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Body mass index and its impact on dental caries

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ABSTRACT

Obesity is a chronic disease with global epidemic spread. The worldwide prevalence of obesity is a considerable source of concern given its potential impact on morbidity, mortality, and cost of health care. The World Health Organization (WHO) has recognized obesity as a predisposing factor to measure chronic diseases ranging from cardiovascular diseases to cancer. Once considered a problem only in wealthiest countries, the WHO estimates show that overweight and obesity are now dramatically on the rise in low- and middle-income countries. Primary health-care providers, including dental professionals, are well positioned to address this public health problem at the patient level. Both obesity and dental caries have common determinants and require a comprehensive, integrated management approach by multidisciplinary medical teams. Dental professionals should promote healthy diets not only to prevent dental caries but also to reduce the risk of childhood obesity. Obesity and dental caries share common lifestyle factors among adolescents, regardless of the nationality and different health-care systems. Thus, it seems that dental health is becoming a global health concern and further multinational and cultural studies are needed. Improvement of dental health and general well-being of adolescents requires active collaboration between dental and general health-care providers and the implementation of health promotion strategies targeting management of both obesity and dental caries for young people using a holistic approach.

Key words: Body mass index, dental caries, obesity

Introduction

Obesity is a chronic disease with global epidemic spread. The worldwide prevalence of obesity is a considerable source of concern given its potential impact on morbidity, mortality, and cost of health care. The World Health Organization (WHO) has recognized obesity as a predisposing factor to measure chronic diseases ranging from cardiovascular diseases (CVDs) to cancer. Once considered a problem only in wealthiest countries, the WHO estimates show that overweight and obesity are now dramatically on the rise in low- and middle-income countries. The WHO

estimates that over one billion people are overweight globally and that if current trends continue, this number will increase to 1.5 billion by 2015. This is due to a number of factors including a global shift in diet and a trend toward decreased physical activity due to the sedentary nature of modern work and transportation and increasing urbanization.^[1] According to the WHO, obesity can be defined as an abnormal or excessive level of fat accumulation that may impair health.^[2] Like many chronic diseases, obesity has significant associated morbidity, mortality, and economic impact

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and is largely preventable.^[3] Primary health-care providers, including dental professionals, are well positioned to address this public health problem at the patient level. It is increasingly evident that the dental profession is a stakeholder in the weight status of its patients and can be part of a coordinated effort to prevent and intervene in obesity problem. In 2010, the WHO reported that 65% of the world's population lives in countries where overweight and obesity kill more people than underweight conditions. The onset of type 2 diabetes mellitus (DM) in young children aged 6–11 years with type 2 DM had doubled in the past 20 years.^[4] Internationally, it was estimated in 2008 that 1.5 billion adults, 20 years and older, were overweight. Of these, over 200 million men and nearly 300 million women were obese. It was concluded that more than 1 in 10 of the global adult population is considered obese, a trend that has developed in the past decade.^[2] Demographically, 13.9% of people met the adult classification of obesity with a body mass index (BMI) of 30 or greater. The National Health and Nutrition Examination Survey results from 2009 to 2010 found that more than one-third of adults were obese and there were no significant differences found between genders.^[5]

Body Mass Index and Body Mass Index Percentile

BMI is defined as an individual's body mass divided by the square of his/her height. The formulae universally used in medicine produce a unit of measure of kg/m².

$$\text{BMI} = \text{mass [kg]} / (\text{height [m]})^2$$

The WHO considers a BMI of <18.5 as underweight and may indicate malnutrition, an eating disorder or some other health problems, while a BMI of >25 is considered overweight and above 30 is considered obese.^[6] These ranges of BMI values are valid only as statistical categories.

Table 1: Calculations and Interpretation of BMI

Measurement units	Formula and calculation
Kg and m (or, cm)	Formula: Weight (kg)/height (m) ² With the metric system, the formula for BMI is weight in kg divided by height in m ² . Since height is commonly measured in cm, divide height in cm by 100 to obtain height in m Example: Weight=68 kg, height=165 cm (1.65 m) Calculation: 68/(1.65) ² =24.98
Pounds and inches	Formula: Weight (lb)/(height [inch]) ² ×703 Calculate BMI by dividing weight in pounds (lbs) by height in inches squared and multiplying by a conversion factor of 703 Example: Weight=150 lbs, height=5'5" (65") Calculation: (150/[65] ²) × 703=24.96

BMI = Body mass index

Calculations and Interpretation of Body Mass Index

BMI is calculated the same way for both adults and children. The calculation is based on the following formulae shown in Table 1.

Health Consequences of Obesity on General Health

Overweight individuals are at increased risk for many diseases and health conditions including hypertension, dyslipidemia (for example, high low-density lipoprotein cholesterol, low high-density lipoprotein cholesterol, or high levels of triglycerides), type 2 DM, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea, and respiratory problems and some cancers (especially, endometrial, breast, and colon).^[7] Moreover, obesity also has psychological, social, and economical as well as oral health consequences. The only positive effect of obesity is a reduced risk of developing premenopausal breast cancer and osteoporosis in females.^[8] Obesity is a systemic disease that predisposes to a variety of comorbidities and complications that not only affect the overall health but also influence oral health.

Health Consequences of Obesity on Oral Health

The most common health consequences of obesity on oral health include obesity which is related to several aspects of oral health, such as caries, periodontitis, and xerostomia. In addition, obesity may have implications for the dental treatment plan. Children, who are obese and overweight, also, prefer sweet and fatty foods more frequently compared to children with normal weight. Hence, there is a higher prevalence of dental caries in overweight and obese children in both primary and permanent teeth. Elevated BMI is associated with an increased incidence of permanent molar interproximal caries.^[9] Several recent studies suggest that periodontitis occurs more frequently in obese individuals than in individuals with normal body weight. Obese individuals exhibited significantly greater mean pocket depth and a higher percentage of sites exhibiting visible plaque. Obesity has emerged as a risk indicator of periodontal disease and studies have reported that individuals with periodontitis had higher blood pressure than individuals without periodontitis. Furthermore, many studies have reported that periodontitis is more prevalent in individuals with diabetes and that individuals with periodontitis have abnormal lipid metabolism.^[9] Recently, obesity has emerged as one of the major risk indicators of periodontal disease, and conversely, the remote effects of periodontal disease on various

systemic diseases have been proposed. Among the systemic health disorders, type 2 DM and CVD are established obesity-related diseases. If obesity is a true risk factor for periodontal disease, the association among periodontal disease, obesity, and type 2 DM, or CVD must be very complex because each is a confounding factor for the other. In addition, several studies have suggested that periodontal disease affects both glucose and lipid metabolism which are themselves very important factors in the development of both type 2 DM and CVD.^[9] Hormonal changes in the obese patients may affect mineral metabolism. The metabolic changes caused by obesity that have an impact on bone growth, also, affect tooth eruption. Children with a high BMI had higher eruption rates. There are various methods to measure body fat which includes skinfold thickness measurements, underwater weighing, bioelectrical impedance, dual-energy X-ray absorptiometry (scans), and isotope dilution methods. However, these methods are not always readily available and they are either expensive or need highly trained personnel. Furthermore, many of these methods can be difficult to standardize across observers or machines complicating comparisons across studies and time periods.^[10] Obtaining BMI and BMI percentile measurements can be a feasible addition to the dental protocol as it is noninvasive and requires a small time commitment and minimal cost.^[11] Accepting the premise that weight status is associated with oral health, weight screening, obesity prevention, and intervention in dental offices can be advocated as part of the comprehensive dental assessment and treatment. Calculating BMI is one of the best methods for population assessment of overweight and obesity. The BMI or Quetelet index is actually a proxy for human body fat based on an individual's weight and height. Because calculation requires only height and weight, it is inexpensive and easy to use for the clinicians. It is a fairly reliable indicator of body fat for most adults. Numerous research studies have related BMI, especially the degree of overweight to an increased risk of developing various diseases as well as premature death. Given the tremendous increase in the prevalence of obesity, dental professionals should promote a healthy diet not only to prevent dental decay but also to reduce the risk of obesity. In future preventive programs, the importance of nutrition should not only be emphasized with respect to general diseases but also with regard to carious lesions, periodontal diseases, oral cancers, and various other oral diseases. Dental professionals should participate in multidisciplinary medical teams managing obese individuals. Obesity is a complex disease and its relationship to oral health has been realized in recent years, and therefore, the purpose of

the study was to undertake a systematic review of the relationship between BMI and oral health.

Causes and Factors Associated with Obesity

Having multifactorial causes, obesity is largely attributed to the systemic energy imbalance created by excessive caloric intake and inadequate levels of physical activity. Since the 1970s, diets have shifted toward processed foods and beverages. Furthermore, the advent of new technologies has allowed for markedly more sedentary lifestyles.^[12] Some of the key factors associated with obesity risk include socioeconomic factors, minority status, geographic location, access to education, cultural beliefs, and genetic influences.^[12,13]

Burden of Disease

Obesity has both physical and psychological complications. Physiologically, it increases the risk of type 2 DM, sleep apnea, orthopedic complications, certain cancers, periodontal disease, high blood lipids, hypertension, and other cardiovascular risk factors.^[14,15] A recent study indicates that obesity may affect children from birth linking maternal obesity and diabetes with autism spectrum disorders and development delays.^[16] Psychosocially, obesity may have a long-term negative impact leaving the patient vulnerable to the development of depression, anxiety, social isolation, discrimination, a lower quality of life (QoL), and stigmatism. It has also been associated with unemployment, absenteeism, and the potential for lower wages in comparison with nonobese employees.^[17]

Body Mass Index and Dental Caries

Overweight and obesity are increasing as health problems at global level. Dental caries and obesity are both multifactorial diseases and are associated with dietary habits. Research on the causes of obesity has found associations with high consumption of sweetened foods and beverages which have also been shown to be risk factors for dental caries, but studies investigating a possible association between dental caries and obesity have had conflicting results. In line with earlier studies, obesity and dental caries share common lifestyle factors among adolescents regardless of nationality and different health-care systems. Thus, it seems that dental health is a global health concern. There is a need for collaboration between dental and general health-care providers to manage both obesity and dental caries. Obesity-induced inflammation may promote periodontal tissue destruction and bone resorption inducing tooth loss. Nutrition is vital to human development and maintaining health.

Today, more than ever before, people are concerned with optimizing their health by requiring nutritional information and applying it to their daily lives because obesity and other nutrition-related chronic disorders are on the rise (Romit, 2003). Obesity has become a global health concern throughout the postindustrial and developing regions (Gahagan, 2004). Global changes over the past decade have led to serious dietary changes in populations like the trend toward consuming soft drinks and fast foods which together with other lifestyle changes have contributed to the ever-increasing number of overweight people worldwide. Dental professionals must be aware of how nutrition impacts on general and oral health and how dental treatment can impact patient's nutritional status. Diets high in sugar have been associated with various health problems such as dental caries, dyslipidemias, obesity, bone loss and fractures, and poor diet quality. Dental caries and obesity are both associated with dietary habits (Marshall *et al.*, 2007). It is well established that dental caries and the frequent ingestion of refined carbohydrates are highly correlated. The WHO states that nutrition should be placed at the forefront of public health policies and programs because foods containing high sugar contribute to obesity and dental diseases (WHO, 2003). Controversially, some studies concluded that there was no significant association between dental caries and obesity.^[18] In a study conducted by Hong *et al.*, there appears to be no significant association between childhood obesity and caries experience after excluding age, race, and poverty/income ratio as the major confounding factors.^[19] Benzian *et al.* proved a significant association between caries and BMI and particularly between odontogenic infections and below normal BMI.^[20] Education of parents and facilitation of oral health services may help in improving their weight and QoL as it has been stated by Gaur and Nayak.^[21] In a study conducted by Trikaliotis *et al.*, overweight children were found to show statistically significant differences in decayed, missing, and filled surfaces index scores compared to both children of normal weight ($P < 0.001$) and those underweight ($P = 0.015$), and the study concluded that the overweight preschool children are at higher risk of dental caries.^[22] Honne *et al.*, however, found that there was a significant difference in the frequency of sugar consumption between the BMI groups, and obese group of children had more caries than the overweight and low-normal-weight children.^[23] Sharma and Hegde had similar results in accordance with Honne T and found that children with obesity and overweight had increased prevalence of dental caries in both primary and permanent dentition compared to normal weight children, which was statistically significant.^[24] In addition, obese and overweight children had frequent

preference to sweet and fatty food snacks compared to children with normal weight. No correlation between dental decay in obese and nonobese children was detected ($P = 0.99$) in a study conducted by Swati *et al.*^[25] Tramini *et al.* showed a significant association between decayed, missing, and filled teeth (DMFT) and sugar consumption but not with BMI and concluded that there was no association between these two variables.^[26] Hilgers *et al.* analyzed caries severity averages against children's BMI with gender and age used as covariates.^[27] The mean caries average for permanent molars significantly increased with increased BMI even after adjusting for age and gender concluding that elevated BMI was associated with an increased incidence of permanent molar interproximal caries. Mod  r *et al.*'s results indicated that childhood obesity was associated with reduced flow rate of stimulated whole saliva and dental caries and further strengthens obesity's negative impact on children's oral health.^[28] Cameron *et al.*, in their study, obtained the results in which severe dental decay was associated with underweight children.^[29] Vania *et al.* stated that more children in the case group were underweight than in the control group (10% vs. 4.94%).^[30] The Early Childhood Caries (ECC) population did not had a typical weight distribution and the underweight finding in a significant number of Severe ECC (S-ECC) children was due to the chewing alteration related to the dental pain due to caries and to missing teeth after hard tissue breakdown. Sadeghi *et al.* stated that there was no significant difference between DMFT scores among the BMI-for-age groups.^[31] Pinto *et al.* conducted a study to evaluate the association between weight and dental caries in a random, prospective cohort of children in an urban dental school; however, no correlation between dental decay in obese and nonobese children was detected ($P = 0.99$).^[32] Macek and Mitola stated that there was no significant association between BMI-for-age and dental caries prevalence in either dentition.^[18] In addition, among children with a positive history of dental caries, BMI-for-age was significantly associated with dental caries severity in the permanent dentition with overweight children had a lower geometric mean DMFT scores than did normal weight children. Although it was hypothesized that age-specific BMI would be associated with increased dental caries prevalence and severity, these associations were not found. Rather, obesity was found to be associated with lower geometric mean DMFT scores. Alm *et al.* concluded that overweight and obese adolescents and young adults had more caries than the normal weight individuals.^[33] Sheller *et al.* concluded that in children with S-ECC, the BMI percentile was not correlated with DMFT or the number of pulp-involved teeth even after adjusting

for the confounding factors.^[34] Bailleul-Forestier *et al.* stated that there was a significant association between BMI and DMFT indices ($P = 0.01$) in the severely obese group.^[35] The obese adolescents were more likely to have caries than the nonobese ones. The severely obese children had a high level of caries experience. D'Mello *et al.* found no significant association between the BMI and caries experience.^[36] Principal component analysis revealed that DMFT and obesity were interrelated in Danish adolescents according to a study conducted by Cinar *et al.*^[37] To conclude, however, studies of the relationship between dental caries and BMI in children have largely remained inconclusive. Most studies have not found a significant association between BMI for age and caries prevalence in primary and/or permanent dentition.^[18]

A Role for the Dental Professionals

It has been demonstrated that specific repeated messages from multiple resources are more likely to promote behavioral change than single-source message. Primary care physicians and pediatricians are well equipped to address the obesity issue. The American Academy of Pediatrics recommends that the health-care providers should encourage healthy eating patterns and routine physical activity and discourage TV and video time by providing families with education and anticipatory guidance.^[38] However, evidence suggests that busy providers do not adequately follow these recommendations. Several studies have found that the detection of obesity during routine medical appointments is low and time constraints limit how much a clinician is willing or able to discuss with patients.^[39] Tools targeting specific behaviors may be helpful. Dental professionals are in a good position to be able to supplement and reinforce the information received in the medical setting as well as to initiate the conversation. Tavares and Chomitz developed and tested the feasibility of a dental office-based tool for children targeting obesity risk behaviors.^[40] The healthy weight intervention based on the concepts of motivational interviewing was designed for children of all weights and requires approximately 10 min during the routine hygiene visit.^[41] Using standard, evidence-based recommendations for improving obesity risks, this preventive intervention does not require specialized training. The dental team is in a unique and favorable position to offer healthy weight intervention and obesity prevention. Most healthy patients visit dental professionals more frequently than a physician on an annual basis. Children and adolescents, in particular, follow the paradigm of annual medical and semi-annual dental visits potentially allowing for twice the annual frequency of any intervention. In

addition, it is already a standard practice for the dental professionals to promote dietary habits that avoid calorie and sugar-dense foods and beverages for caries prevention. They can easily expand their counseling to emphasize the implications of these dietary practices, in addition, to the positive effects of physical activity and other lifestyle changes on both oral and systemic health. For patients with suspected weight issues, the dentist can work alongside pediatricians, family physicians, and dietitians by providing referrals.^[42] Some dental settings, particularly, pediatric dental practices, already measure weight and height for other purposes particularly for calculating dosages for local and general anesthesia.^[42] Obtaining BMI and BMI percentile measurements can be a feasible addition to the dental protocol as it is noninvasive and requires a small time commitment and minimal cost.^[11] Accepting the premise that weight status is associated with oral health, weight screening, obesity prevention, and intervention in dental offices can be advocated as part of the comprehensive dental assessment and treatment.^[11] There are strong links between obesity and oral health, particularly, with respect to diabetes and periodontal disease. Decreasing obesity risks through diet and lifestyle changes can have a positive impact on oral as well as systemic health. It is important for the dental team to consider all the key domains of obesity risk behaviors such as physical activity, screen time, and meal patterns, not only the diet.^[40]

Conclusion

Dental professionals must be aware of the increasing numbers of the obese patients and of the significance of obesity as a multiple risk factor syndrome for oral and overall health. Both obesity and dental caries have common determinants and require a comprehensive, integrated management approach by multidisciplinary medical teams. Dental professionals should promote healthy diets not only to prevent dental caries but also to reduce the risk of childhood obesity. Obesity and dental caries share common lifestyle factors among adolescents, regardless of the nationality and different health care systems. Thus, it seems that dental health is becoming a global health concern, and further, multinational and cultural studies are needed. Improvement of dental health and general well-being of adolescents requires active collaboration between dental and general health-care providers and the implementation of health promotion strategies targeting management of both obesity and dental caries for young people using a holistic approach.

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Conflicts of interest

There are no conflicts of interest.

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