake can be made by analysis of the type and amount of reported foods, but reporting problems can make such analysis unreliable.

9. Early Childhood Caries (ECC)

Dental caries is a complex, multi-factorial disease and is a significant health and social problem which affects people of all ages and is responsible for a vast amount of pain, misery and economic loss. It is a major problem in young children. Caries of the primary teeth "Early Childhood Caries" or ECC is one of the most prevalent health problems in infants and toddlers (Mayanagi et al, 1995). It can be considered an epidemic in lower-income families and in under developed parts of the world (Ismail & Sohn 1999). ECC is one of the major causes of hospitalization in young children, who often need to receive general anaesthesia for extraction or tooth restoration (Sheller et al, 1996).

10. Public health aspects of dental caries

Despite improvements in the oral health of children in recent decades, early childhood caries (ECC) remains a serious threat to child welfare. ECC is manifested by severe decay of primary teeth. This can be a debilitating condition that can not only affect the children but also their families and the communities in which they live. Toothache leads to school absence, which is a ready indicator of children's health. In the USA, where caries is lower than elsewhere, visits or dental problems accounted for 117 000 hours of school lost per 100 000 children (Gift et al, 1992). Because most school dental services work mainly during school hours, loss of schooling among the poor, who have higher caries rates, is high. Other manifestations of ECC include pain, infection, abscesses, chewing difficulty, malnutrition,

gastrointestinal disorders, and low self-esteem (Ripa, 1988). ECC might also lead to malocclusion and poor speech articulation, and is associated with caries in the permanent dentition (Kaste et al, 1992).

The problems associated with this disease often generate fear and aversion to treatment, and severely affected patients may require extensive restorative treatment, stainless steel crowns or tooth extraction, which may involve sedation or general anesthesia(Ripa, 1988; Weinstein et al, 1992).

Treatment of ECC is expensive and if general anaesthesia is used, the cost can increase along with the medical risk to which the children involved are exposed. ECC is the most prevalent infectious disease among children, 5 times more common than asthma and 7 times more prevalent than hay fever (Rockville, 2000).

In the absence of widely accepted standards for diagnosing ECC, various diagnostic criteria have been used(Derkson, 1982; Ripa, 1988; Kelly & Bruerd, 1987; Winter, 1966). The lack of standard diagnostic criteria affects reported prevalence rates and makes it difficult to compare data from different studies (Kaste et al, 1992). Nevertheless, ECC is clearly a common problem in the United States and other countries particularly among economically disadvantaged children (Milnes, 1996; Kelly & Bruerd, 1987; Winter, 1966; Broderick et al, 1989) . Five to 10 percent of young children and twenty percent of children from families with low income have ECC and the rate is higher among the families from ethnic and racial minorities.

Most studies of ECC have focused on clarifying disease etiology by investigating demographic variables and by characterizing risk behaviours (Barnes et al, 1992; Dilley et al, 1980; Goepferd, 1986; Babeely et al, 1989). Some investigators have conducted several studies that are directly relevant to the proposed project, including evaluation of risk factors for ECC in underserved ethnic groups, the use of different criteria to diagnose ECC, the cost of treating ECC, laboratory analysis of salivary risk factors for cariogenesis, and development of caries risk assessment models. However, most studies failed to investigate the role of childhood caries in the quality of life and well-being in this vulnerable group and the effects of it later in the affected individuals' lives.

Therefore ECC is undoubtedly an important issue from public health point of view as it is so widespread, is preventable, and can impact on general well being and perhaps overall health. The accepted model for the development of caries consists of three categories of risk factors: micro-organisms, substrate/oral environment, and host/teeth. Recent scientific evidence strongly suggests that the first step in the development of ECC is primary infection by Mutans Streptococci.

The most important predisposing factors for ECC are listed as diet, nutrition and feeding behaviour. Certain inappropriate feeding practices have also been associated with ECC. The bottle contents, the frequency and duration of feeding, and how long the child is bottle-dependent, are especially important. Bottle-feeding with liquids such as Jello water and soda-pop is particularly harmful because these drinks contain sucrose, a highly cariogenic substrate. Prolonged use of a bottle containing high-fructose liquid at naptime or bedtime is strongly associated with ECC (Reisines & Douglass, 1998).

There are many studies concerning the role of type, frequency and content of consumed foods; however a reliable and valid instrument has not been developed to reliably measure diet in relation to caries development in individuals. However there is no doubt that the frequent consumption of sugary food plays a role in the development of ECC.

Other studies have shown that lack of oral hygiene and certain family characteristics also increase the risk of ECC: parents of children with ECC had less education and more caries, were more obese, were more likely to be overindulgent and less likely to say "no" to their children, and cleaned their children's teeth less frequently than parents of children without ECC (Acs et al, 1992; Winter, 1966).

Although the type of sugar consumed is an important factor in the development of caries, the frequency of sugar consumption is of greater significance. Several studies support this hypothesis (Amiutis, 2004; Zita & McDonald, 1959). Since the publication of the Vipeholm study, (Gustafsson et al, 1954) it has been accepted that the frequency of ingestion of sugar-containing foods is directly proportional to caries experience. In addition a study by Konig showed a positive correlation between the frequency with which animals ate cariogenic foods and dental caries severity (Konig et al, 1968) and Holt found that the pre-children with caries have between meal snacks approximately four times each day(Holt, 1991) .

There are many studies which suggest that children with ECC have a high frequency of sugar consumption, not only in fluids given in the nursing bottle, but also of sweetened solid foods. Results of clinical studies suggest that this dietary characteristic is likely to be one of the most significant caries risk factors in ECC (Konig et al, 1968; Sheiham, 1991). Increased frequency of eating sucrose increases the acidity of plaque and enhances the establishment and dominance of aciduric Mutans Streptococci.

The increased total time sugar is in the mouth increases the potential for enamel demineralization, and there is inadequate time for demineralization by the buffering action of saliva (Loesche, 1986). There is also evidence that the amount of sugar consumed is an important factor in caries development, although it is very likely that the frequency of eating sugar rises as the amount of sugar consumed rises. A high positive correlation between amount and frequency of eating sugary foods can therefore be assumed (Burt, 1986).

11. Feeding pattern in children with ECC

The relationship between sugar consumption and dental caries is one of cause and effect. The evidence to support such a relationship is generally considered overwhelming (Burt, 1986). Epidemiological studies have shown that caries prevalence was highest among children who ingested a diet high in sugar (Sheiham, 1991). Surveys have also shown that high consumption of cariogenic drinks and foods at bed time by pre-school children is an important factor in risk of caries (Palmer, 1971). Holt's study in 1991 on a group of preschool children showed that children consume sweets, biscuits and sweet drinks regularly and that mean dmft increases significantly with a higher rate of sugar consumption (Holt, 1991).

12. Diet, nutrition and dental health

It has been well-documented in animals that early malnutrition affects tooth development and eruption (Mellanby, 1928) and can result in increased dental caries later in life. But in

humans, a causal relationship between nutritional status and dental health has not been directly demonstrated (Alvarez & Navia 1989). However two separate cross-sectional studies in Peruvian children have shown that malnutrition is associated with delayed tooth development and increased caries experience (Alvarez et al, 1988, 1990). However it has been shown beyond reasonable doubt that there is a distinct relationship between diet and dental caries (Gustafsson et al, 1954). These effects are accepted, but there are two important aspects to the relationship; food choice and nutrient intake, both may affect and be affected by, poor dental health.

The role of nutrition in the maintenance of health is well known. Nutritional deficiencies in the growing child, whether due to deprivation, over-indulgence, or mal-absorption syndrome may have significant impact on somatic growth (Root et al, 1971). The potential impacts of eating disorders on overall health have also been established (Gross et al, 1986). The constellation of poor dietary habits which result in early childhood caries is currently most recognized for its impact on the dentition, rather than on overall health. However recently, some reports have claimed that severe dental decay could be a contributing factor for poor growth in children (Miller et al, 1982; Acs, 1992; Ayhan et al, 1996; Malek Mohammadi et al, 2009).

One of the most important indicators of health is normal growth and normal growth is an indicator of nutrition. The health of the dentition would appear to have some effects on nutrition. Therefore, there may be a relationship between the health of the dentition and growth. Miller's study (as mentioned above), showed that 1105 children with severe dental caries who needed extractions of deciduous teeth under general anaesthesia (GA) were significantly lighter than 527 control children (Miller et al, 1982). One part of the study was a retrospective comparison of clinical records. The children were weighed as a routine and their height measured as well. A control group was selected from children who were attending for routine dental care (DC). The children in the GA group were lighter than those in the DC group and in the GA group 31.3% were below the 23rd percentile compared with only 17.1% in the DC groups. The second part of the study compared the diet history of the two groups. The frequency of eating was higher in GA group. The DC group ate animal protein more frequently than the GA group and the GA group had a higher fat intake. There was a significant difference between the groups, in their intake of refined solid carbohydrate between meals.

Another retrospective case control study was conducted in a paediatric population by Acs in 1992 and a review of anaesthesia records of children with nursing caries was undertaken (Acs, 1992). The weights of 115 children with no special medical history were compared to subjects matched for age, gender, race and socioeconomic status. The study group had at least one pulpally involved tooth and the comparison subjects had no gross carious lesions. The weight of children with caries was significantly lower than the control group and 8.7% of children with caries weighed less than 80% their ideal weight, compared with only 1.7% of the comparison group. The mean age of the low weight children with caries was significantly greater than for children at or above their ideal weights. This was interpreted as indicating that progression of caries may affect growth adversely.

In a similar study in Ankara similar results were obtained (Ayhan et al, 1996). In this study, the mean weight of 126 children, aged 3 to 5 years old with caries was compared with the mean weight of children with no caries but similar age and sex. The mean weight of case

children was between 25th and 50th percentiles while the mean weight of control group was between 50th and 75th percentiles. Seven percent of children with caries weighed less than 80% of their ideal weight compared 0.7% of the control group children. Evaluation of height showed that it was similar to weight but head circumference was not statistically different in the two groups.

In a recent published study, data analysis from National Oral Health Survey in Philippines (Benzian et al, 2011) showed that prevalence of low BMI was significantly higher in children with odontogenic infections as compared with children without odontogenic infections.

The regression coefficient between BMI and caries was highly significant ($p < 0.001$). Children with odontogenic infections (PUFA + pufa > 0) [PUFA/pufa is an index used to assess the presence of oral conditions and infections resulting from untreated caries in the primary (pufa) and permanent (PUFA) dentition] as compared to those without odontogenic infections had an increased risk of a below normal BMI.

13. Effect of improved dentition on nutrition and growth in children

The reported association between chronic malnutrition, growth, and dental caries suggests that dental decay might contribute to poor weight gain in children (Alvarez et al, 1990). Four cases of children with early childhood caries and subsequent dental rehabilitation were published by Acs in 1998 (Acs et al, 1998). Regardless of the presumptive aetiology of the poor weight gain, all of these children demonstrated an immediate increase in weight, propelling them to higher weight percentile categories with increased adjusted 6-month increments of growth after their carious teeth had been repaired. At the end of the observation, none of these children continued to satisfy the criteria for the designation of faltering growth. These observations were consistent with the phenomenon of catch-up growth that has been observed in faltering growth children (Prader et al, 1963).

The effect of dental health improvement on growth was evaluated through another study by Acs in 1999 (Acs et al, 1999). The percentile weight categories of children with non-contributory medical histories and early childhood caries were compared to caries free patients, before and after comprehensive dental treatment under general anaesthesia. Percentile weight categories of the test subject were significantly less than that of the comparison group and 13.7% of ECC patients weighed less than 80% of their ideal weight. Following complete dental rehabilitation, children with ECC exhibited significantly increased growth velocities through the course of the follow-up period. At the end of the follow-up period there were no longer any statistically significant differences in the percentile weight categories of the test and comparison groups.

In a longitudinal clinical trial study in Manchester treatment of severe caries resulted in weight gain in 5-6 year-old children. (Malek Mohammadi et al, 2009) One thousand two hundred children aged 2-12 year-old had carious teeth extracted under general anesthesia during the study period. Of these, 218 five and six year old children participated in the study. Most of the children recruited to the study had a high caries rate, as expected. The mean (SD) dmft was 7.18 (3.27). 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 at baseline was 6.9% (15),

whilst 8.3% (18) were below the standard's 10th percentile for height. 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. On average the children showed a clear gain in weight at follow up and a slight gain in height. The 15 children with low weight (<10th percentile) at baseline also had significant increases in SD scores for weight and BMI ($p<0.001$) at follow up.

These studies suggest that children's ability to gain weight may be negatively affected by the presence of carious teeth in their mouths and that weight is gained more quickly than normal in the six months after tooth extractions.

In another longitudinal birth cohort, children who had caries at 61 months had slower increases in weight and height between birth and 61 months than those without decay at 61 months (Kay et al, 2010). It is possible that the chronocity of ECC may have a similar influence like other chronic diseases on a child, making them unable to sustain normal growth, and therefore, impacting on general health and well being.

Whilst nutrition is very important in growth and development, recently it has been suggested that children who do not have any medical problems, but who are deficient in growth, may have higher levels of caries. Growth deficiency and ECC may therefore be related in some way. Oral health affects people physically and psychologically and influences how they grow, enjoy life, look, speak, chew, taste food and socialize, as well as their feelings of social well-being (Locker, 1997).

If dietary intake alters as a result of caries this could result 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. 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 studies presented and also seem plausible, both biologically, and behaviorally.

Severe caries detracts from children's quality of life: they experience pain, discomfort, disfigurement, acute and chronic infections, and eating and sleep disruption as well as higher risk of hospitalization, high treatment costs and loss of school days with the consequently diminished ability to learn. Caries may also affect nutrition, growth and weight gain. Children of three years of age with nursing caries weighed about 1 kg less than control children probably because toothache and infection alter eating and sleeping habits, dietary intake and metabolic processes. Disturbed sleep affects glucosteroid production (Acs, 1992).

Dental problems which cause chewing to be painful may affect the intake of dietary fibre and some nutrient-rich foods; consequently, serum levels of beta carotene, folate and vitamin C have been observed to be significantly lower in those with poorer oral status (Sheiham & Steele, 2001).

It is likely that younger children, with early caries, prior to the onset of pain and infection have poor feeding habits, particularly high carbohydrate intake. However as the children age and caries progresses, the onset of pain and infection may alter eating habits eg. If carious teeth become pulpitic, the eating of refined carbohydrates will cause pain and the child would therefore be more likely to avoid such foods. Altered dietary intake secondary to pain could therefore result in an alteration of established growth patterns.

Because oral and other chronic diseases have determinants in common, more emphasis should be on the common risk factor approach. The hypothesis that ECC and growth may be related through the common factors of diet and nutrition seems plausible. While there are many studies which have investigated the role of diet in children's growth and in dental caries, diet as a common casual factor for poor growth and dental caries has not previously been fully investigated.

Dental caries, which is associated with what children eat, poses a real, and potentially life threatening danger to the children affected by it, because it frequently results in general anaesthesia quite apart from any other effects it may have on child wellbeing. Diseases which do not cause small children to undergo general anaesthesia and all the risks and problems it entails, but which affect individuals' health many years later cause disquiet amongst nutritionists and paediatricians. It is unfortunate that a disease such as dental caries, which causes extreme pain and leads to outpatient general anaesthesia, does not seem to engender the same levels of worry and concern. It would seem that the impact of the caries on children's general health and well-being has largely been ignored.

14. Summary and conclusion

Good nutrition is essential for good physical health. Nutrition also plays a key role in the development and maintenance of a healthy mouth, especially the teeth and gums. The food we eat affects our teeth both before and after their eruption into the mouth. The relation of dental caries and periodontal diseases to the type and frequency of diet and to intake nutritional elements is well-known. At the same time, the health or lack of health of our teeth and gums can affect what we eat. Missing teeth are a factor in food choices and may affect individuals' ability to consume the necessary nutritional elements. Nutritional deficiencies in growing children, whether due to deprivation or mal-absorption syndromes may have significant impact on their natural development and somatic growth. The potential impact of eating disorders, chronic diseases and infection on overall health via physiologic and hormonal mechanisms has also been well established.

- Early childhood caries is a chronic disease with a form of rampant decay of the primary dentition distinguished by the specificity of tooth surfaces involved and the rapid progression of carious lesions on those surfaces. It is usually associated with the onset of acute or chronic pain and infection. It appears that the chronicity of childhood caries might have the same influence on a child's ability to sustain normal growth patterns as any other chronic disease or infection, and therefore caries may impact upon general health and well being. Numerous studies have reported the prevalence of the disease as to affect up to 70% of the childhood population, especially in socio-economically deprived population.

- Inadequacy of the host's immune-defences may play a role in the acquisition of carious lesions. However, feeding habits are more important, especially in early childhood, and the role of feeding habits and behaviors in producing dental decay in childhood has been established by numerous studies.
- It has been reported that childhood caries inhibits adequate nutrition, thereby adversely affecting the growth of the body, specifically weight. Children with childhood caries have been noted to be significantly more likely to weigh less than 80% of their age-adjusted ideal weight, thereby satisfying one of the criteria for failure to thrive.
- The phenomenon of catch-up growth has been reported to occur in children whose growth had been slowed by illness or malnutrition and a case report has suggested that children with low weight and carious teeth demonstrated significant weight gain following dental rehabilitation.
- However, although many studies of the role of a healthy mouth in dietary intake pattern and nutritional intake have been reported, but there are very few epidemiological or intervention studies concerning the association between the growth of children and their oral health or the role of diet and nutrition in this association.
- The most important issue to be gleaned from the literature is that health professionals, especially paediatricians, do not routinely consider the effect of oral health in growth due to lack of dental knowledge or awareness of the importance of a healthy dentition in overall health. It seems that dental health professionals could play an important role in highlighting this issue and like other primary health carers, could perhaps be helpful in diagnosing and managing these two important health problems through dietary advice and encouragement of appropriate feeding behavior. Therefore, by preventing one it may be possible to prevent, or at least reduce, the risk of the other.

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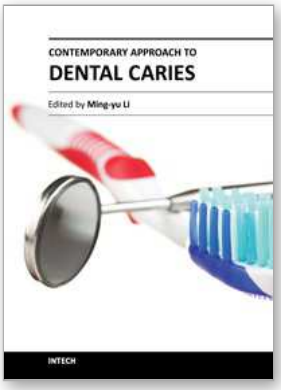

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With an update of the recent progress in etiology, pathogenesis, diagnosis, and treatment of caries, it may be said that the final defeat of dental caries is becoming possible soon. Based on the research in this area in recent decades, "Contemporary Approach to Dental Caries" contained the caries in general, the diagnosis of caries, caries control and prevention, the medical treatment of caries, dental caries in children and others such as secondary caries. This book provides the reader with a guide of progress on the study of dental caries. The book will appeal to dental students, educators, hygienists, therapists and dentists who wish to update their knowledge. It will make you feel reading is profitable and useful for your practice.

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