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The Association of Body Mass Index with Dental Caries in Children: A Systematic Review

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ABSTRACT

Background: In the last few decades, industrialization, urbanization, economic development and market globalization have had a significant impact on changes in lifestyle and diet. Thus, food choices and nutritional intake greatly affect oral health and body weight. This has a significant impact on health and nutrition, particularly through higher carbohydrate intake and lower physical activity, particularly among younger members of the population. High sugar intake, such as sugar-containing snacks and soft drinks, was reported it is more common in children/adolescents who are overweight and obesity than those of normal weight. Frequent sugar intake is also a risk factor for dental caries. Given this, there is strong evidence that supports the relationship between dental caries and dietary intake has been associated with the development of obesity at a young age. Thus, it is possible to conclude that there is a biological relationship between dental caries and body weight. Objective: To see the relationship between body mass index and dental caries in children. Methods: Scientific evidence and clinical cases were drawn from the literature to support this review and information on the relationship between body mass index and dental caries in children. Result/Discussion: There is some scientific evidence showing a specific relationship between body mass index and dental caries in children. Conclusion:Body mass index has a significantrelationshipwiththeincidenceof dental caries in children. However, thisconditiondoes not account for which category the incidence of dental cariesis greatest. This is associated with multifactorial interactions that mutually influence the occurrence of dental caries in children.

Keywords: BodyMass Index, Underweight, Normal Weight, Overweight, Obesity, Dental caries, Children, Preschool, Schoolchildren

1. INTRODUCTION

Dental cariesis a chronic infectious disease of the teeth that can affect all ages and is characterized by damage to the teeth due to the products of microorganisms in carbohydrate fermentation.[1,2]Without adequate intervention, dental caries can cause pain and discomfort in the teeth and ultimately lead to tooth loss. [2]In children, dental caries is one of the most common chronic infectious diseases and epidemiological surveys over thelast 20 years have reported a substantial increase in the rate of development.[2,3,4]

During childhood, dental caries affects 60% - 90% of children worldwide.[1]Children aged 6-11 years have experienced dental caries in permanent teeth with the proportion varying from 14% to 29% in 2011 - 2012.[1,2]China's Fourth National Oral Health Epidemiological Survey states that 70.1% of 5 year old children have caries in their deciduous teeth and 34.5% of 12 year old students have experienced dental caries on their permanent teeth.[3]In

studiesshowingthevariousprevalenceof dental caries in childrenaroundtheworld, Cambodiaand Indonesia reportedthattheexcessiveburdenof dental caries in children has reached 90%. Basedonthe 2007 National Basic HealthSurvey, theprevalenceof dental and oral problems in Indonesia is 23.4%, whichgraduallyincreasedto 25.9% in 2013. In addition, theprevalence data for dental caries in 2013 showsthat 53.7% Indonesian residentshave dental cariesand 72.6% have dental caries.[1]

In the last few decades, industrialization, urbanization, economic development and market globalization have had a significant impact on changes in lifestyle and diet. Thus, food choices and nutritional intake greatly affect oral health and body weight.[3,7]This has significant health and nutrition implications, particularly through higher carbohydrate intake and lower physical activity, especially among the younger members of the population.[5]A person who has anunbalanced diet thatincludessugaryandcalorie-densefoodswithlownutritionalvalue, generallysuffersfrommalnutritionand dental caries. Itisalsoassociatedwithincreasedsusceptibilitytocariesduetoimpairedsalivarysecretionduetosalivary glandhypofunction. andchanges in salivarycompositiontherebyincreasingcariogenic activity.[3,6]

High sugar intake, such as 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 risk factor for dental caries. Given this, there is strong evidence that supports the relationship between dental caries and dietary intake has been associated with the development of obesity at a young age. Thus, it is possible to conclude that there is a biological relationship between dental caries and body weight.[3]

Thisassessmentiscarriedoutusing BMI (bodymassindex) toidentifychanges in bodyweightforheightwithseveralcategoriessuch as underweight, normal weight, overweight, andobesity. This assessment was carried out to see whether there was a specific relationshipbetweenbodymassindexandtheincidenceof dental caries in children. Therefore, thisliteraturereviewwillexaminetheextenttowhichbodyweightthroughbodymassindexaffectstheinc idenceof dental caries in children.

2. MATERIALS AND METHODS

Scientific evidence and clinical cases were drawn from the literature to support this review and information on the relationship between body mass index and dental caries in children.

LITERATURE SEARCH

A systematic review of the literature was carried out looking for all published articles on the association between body mass index and dental caries in children. On December 24th2020, a literaturesearchwascarriedoutusingthefollowingkeywords:"*bodymassindexanddental caries*, *bodyweightand dental caries*". The followingdatabases were searched: PubMedandGoogleScholar.

3. DISCUSSION

3.1 BodyMass Index

Body Mass Index (BMI) is an index of statistical measurements of individual body weight andheighttoclassifyindividualsintogradecategoriesbasedonbodyweight.
Thisweightindexconsistsoffourcategories, namelyunderweight, normal weight, overweightand

obesity.[8,9]A low BMI (underweight) indicates a body weight that is below normal because of lower calorie intake compared to daily calorie intake. Meanwhile, a high BMI (overweight and obesity) indicates that you are overweight because there is more daily calorie intake than the actual needs.[8]

CalculationofBodyMass Index (BMI) iscalculatedbasedonthe formula ofbodyweight in kilograms (kg) dividedbyheightin meterssquared(m^2).[7,10]A person will be considered underweight if their BMI is in the range of 15 to 19.9; normal weight if the BMI is 20 to 24.9; overweight if his BMI is 25 to 29.9; and obesity if the BMI is 30 to 35 or more. John S. Garrow in 1981, classified the body mass index on several levels, namely; for a BMI up to 25 is categorized as desired or normal body weight, BMI of grade I obesity is between 25 and 29.9, while BMI between 30 and 40 is categorized as grade II obesity, and for BMI greater than 40 is categorized as grade III obesity.[11]

In 1997, The International Obesity Task Force expanded the number of BMI categories to include different degrees of obesity. A BMI from 25 to 29.9 is referred to as "preobesity" A BMI of 30 to 34.9 is class I obesity, 34.9 to 39.9 is class II obesity, and a BMI of 40 or greater is class III obesity.[11]Meanwhile, accordingtothe Center forDiseaseControl (CDC) thecalculationof BMI iscarriedoutbasedon a growthchartfor a certainageand gender, thesubjectiscategorized as underweight (<5%), normal weight (<5% to<85%), overweight (85 to< 95%), andobesity (≥95%).[12]

3.2 Dental Caries in Children

Dental cariesis a global oral health problem, althoughconditionssuch as oral andpharyngeal cancer and oral tissuelesions are alsosignificanthealthproblems. Worldwide, approximately 2.43 billionpeople (36% ofthepopulation) have dental caries in theirpermanentteeth. In deciduousteeth, itaffectsabout 620 millionpeopleor 9% ofthepopulation. The diseaseismostcommon in Latin American countries, countries in theMiddleEast, andSouth Asia, andleastprevalent in China. In the United States, dental cariesisthemostcommonchronicchildhooddisease, atleastfivetimesmorecommonthanasthma. Itis a majorpathologicalcauseoftoothloss in children.[13]

In general, dental cariesisknown as aninfectiousdiseasewhichreferstothelocaldestructionofthesusceptiblehardtissuesoftheteethbytheacidbyproductsofbacterialfermentationofdietarycarbohydrates. Thisdiseaseis a chronicdiseasethatdevelopsslowly in mostpeoplecausedbyanecologicalimbalance in thebalancebetween dental mineralsand oral biofilm (plaque).[3,13]Cariogenic bacteria, fermentable carbohydrates, susceptible teeth and hosts, and time play a major role in the formation of dental caries.[2,3] Cariogenicbacteria, fermentablecarbohydrates, susceptibleteethandhosts, andtimeplay a majorrole in theformationof dental caries.[1]

Streptococcus mutans is a bacteria that causes dental caries. These bacteria adhere to the surface of dental plaque and produce acids that will produce organic acids in the pH range 3.8 to 4.8 when exposed to dietary carbohydrates. This acidity can cause demineralization on the tooth surface, which can result in the formation of a cavity in the tooth enamel layer. If not treated promptly it can cause severe pain, difficulty chewing food, and impaired digestive production, which can lead to malnutrition.[1,13]

3.2.1 Typesof Dental Caries

a. Early childhoodcaries

Early childhoodcaries(ECC) is a typeof dental carieswith a patternofdamagefound in deciduousteeth in children. Thistypeischaracterizedbythepresenceofmultiple dental cariesonthedeciduousteeth, withrapidprogressiontothe pulp andperiodontaltissues, mostlyinvolvingthe anterior teeth.[13,14]This type of caries arises as a result of letting children fall asleep with a sweet liquid in their bottle or feeding children a sweet liquid several times throughout the day.[13]

ECC shows a characteristic pattern related to the sequence of teeth appearance and tongue position during breastfeeding. The lower teeth are protected from exposure to the fluid ingested by the tongue during breastfeeding and by the build-up of saliva so they are generally unaffected. The maxillary incisors were the first maxillary teeth to erupt first, thus most likely to be the hallmark of ECC.[13]

b. RampantCaries

Rampantcariesis a typeof dental caries that's hows the occurrence of severe damagetomanysurfacesofthe teeth.[13]A typeof dental caries in deciduousteeththatiscommon in children. This caries is mostly found in childrenunderfiveyearsofage (toddlers), withthehighestspread in childrenagedthree years.[15]This caries affects several teeth, including teeth that are usually free of caries, namely the lower anterior teeth, and is most commonly found in deciduous teeth.[16]

The habit of consuming cariogenic foods and drinks or in children under five who often consume cariogenic foods among the main foodsisoneofthetriggersforthistypeof dental caries. Rampantcariesisalsoanacutelesionthatcoverspartorallooftheeruptedtooth, destroys the crown tissue ofthetoothquicklyandaffectsseveralteethandoftencausespain, difficultyeatingandspeechproblems. If leftuntreated, itcanleadtochewingdifficultiesduetotoothacheorprematurelossofdeciduousteeth. The prevalenceoframpantcariesishigh in manycountriesanditsseverityincreaseswithincreasing age.[13,15,16]

3.3 RelationshipbetweenBodyMass Index and Dental Caries in Children

The relationship between weight loss and tooth decay has become a controversial health issue in various countries.[7]An unhealthy diet, such as a high calorie diet, has been reported to be a significant determinant of the increased prevalence of dental caries.[3]People who have an unbalanced diet that includes sugary, calorie dense foods with low nutritional value, usually suffer from malnutrition and dental caries.[6]

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.[1,2,13]

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.[1,2]

Tabel 1. Research about associationofbodymassindexwith dental caries in children

No.	Authors and Titles	Year	Result and Conclusion
1.	HarianiRafitha, Putri Bungs, RatnaDjuwita, DwiGayatri, FakhranaArianiAyub Title : Overweight and Obesity Status with Dental Caries among Children Aged 7–12 Years Old in Badung District, Bali 2018 Journal:National Public Health Journal. 2019; 14 (2): 65-69	2019	Result: This study found that covariate variables, such as family income, eating habits and sugary drinks, and oral hygiene behavior, influenced the strength of the association between being overweight and obesity in children and dental caries. Family income can affect dental caries, it is evident from previous studies which reported that family income was significantly associated with the lower prevalence of dental caries in children (OR:1.22; 95% CI:1.01–1.50). Sugary drinks were found to be significantly associated with dental caries in children (OR:1.686; 95% CI:1.03-1.50). This study revealed a significant relationship between dental hygiene practices and caries (OR: 1.683; 95% CI: 1.13-2.50) Conclusion: There is a relationship between obesity in children and the incidence of dental caries after controlling for other variables in children aged 7-12 years in Badung Regency, whereas in obesity children there is a double risk of dental caries compared to children who are not obesity.
2.	FotedarShailee, Sogi GM, Sharma KR Title: Association Between Dental Caries and Body Mass Index Among 12 and 15 years School Children in Shimla, Himachal Pradesh Journal: Journal of Advanced Oral Research .2013:4(1)	2013	Result: A lower percentage of children fall within the normal range of body mass index in public schools compared to private schools and the difference was statistically significant (P <0.001). Correlation analysis showed that BMI was negatively associated with DMFT (r = 0.312, P <0.011). Conclusion: The results showed that the percentage of children in the BMI category with underweight was higher and the mean DMFT was higher in the underweight group than in the overweight group. These children will experience acute or chronic nutritional stress due to poor socioeconomic status and lack of knowledge about general and oral health. Continued

			education and motivation from parents and children can help improve their health status to some extent.
3.	Dini ChairaniPrima, Murniwati Title: The Relationship Between Body MassIndex And Caries Status OnPreschooler In Public Health CenterRawang District Journal:Andalas DentalJournal.2016:4(2) 124-31	2016	Result: This study showed that there was a significant difference ($p<0.05$) between BMI (underweight, normal weight, and obesity) and caries status, where the underweight-obesity category showed a significant difference ($p<0.05$), while in the underweight category – normalweight and normal weight - obesity there was no significant difference ($p<0.05$). The results of this study indicate that the highest caries score is in the underweight underweight category. Conclusion: This study showsthatthereis a relationshipbetweenBodyMass Index (BMI) andCaries Status.
4.	Yi-hong Cheng1, Yi Liao, Ding-yan Chen, Yun Wang, Yu Wu Title : Prevalence of dental caries and its association with body mass index among school-age children in Shenzhen, China Journal : BMC Oral Health (2019) 19:270	2019	Result: A total of 1,196,004 students participated in the census. The mean age of the participants was 10.3 years, ranging from 6 to 20 years. The prevalence of dental caries was 41.15% in this study, which was higher in female (42.88%) than in male (39.77%) with p value <0.001. Students in public schools showed a much lower prevalence of caries ($p<0.001$) (37.36%) compared to students in private schools (47.96%). The student caries recovery rate in Shenzhen is only 10.30%, which means only one in ten students with caries receives recovery. The mean dmft and DMFT values were 0.97 and 0.33, respectively. More girls (10.96%) had their teeth filled than boys (9.78%). The recovery rate was higher ($p <0.001$) in public schools (11.73%) than in private schools (8.35%). Children who are overweight or obesity have a lower risk of developing caries than children with normal weight (OR = 0.74 / 0.64). Caries is inversely related to BMI in elementary and middle school students in Shenzhen. Conclusion: The prevalence of dental caries in primary and

			secondary school children was found to be related to gender, school type, region, and BMI.

Research conducted by RafithaH et al.[1]showsthatthereis a significant relationship between obesity and dental caries. This study is in linewithresearchconductedby Hayden C, etal. In Rafitha H, etal. 1 whichstatedthattherelationshipbetweenobesityand dental caries had a p-valueof 0.049. ResearchconductedbyBhayat, etal in RafithaH et al.[1]suggested a strong association between obesity and the incidence of caries in teeth. Their research was carried out by comparing the normal weight sample with the obesity and overweight samples and obtained an OR value of 1.77 and p value of 0.016; Thus, children with BMI obesity have a 1.77 times risk of experiencing dental caries. In addition, Bafti et al, in Rafitha H. et al.[1]also suggested a significant relationship between body mass index (normal weight vs overweight) and dental caries with value p 0,0001 (OR: 1,449).[1]In addition, a recentsystematicreviewand meta-analysisconductedbyHayednetalChengetal.[3]demonstrated that, overall, there was a significant association between childhood obesity and dental caries. However, this relationship is not significant for newly industrialized countries similar to the study conducted in Mathura, India. This may be due to the fact that obesity and dental caries are multifactorial in etiology and various genetic and environmental factors impact both. Another common risk factor for obesity and dental caries is high sugar intake.[3]

Dental cariesandobesity are considered as multifactorial entities with genetic predisposition and environmental conditions. Most of the factors involved in obesityandtoothdecayresultfromchanges in lifestyleandenvironmentalfactors. Changes in physical activity and nutritional services occur in the home and school environment. Whenchildrenwatchtelevisionfrequentlyfor long periodsoftime, theytendtosnackmorethanusual, especiallyonfoodsthatcontainhighamountsoffatand/or sugar.[1]

This condition increases overall calorie intake, which can lead to obesity, and increases the risk of tooth decay due to prolonged contact between food and tooth surfaces. In addition, the simultaneous intake of sugary foods can lead to weight gain and weight gain increasing the risk of caries. Obesity children are at twice the risk of dental caries compared to children who are not obesity.[1,13]

However, a study conductedbyShailee F, et al12 showed that there was nosignificant association between overweight and obesity and the incidence of dental caries in childrenaged 15 and 12 years. Thisis linewithresearchconductedbySwatiTripathi, Prashant ST, Ana F Granvile-Garcia, etal.Shaileeet al.[12]. ThisisassociatedwithresearchconductedbyShaileeF et al[12] Itwasfoundthatthemeanof DMFT washigher in childrenwith BMI who were underweightcomparedtoother BMI categories.

Thisisassociatedwiththesechildrenexperiencingacuteorchronicnutritionalstressduetopoorsocioeconomic status and lack of knowledge about general and oral health. Continuingeducationandmotivationofparentsandchildrencanhelpimprovetheirhealth status tosome extent.[12]

Research conducted by Prima DC et al.[7]To assess the relationship between body mass index and dental caries in preschoolchildrenshowedthattheincidenceof dental carieswashigher in childrenwith BMI who were underweight. In his research, thedef-t index in childrenwithunderweightwas 5.89 whichwasincluded in thehighcategorybasedonthe WHO def-t calculation category.[7]The sameresultwasobtainedbyChenget al.[3]whichstatesthatstudentswith a

lower BMI category (underweight) have a higherriskofdevelopingcaries in girlsandboys. This study alsofoundnosignificantassociationbetween dental caries (DMFT/dmft) anddaily sugar intake. Even withanincrease in consumptionor a high sugar intakethereis a decrease in dental caries.[3]

Liang et al. In Cheng et al.[3] has shown that children with overweight and obesity were less likely to develop dental caries after adjusting for age and sex in a cross-sectional study in Guangzhou city. Also, according to data from the National Health And Nutrition Examination Survey III in the United States in Chenget al.[3], overweight may be associatedwithdecreasedcariesrates in childrenaged 2 to 18 years. However, a separate study (albeitwith a smallersamplesizeof 835 participants) did not find a significantassociationbetween BMI and caries.[3]

This may be attributed to widespread exposure to fluoride not only through drinking water but also through toothpaste, professional applications, and through the presence of fluoride in processed foods and beverages.[3]These results are consistent with the findings of a systematic review by Burt and Pai in Cheng et al.[3]who concluded that the association between sugar consumption is much weaker in the modern era and exposure to fluoride. Another study by Loveren in Chenget al.[3]concluded that if good oral hygiene is maintained and fluoride is frequently supplied, teeth will remain intact even if carbohydrate-containing foods are frequently consumed.[3]

Research conducted in England stated that there was no significant association between obesity and caries.[17] The association between BMI category and complex dental caries because it is a multifactorial disease that varies depending on many factors, such as: age, gender, race, oral hygiene, intake. nutrition, saliva, and family income. However, obesity and poor oral health can increase a person's risk for systemic disease and poor dietary habits can be one of the factors linking the two multifactorial conditions together.[18,19,20,21,22,23]

Local oral factors such as retention around the teeth and salivary function can be factors that greatly influence caries activity. Oral hygiene is a basic factor for oral health. Poor oral hygiene causes dental plaque buildup which plays an important role in the etiology of dental caries.[3]

4. CONCLUSION

Bodymassindex has a significantrelationshipwiththeincidenceof dental caries in children. However, thisconditiondoes not accountforwhichcategorytheincidenceof dental cariesisgreatest. Thisisassociatedwithmultifactorialinteractionsthatmutuallyinfluencetheoccurrenceof dental caries in children.

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