Evidence-Based Dentistry

Is There an Association Between Weight and Dental Caries Among Pediatric Patients in an Urban Dental School? A Correlation Study


Abstract: Obesity in the young is a public health priority. The prevalence of overweight children in the United States has risen almost threefold in the last two decades. An association between weight and oral health has been suggested in adults, whereas evidence supporting this association in children is controversial at best. The aim of our study was to evaluate the association between weight and dental caries in a random prospective cohort of children at their initial visit at an urban dental school. One hundred and thirty-five children were recruited in a four-month period. The DS/ds index was used to assess caries, and BMI percentile was calculated based on age and gender-adjusted published scales. Correlation analyses, linear, and multivariate regression including age, gender, and BMI were calculated with a significance threshold of p>0.05. No correlation between dental decay in obese and non-obese children was detected (p=0.99). These findings support recent U.S. population-based literature that reports an inverse association between caries and weight in certain pediatric groups. Nevertheless, the impact of interventions to address the epidemic in the dental setting has not been investigated. As part of a health care team, dental students should be exposed to the changing demographics and sequelae of overweight in children.

Dr. Pinto is Assistant Professor of Oral Medicine and Director, Oral Medicine Clinic; Ms. Kim is a D.M.D. Candidate and Research Assistant; Dr. Wadenya is Assistant Professor of Pediatric Dentistry; and Dr. Rosenberg is Associate Professor of Pediatric Dentistry—all at the University of Pennsylvania School of Dental Medicine. Direct correspondence and requests for reprints to Dr. Andres Pinto, The Robert Schattner Center, University of Pennsylvania, School of Dental Medicine, 240 S. 40th St., Suite 214, Philadelphia, PA 19104; 215-573-2440 phone; 215-573-7853 fax; apinto@dental.upenn.edu.

Key words: overweight, pediatrics, oral health, epidemic, children

Submitted for publication 4/29/07; accepted 8/26/07

Excessive weight in children is a major public health concern. The number of affected individuals is increasing, and the health consequences of pediatric obesity into adulthood are only now being perceived. Weight status in children is measured by assessment of body mass index (BMI) corresponding to gender and age-ranked percentages. Children are considered at risk of being overweight if they are between the 85th and 95th percentile of age and gender-related BMI and are considered overweight if they are at or beyond the 95th percentile of age and gender-related BMI according to Centers for Disease Control and Prevention (CDC) guidelines. For example, an eight-year-old boy with a BMI of 19 is classified in the at-risk-of-being-overweight category (less than 95th percentile BMI adjusted by age and gender), while a six-and-a-half-year-old boy with the same BMI is considered overweight (at or beyond the 95th percentile). Children classified in the overweight category are considered obese.

The number of overweight children has almost tripled in the United States from 1980 to 2002. Moreover, the prevalence of overweight children doubled in the six to eleven year age group and tripled among twelve to seventeen year olds in the last twenty years. This phenomenon is not confined to the United States but affects children worldwide. Longitudinal data from Europe have identified children as being at a greater risk of being overweight than the rest of the population. Additional studies have reported that more than half of overweight children between the ages of five and ten are at risk for cardiovascular disease, compared to less than 10 percent of normal-weight children. Furthermore,
children who are at risk for being overweight during preschool years carry a greater probability of being overweight by age twelve.7

Diet plays an important role in the obesity epidemic, as dietary habits in children have suffered major changes in the last thirty years.8 Consumption of soft drinks is associated with reduced vitamin and mineral intake and an excess of dietary carbohydrates. The oral health implications of nutritional practices were demonstrated by a review of children’s eating habits in the United States between 1988 and 1994.9 The authors of that study found an association between poor dietary practices (meal fragmentation, missed breakfast, low fruit, and higher carbohydrate intake) and caries.

Current research in dental medicine trends towards exploring the link between oral health and systemic health, an effective way of underscoring the public health impact of oral care and influencing health care policy. Active participation of health care providers is critical to the success of obesity prevention strategies. Previous studies have heightened the awareness of dentists about the connection between obesity and oral health in the young.10,11 An association between dental caries and weight in children has been proposed by preliminary and population-based studies,12-14 although stronger evidence exists for the association between periodontal health and weight in adults.

In summary, given the strong evidence supporting the association of dental caries with irregular dietary patterns and quality9 and the fact that abnormal dietary intake has been linked to the development of obesity at a young age,8 a link between dental caries and weight is biologically plausible. The challenge in exploring this relationship lies in measuring possible confounders (e.g., diet, socioeconomic status) or effect modifiers (e.g., age, oral hygiene, fluoridation) in a standardized and comprehensive manner.

Dental students should be exposed to the complications associated with pediatric obesity and the role of dental professionals in addressing the prevention of obesity in children.11 There is scant information on the prevalence of overweight children in the dental school setting, so prospective controlled studies on weight and oral health are needed. The aim of this pilot study was to evaluate the association between weight and dental caries in a random prospective cohort of children at their initial visit to an urban dental school.

Materials and Methods

The University of Pennsylvania School of Dental Medicine is located in West Philadelphia and forms part of the University of Pennsylvania campus. Patients attending the pediatric dental clinic at the school are predominantly African American, corresponding to local area demographics. This clinic is student-staffed, and more than thirty children are treated daily. The primary aim of the study was to explore the association between dental caries and weight in a prospective cohort of pediatric subjects attending this clinic for their initial visit. The secondary aim was to observe the period prevalence (four months) of pediatric obesity in this cohort. Our hypothesis was that there was a significant association between obesity and the presence of untreated dental caries among new pediatric patients attending the dental school clinic. Moreover, from the previously reported linkage between obesity and nutrition patterns and the presumed link between caries and nutrition,6 we expected to find an association between weight and caries.

The study protocol was approved by the Institutional Review Board, Office of Human Research of the University of Pennsylvania. Based on a nationally representative sample of children, the prevalence of obesity in African American children ages six to eleven has been calculated to be 19.5 percent.15,16 We expected that at least 15 percent of our population would have indicators of caries. With a double tailed alpha of .05 and a power of 80 percent, a minimum number of 135 children needed to be recruited for this study. This number of subjects would detect a relative risk of two (risk of poor oral health in overweight subjects). Sample size was calculated using PS Sample Size and Power Calculation software (Dupont and Plummer, Vanderbilt University) version 2.1.31.

In assessing oral health status, the decayed surfaces (Ds/ds) index was used. All exams were performed by one of two calibrated examiners who were trained in the assessment of the Ds/ds prior to study initiation. After an initial period of observation and training in caries detection, fifteen children participated in a pilot to calculate inter-observer reliability. Weighted Kappa coefficient in this pilot phase was 0.72, indicating good agreement among examiners. Assessment and classification of BMI were performed following established guidelines.1
A total of 142 subjects visiting the pediatric dental clinic for the first time were randomly selected using a computer-generated table (two subjects were selected per clinic session, total of two sessions per day) and asked to participate in the study. Subjects had not been solicited to become patients of the dental school. All but seven parents/guardians or children agreed to participate in the study. Subjects were representative of the pediatric population in West Philadelphia, as the entire sample resided within this area.

Anthropometric measurements were taken prior to dental exams by one investigator. Weight was assessed using a single calibrated scale (Tanita Ultimate series 2204®, Tanita Corporation Inc., IL). Height was measured using a stadiometer by having the subject standing straight without shoes. Body mass index was calculated using the following formula: Kg/(height in meters) squared.1,2 A second investigator, blinded to the anthropometric measures, proceeded to record the Ds/ds index in a separate operatory. Subjects were then stratified into at-risk-of-being-overweight and overweight categories. All data were collected on standardized forms, and a database (Microsoft Access®) was created with all collected information, including age and gender. To protect confidentiality, the database was password secured and only accessible to one data analyst.

Descriptive summary statistics were obtained for all demographic and outcome variables. To assess the overall relationship between caries and overweight, a bivariate scatterplot, Spearman Rho correlation, and simple regression were calculated. Multivariate regression included age, gender, ethnicity, and BMI as predictors and caries as outcome. Analysis was performed using Medcalc 9.0.1.0. statistics software (Medcalc®, Belgium). Chi square analysis was used to compare outcomes in the at-risk-of-being-overweight and normal weight groups and the overweight and normal weight groups.

Results

Sample demographics can be seen in Table 1. Subjects fell within the eight to nine year age range, with an almost symmetric gender distribution. The majority (81.48 percent) of subjects were African American. Approximately 12 percent of subjects fell into the at-risk-of-being-overweight category, and 15 percent were considered overweight. This number represents a slightly lower prevalence of obesity in this cohort than the reported national averages when compared to a predominantly African American group. Most subjects had clinically detectable caries, albeit affecting a very limited number of surfaces per subject. The overall prevalence of caries was low, with the exception of several outliers. Due to non-normal data distribution, nonparametric analyses were done. Spearman’s correlation between Ds/ds and BMI was not significant (p=0.99). (See Figure 1.) Linear and multivariate modeling including demographic and descriptive variables (age, gender, ethnicity) only retained age in the model. Linear regression excluding significant outliers also did not yield significant results (p=0.12), and subgroup analysis dichotomizing subjects either at risk for overweight or overweight did not reach statistical significance (p>0.05).

Discussion

Dental caries is a multifactorial infectious disease.17 Factors affecting the onset of carious lesions include oral hygiene, diet composition and frequency, socioeconomic status, salivary immunoglobulins, bacterial load, and fluoride intake.18 This milieu makes the study of dental caries a daunting task. Recent evidence has shed light on the importance of oral health in the management of systemic health,

<table>
<thead>
<tr>
<th>Table 1. Sample characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age:</td>
</tr>
<tr>
<td>Gender:</td>
</tr>
<tr>
<td>Ethnicity:</td>
</tr>
<tr>
<td>Mean Weight:</td>
</tr>
<tr>
<td>Mean Height:</td>
</tr>
<tr>
<td>Mean BMI:</td>
</tr>
<tr>
<td>Mean number of teeth:</td>
</tr>
<tr>
<td>Mean Ds score: (entire cohort)</td>
</tr>
</tbody>
</table>
and a myriad of diseases have been linked to indicators of oral disease. Caries, in particular, has been linked to syndromes causing xerostomia, endocrine pathology, and medication intake.

Obesity is characterized by energy and metabolism imbalance and is responsible for the onset of multiple health complications. Among the most pertinent conditions caused by excessive weight is metabolic syndrome (characterized by the presence of insulin resistance, hypertension, abnormal lipid profile, and obesity), a relevant risk factor for cardiovascular disease. More than half of severely overweight children have clinical and laboratory characteristics of metabolic syndrome.

The early onset of diabetes in the young is changing the epidemiology and natural history of this disease. Diabetes in children heralds the development of severe kidney failure, more so than in late or adult onset disease. Other organ systems affected by pediatric overweight are respiratory (development of obstructive apnea), gastrointestinal (fatty hepatic steatosis), musculoskeletal, and endocrine.

Exploration of the link between weight and oral health in children has been controversial. A recent study in elementary school children in Germany (n=1290) found a positive correlation between weight and caries experience in primary and mixed dentitions. Other studies, however, have not found any association. Several reports, including ours, describe an inverse relationship between dental caries and weight. The nature of the hypothesized protective effect of weight on dental caries in the permanent dentition is still obscure, as other factors influencing this relationship have not been measured. A recent article describes an association between BMI and accelerated dental development in a sample of 104 children. The significance of such a finding has to be evaluated in light of future reports that will replicate this conclusion. In addition, a recent systematic review only identified one study as having a sufficient level of evidence to substantiate a positive correlation between dental caries and weight in a pediatric cohort. Most of the published literature is characterized by a retrospective design and represents diverse
populations. Furthermore, other measures of body fat distribution, such as waist circumference and waist to hip ratio, have not been reliably included in these analyses. In other research, our team has conducted a prospective cohort study that reports the utility of these measures in the pediatric population. The current literature on this topic, with few exceptions, is fraught with issues regarding study design, sample size, and generalizability of findings.

Limitations

This study is limited by sample size and external validity, which was challenged by the demographic characteristics (mostly African American) of the sample. We attempted to minimize sampling bias by randomly selecting patients to approach for the study. As a result, we do consider that this cohort represented the local pediatric population. All subjects were new patients at the dental school, and we excluded subjects who were having dental discomfort or seeking emergency care. In addition, all subjects had similar dental insurance coverage. The Ds/ds index represents a cross-sectional approach to the evaluation of caries, whereas other indices may better reflect past caries experience. The low prevalence of caries found in this sample could have biased the results towards a negative correlation and can be partially explained by the active water fluoridation in the city of Philadelphia. In addition, parents in this group could have represented health-seeking parents who are more involved in monitoring and enforcing their children’s oral hygiene practices.

Obesity is commonly stigmatizing for young individuals and their families, which could have affected the enrollment of the seven parents who refused to provide consent to participate in the study. Although we did not perform a formal socioeconomic assessment of our sample, the well-characterized geographic localization of our subjects and known characteristics of the area, in our view, provided homogeneity to the group.

Conclusion

Notwithstanding the fact that the results of this preliminary study do not support an association between dental caries and obesity, future longitudinal research should incorporate validated dietary assessments, socioeconomic status, oral hygiene compliance, and other factors that may act as confounders or effect modifiers. Study of dental caries at an individual level must account for these variables.

It is critical for dental students to be exposed to the epidemiology of obesity in children, as many of these children will require significant dental care modifications for safe provision of care. As obesity results in many health complications, association with oral health parameters seems plausible, albeit not supported by the current evidence.

Even if a link between oral health and weight in children is not clear, our obligation as health care providers is to seek creative methods by which we can effect change in our pediatric patients. We also suggest that BMI calculation should be included in the standard medical evaluation of any pediatric patient, as it can provide a screen for potential health complications of the growing child. The impact of weight in total health should also be emphasized within dental school curricula. Presently, many complications deriving from obesity may form part of the pathology, physiology, or diagnostic sciences courses. We consider that a more global approach to the obesity epidemic should form part of the education of our future colleagues, as they will come into practice in a world with many changing trends.

The effect of interventions targeting obesity in primary dental settings has not been evaluated. Exploring the role of the dentist as screener and active member of overweight policy presents an exciting area for future research and practice.

REFERENCES

6. Freedman DS, Khan LK, Dietz WH, Srinivasan SR, Berenson GS. Relationship of childhood obesity to coronary


