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Body mass index and dental caries

(Graduation Project)

A project submitted to
the Scientific Committee of the Department of Oral & Maxillofacial Surgery, College of Dentistry / University of Baghdad,
in partial fulfillment of requirements for the BDS Degree

By

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بسم الله الرحمن الرحيم

﴿وَمَا أُوتِيتُمْ مِنَ الْعِلْمِ إِلَّا قَلِيلًا﴾

صدق الله العظيم

سورة الاسراء

آية (85)

Declaration

I certify that this project was prepared by the undergraduate students **Mohammed Majeed Abass** under my supervision at the College of Dentistry / University of Baghdad in partial fulfillment of requirements for the degree of Bachelor in Dental Surgery (BDS).

Signature

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Dedication

We dedicate it to our families for their unlimited support throughout all these years and our appreciations and thanks to every one taught us a letter from our childhood until today.

Acknowledgment

First and foremost, We would like to express our utmost gratitude to **Allah** for giving us the strength, endurance and patience to achieve this difficult project.

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INTRODUCTION

Oral diseases, especially dental caries, are still mainly prevalent in most developing countries, affecting people from all races, socioeconomic status, and ages. This disease, dental caries, still continues to be a public health problem in spite of technological advancements and a better understanding of the carious process.(Rao A etal ; 1999) Dental caries is a multifactorial disease attributed to both modifiable risk factors like dietary factors, water fluoride levels, tooth brushing frequency, and nonmodifiable risk factors like socioeconomic status and previous caries experience. The focus now is shifted to modifiable factors, specifically diet, in the prevention of dental caries. (Rao A etal ; 1999)

Body mass index is an anthropometric measurement which measures weight relative to the height. Though it is often used to estimate the level of body fat in individuals, it provides an excellent indicator of obesity-related health risks. (Rao A etal ; 1999)

The world is witnessing an increasing number of overweight individuals owing to the consumption of fast food and soft drinks coupled with lack of activity and exercise. Overweight individuals are associated with prolonged exposure to carbohydrates.(Willerhausen B etal ; 2004) Excessive consumption of refined carbohydrates, especially sugar in its refined form, is associated both with dental caries and being overweight and obese.(Kopycka-Kedzierawski DT etal ; 2008) An association between BMI and dental caries works probably on this possibility. The Scientific Advisory Committee on Nutrition (London) reported an association of higher consumption of free sugars with dental caries. The consumption of sugar-sweetened beverages further leads to greater weight gain and increase in BMI.

Literature provides evidence for the coexistence of obesity and dental caries, as they have common risk factors like consumption of free sugars and socioeconomic deprivation. Overweight and dental caries are attributed to complex behavioral and societal factors which include genetic component, increased

media exposure through television and computer games, overall calorie intake along with increased intake of sugary foods and beverages, physical activity, habits of both oral hygiene and personal. Various literature stands evidence to the coexistence of the two conditions in the same individuals and populations, but with variations.(Moynihan PJ and Kelly SA ; 2014)

Dental caries are more common among children with a high sugar diet and among children who consume carbonated soft drinks and sugary snacks(James J and Kerr D; 2005) The relationship between dental caries and body mass index (BMI) in children has been studied worldwide. Consumption of sugary snacks between meals, high-fructose containing beverages and high carbohydrate foods is associated with higher prevalences of dental caries and obesity. (Oliveira LB etal ; 2008)

However, some studies have found dental caries to be related to a low BMI in children with negative eating habits, such as being a picky eater, leading to malnutrition and inability to consume food adequately. (Norberg C etal ; 2012) Some studies found no association between dental caries and body mass index in children. In the US, diet counseling is part of preventive advice given by pediatric dentists. Pediatric dentists have been recommended to screen their patients for an inappropriate diet. The US Department of Agriculture has developed the Healthy Eating Index (HEI), which measures the quality of diet compare to the recommendations set forth in “Dietary Guidelines for Americans” (Oliveira LB etal ; 2008) .

Aims of the study

A review of relationship between dental caries and bodymass index

Chapter One

Review of literature

1-1 BodyMass Index

The body mass index (BMI) is the metric currently in use for defining anthropometric height/weight characteristics in adults and for classifying (categorizing) them into groups. The common interpretation is that it represents an index of an individual's fatness. It also is widely used as a risk factor for the development of or the prevalence of several health issues. In addition, it is widely used in determining public health policies.The BMI has been useful in populationbased studies by virtue of its wide acceptance in defining specific categories of body mass as a health issue. However, it is increasingly clear that BMI is a rather poor indicator of percent of body fat. Importantly, the BMI also does not capture information on the mass of fat in different body sites. The latter is related not only to untoward health issues but to social issues as well. Lastly, current evidence indicates there is a wide range of BMIs over which mortality risk is modest, and this is age related. (Keys A etal ; 1972)

Adoption of the BMI as an Index of Obesity

In 1972, Keys et al 16 severely criticized the validity of Metropolitan Life Insurance published data , and the then-published tables of desirable weight for height, as well as the tables used to define people who were underweight or overweight. (Metropolitan Life Insurance Company , 1959) (The pejorative term ‘‘obese’’ was rarely used in that) . Instead, Keys et al, using better documented weight for height data, popularized the Quetelet Index in population-based studies. They referred to it as the body mass index (BMI). Thus, Quetelet Index = body weight (kilograms) divided by height squared (meters) = BMI. As indicated above, by squaring the height, it reduces the contribution of leg length in the equation and tends to normalize the bodymass distribution at each level of height; that is, it reduces the effect of a variance in height in the relationship of weight to height. This was considered to be

important because most of body fat is in the trunk. Nevertheless, even the BMI rather poorly represents a person's percent of body fat.(Keys A etal ; 1972) Despite all the criticisms, the Metropolitan Life criteria for defining obesity were widely used in the United States until the early 1990s. At about that time, the World Health Organization (WHO) classification of body weight for height, based on the BMI, was published, and later it was widely adopted.(WHO; 1995)

Problems With the Wt/Ht (Body mass index)

Early on it was recognized that tall people had a lower death rate than did short people. with the same Wt/Ht ratio. It also was recognized that a person's height in general and leg length in particular could affect the calculated body mass adjusted for height. A person's bony frame, that is, bone mass, also could affect the interpretation of this ratio. In general, it reflected whether one was narrowly or broadly built. Thus, efforts were made to eliminate lower limb length and frame size as variables. (Metropolitan Life Insurance Company ; 1959) The strategy was to develop representations of body build, that is, charts of weight/height that were independent of these variables. The overall goal was to have the same distribution of Wt/Ht at each level of height.

Although not stated, the implicit goal in developing these tables was to define a person's fat mass as a proportion of their total mass, irrespective of their height or frame size.(Khosla T and Lowe CR ; 1967) Efforts were made to adjust for frame size (nonfat mass) by categorizing people as those with a small, medium, or large frame. Estimation of frame size was attempted using a number of measurements including shoulder width, elbow width, knee width, ankle width, and so on. None of these were widely adopted. Nevertheless, frame size based on elbow width was included in the Metropolitan Life weight/ height, even though it was never validated.Himes JH and Bouchard C ; 1985)

Later, it was shown that the body mass for height actually scaled best with weight for height when the height was raised to the 1.6 to 1.7 exponent (Wt/Ht, 1.6 etc).(Benn RT: 1971) Thus, with an increase in Ht, the effect of Ht on the ratio is exponential, whereas the change in Wt is linear. This has the effect of Ht on the ratio to be magnified as Ht increases. Overall, it results in a lower ratio in tall people than will be obtained with just a Wt/Ht ratio. Thus, it potentially compensates for a narrower build in tall compared with short people. This exponent is not convenient for use in populationbased studies, and it was determined that Wt/Ht 2 generally was satisfactory. The latter represents the Quetelet Index. It was developed by Dr Quetelet in the 1800s.(Benn RT: 1971)

BMI Distribution in a Normal Population

Although a BMI determination reduces the effect of lowerextremity length on the Wt/Ht ratio, whether one uses the BMI or merely the ratio of weight to height, the population distribution is still not Gaussian. That is, it is not symmetrical but is always skewed to the right, that is, toward a higher ratio of weight (body mass) to height. For example, the distribution of BMIs in adult American men and women was determined in 1923 in 1026 individuals. (Must A etal ; 1991) The distribution curve clearly indicated a skewing toward an increase in BMI, and this trend has continued.(Rony H; 1940)

This skewing is not surprising because a markedly reduced BMI, theoretically and actually, would be incompatible with life because of an excessive reduction in lean as well as fat mass as a result of under nutrition or disease. In contrast, excessive accumulation of body fat with maintenance or usually an increase in lean mass , is at least compatible with life, even though it may eventually affect long-term survival.(Wellens RI etal ; 1996)

Distribution of BMI in the General Population

It should be understood that in Western population-based studies, generally the mean or median BMI is about 24 to 27. Thus, the consequence of adopting the WHO classification is that ~50% or more of the general adult population will always be in the overweight (now preobese) and obese categories. Indeed, the term ‘‘overweight’’ or particularly ‘‘preobesity’’ is prejudicial since people in this category are a major part of the expected normal distribution of BMI in the general population, and this has been the case for decades. Unfortunately, in discussing the so-called ‘‘obesity epidemic,’’ the number of people in the overweight (preobese) category generally is lumped together with those in the obese category in order to advertise and dramatize the perceived seriousness of this issue. Regardless of the terminology and population reference issues, at present the BMI is the currency by which we define the obesity issue throughout the Western world. It was developed for the convenience of the epidemiologists, and indeed it did provide a uniform codification of body weight for height reporting. The BMI categories are shown in (Table 1). (Ogden CL etal ; 2004)

BMI as a Determinant of Body Fat Mass

A particular problem with BMI as an index of obesity is that it does not differentiate between body lean mass and body fat mass; that is, a person can have a high BMI but still have a very low fat mass and vice versa.(StrainGW and ZumoffB; 1992)

Underweight	15–19.9
Normal weight	20–24.9
Overweight	25–29.9
Preobesity	
Class I obesity	30–34.9
Class II obesity	35–39.9
Class III obesity	≥40

Abbreviation: BMI, body mass index

TABLE (1-1) Categories of BMI

From an anatomical and metabolic perspective, the term obesity should refer to an excessive accumulation of body fat (triacylglycerols), and upon these grounds, the accuracy of the BMI as a determinant of body fat mass has been repeatedly questioned, because it clearly has limitations in this regard. Gender, age, ethnic group, and leg length are important variables. It should be noted that in population-based studies women generally have a BMI that is lower than that in men, even though their fat mass relative to their body build or BMI is considerably greater (~20% to 45%+).(Garn SM etl ; 1986)(Norgan NG ; 1994)

Dental caries

Dental caries involves interactions between the tooth structure, the microbial biofilm formed on the tooth sur- face (figure. 1) and sugars, as well as salivary and genetic influences.(Pitts, N. B. and Zero, D. T. ; 2016) The dynamic caries process consists of rapidly alternating periods of tooth demineralization and remin- eralization, which, if net demineralization occurs over sufficient time, results in the initiation of specific caries lesions at certain

anatomical predilection sites on the teeth. It is important to balance the pathological and pro- tective factors that influence the initiation and progression of dental caries. Protective factors promote remineraliza- tion and lesion arrest, whereas pathological factors shift the balance in the direction of dental caries and disease progression. The daily use of fluoride toothpaste is seen by many authorities as the main reason for the overall decline of caries worldwide over recent decades; the mode of action of such toothpastes is concerned with shifting the balance of the oral biofilm towards health.(Koussoulakou, D. S.; 2009)

There is not a direct correlation between the extent of a caries lesion and whether pain and discomfort is felt. However, severe toothache, when it occurs, can be dis- abling, and infection and sepsis arising owing to caries that spreads to involve the dental pulp can occasionally lead to serious systemic consequences, such as spreading local infection and, very rarely, treatment-related death, as well as to tooth loss.(Prima DC, Murniwati. ; 2016)

The clinical detection of caries is traditionally made by detailed visual inspection of clean teeth by trained examiners. Although sharp pointed dental probes (or explorers) are still often used, they provide little addi- tional diagnostic benefit and can do some damage. Dental radiographs or other supportive diagnostic methods are also needed in clinical practice to detect lesions that are hidden to visual assessment, particularly those situ- ated on the approximal tooth surfaces (that is, surfaces that form contacts between adjacent teeth).(Chauhan P,etal ; 2019)

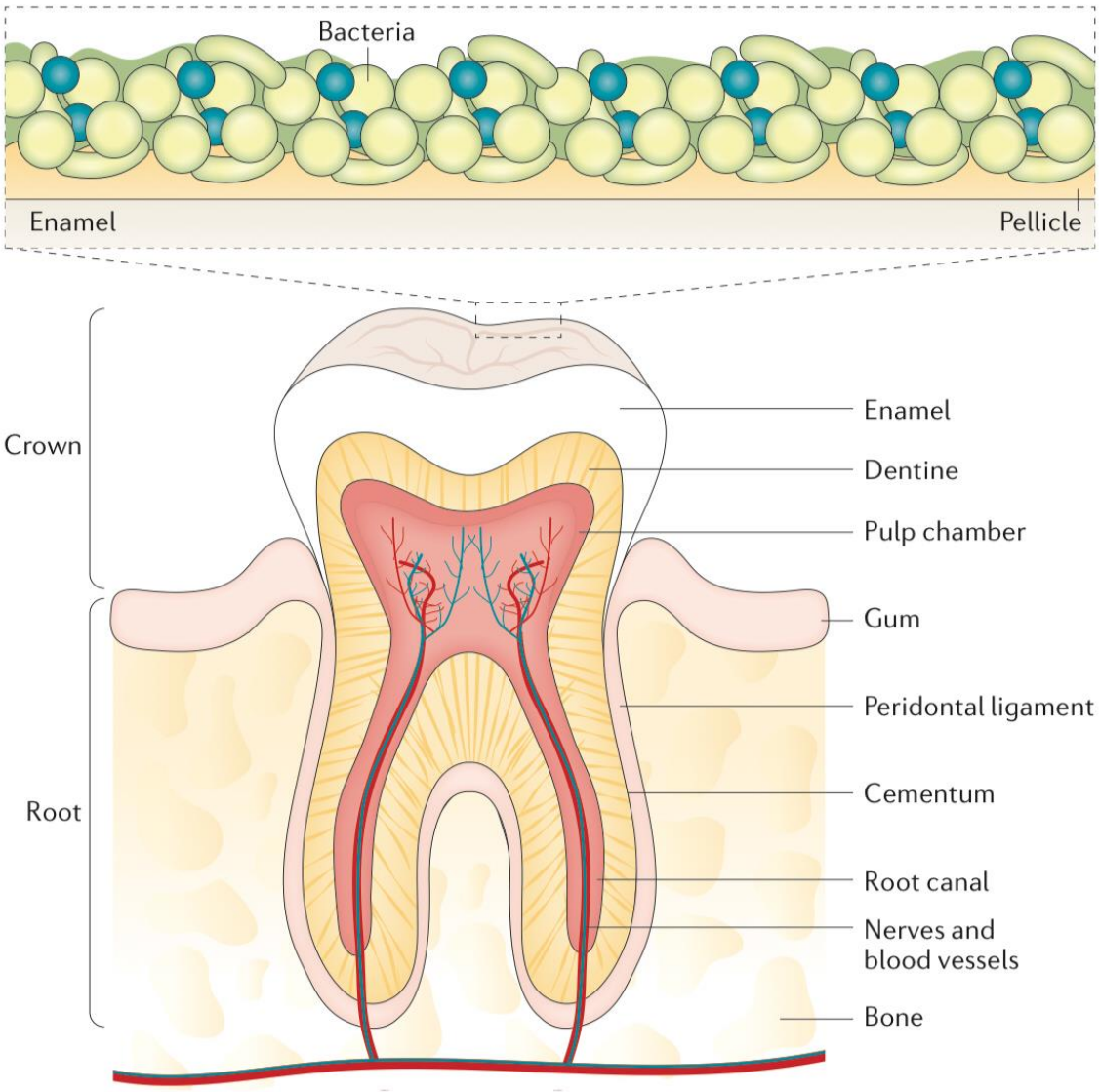

Figure (1-1) : Normal tooth anatomy and developing dental biofilm.

Children with a very high caries risk

To prevent caries and have successful management of oral diseases, perinatal and infant oral health care are essential aspects of early intervention, which facilitate behavioural changes and promote good oral health. An essential step is to start educating caregivers and their health care providers on the importance of dental care during pregnancy and infancy, with the development of child-specific oral health measures and methods to prevent oral diseases . This is especially important for children who are at high risk of ECC

development. Although there is no mechanistic difference in the pathology and principles of care between ECC and other forms of caries in children or adults, the issues related to ECC have more association with specific behavioural risk factors — the most important of which is the use of night-time bottles containing sugary beverages and juices. Although anatomical differences between primary and permanent teeth exist (such as the enamel being much thinner in primary teeth and, therefore, caries can progress faster into the dentine), the mechanisms, pathophysiology and treatment approaches are identical between both types. However, clinical management for the younger patient and the involvement of caregivers brings its own challenges.(Ogden C and Carroll M; 1963–1965)

CAMBRA is an evidence-based approach adapted to the specific needs of the subset of the child population with ECC who experience a very aggressive caries challenge. CAMBRA for ECC assists health care providers in a structured manner to first assess caries risk and the risk of caries progression at an early age in a patient-centred approach, on the basis of age and dental status and risk factors; second, to tailor a specific individualized care or preventive management plan, before deciding on a surgical modality; third, to formalize a follow-up plan based on risk and age of the child; and fourth, to ensure specific guidance for the caretakers with targeted self-management goals based on the age, risk and need of each individual patient at any given time. Disease progression in young children as low, moderate or high risk.(Shamliyan TA ,etal ; 2011).

Relationship between Body Mass Index and Dental Caries in Children

The relationship between weight loss and tooth decay has become a controversial health issue in various countries.(Alswat K;etal; 2016)An unhealthy diet, such as a high calorie diet, has been reported to be a significant

determinant of the increased prevalence of dental caries. People who have an unbalanced diet that includes sugary, calorie dense foods with low nutritional value, usually suffer from malnutrition and dental caries.(Moher D etal ; 2009)

The role of sugar (and other fermentable carbohydrates) as a risk factor in the onset and development of dental caries. Sugar acts as a preferred substrate for cariogenic bacteria that reside in dental plaque, especially Streptococcus mutans, and the acid byproducts of this metabolic process trigger demineralization of the enamel surface. Whether this initial demineralization progresses to clinically detectable caries or whether the lesion is remineralized by mineral plaque depends on a number of factors, which are influenced by the amount and frequency of further sugar intake. .(Moher D etal ; 2009)

Consumption of soft drinks and fast food together with minimal activity and exercise is contributing to an increase in the number of people who are overweight around the world. High sugar intake, for example sugar-containing snacks and soft drinks, is reported to be more common in children/adolescents who are overweight and obesity compared to those of normal weight. Frequent sugar intake is also a recognized risk factor for dental caries. Thus, diet among overweight or obesity children may be a common risk factor for overweight children and dental caries.(United Nations Development Programme; 2016)

Nutrition

Nutrition is the study of how food affects the body. It is the adequate provision of materials like vitamins, minerals, fiber, water and other food components to cells and organisms, to support life. Many common health problems can be prevented or alleviated with good nutrition.

The World Health Organization defines malnutrition as the cellular imbalance between supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions. Malnutrition can

either be over-nutrition or undernutrition. Nutrients generally refer to both micronutrients and macronutrients. (Moynihan P. ;2005)

Nutrition is an integral component of oral health. There is a continuous synergy between nutrition and the integrity of the oral cavity in health and disease . Malnutrition may affect the development of the oral cavity and the progression of oral diseases through altered tissue homeostasis, reduced resistance to microbial biofilms and reduced tissue repair capacity . In the absence of other contributing factors, compromised nutritional status must be considered in patients with refractory periodontitis, poor healing response to surgical procedures, or recurrent oral disease. This is particularly true for elderly patients and patients in institutional settings. Nutrition affects oral health, and oral health affects nutrition. This interdependent relationship sees good nutritional health promoting good oral health and vice versa . Nutrition is a major factor in infection and inflammation8 . Several reports emphasize the synergistic relationship between malnutrition, infectious diseases and the immune system; for example, infections promote malnutrition, the malnutrition elicits dysfunctions of the immune system, and this impaired immunity intensifies the infectious disease . In oral health, dental caries and gum disease, as well as many diseases of the mucous membranes, tongue and salivary glands, are infectious and not only disrupt the integrity of the oral cavity, but also affect general health. Periodontal diseases, characterized by chronic inflammation and a loss of the bone and soft tissues that surround the teeth, constitute one of the most common chronic infections in humans . A nutritious diet, including adequate amounts of protein, vitamins, essential fatty acids and micronutrients, can play an important role in the resistance to infectious conditions including periodontitis. (Sheiham A etal ;2001)

Nutrition and oral general health

Nutritional intake influences the oral tissues to which bacteria bind (i.e. epithelium, collagen, bone, teeth), as well as saliva . Secretory proteins (mucin) found within saliva provide an effective barrier against desiccation, penetration, physical and chemical irritants, and bacteria. Synthesis of glycoproteins, such as mucin, requires vitamin A. Retinol deficiency can reduce mucin production, leading to compromised salivary flow, weakened tooth integrity, and a marked increase in risk for caries .

Malnutrition is also characterized by increased production and secretion of stress hormones (glucocorticoid) and decreased secretion of insulin4 . Elevated circulating levels of cortisol in malnutrition imply a similar change in the content of this hormone in saliva and gingival fluid. Elevated circulating glucocorticoid levels, even at physiological concentrations, elicit macrophage dysfunction and reduce the production of cytokines in response to inflammatory stimuli. Cytokines play a prominent role in growth, differentiation, host defenses, and tissue damage. Cytokines also inhibit chemokines and other cells involved in attracting inflammatory cells at the site of inflammation, which ultimately impact the tissue healing process. (Ritchie CS etal ;2002)

The most common relationship between oral health and poor nutritional habits or deficiencies is seen in the pathogenesis of caries. There is a strong association between caries and frequency of sugar and carbohydrate intake.

A Candida albicans infection has a variety of predisposing factors, but high carbohydrate diets and iron or folate deficiencies have been strongly implicated.(Mandel ID ; 2002)

Recurrent aphthous stomatitis most often is a mild condition; however, severe cases may be caused by nutritional deficiencies such as iron, vitamin B12 and folate deficiencies. These deficiencies can also result to atrophic

glossitis or painful burning tongue which is characterized by inflammation and defoliation of the tongue. (Mandel ID ; 2002)

Dental erosion is the irreversible loss of dental hard tissue due to a chemical process of acid dissolution but not involving bacterial plaque acid, and not directly associated with mechanical or traumatic factors, or with dental caries. Erosion usually coexists with attrition and/or abrasion. Attrition may be defined as direct tooth-to-tooth contact wear, whilst particles moving across and contacting the tooth surface results in abrasion. Soft drinks have been found to have erosive potential, particularly in young age groups. Some alcoholic drinks, such as dry wine and cider are also acidic. Alcohol consumption is linked with gastric reflux and erosion may therefore be from both intrinsic and extrinsic sources. The frequency of, rather than total intake of these drinks may be critical in the erosive process. Fresh fruit, particularly citrus fruit, have erosive potential as do foods pickled in vinegar. Fruit drinks from a feeding bottle, used as a comforter, may be particularly harmful to infants. Extreme dental destruction has been reported from such practices . A vegetarian diet tends to be more acidic. Lacto-vegetarians were reported to have significant dental erosion.(Millward A;1997)

The health of periodontal tissues is strongly related to diet. There is a relationship between calcium intake and periodontal diseases. This may be due to calcium’s role in building density in the alveolar bone that supports the teeth. Calcium is necessary for healthy bones, teeth, muscle contractions and other functions. The relationship between vitamin C and periodontal disease may be due to vitamin C's role in maintaining and repairing healthy connective tissue along with its antioxidant properties. Increased serum triglyceride levels in uncontrolled diabetics are also related to greater attachment loss and probing depths.(Millward A;1997)

Conclusion

Conclusion

Two of the less flawed studies included in the review indicated that BMI and caries were positively related whilst the majority did not find evidence of an association between the two variables. The studies that found positive association were mainly conducted in older children.

The present systematic review indicated no evidence of a consistent association between BMI and caries and this finding is in keeping with those of previous systematic reviews.

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