BRIEF COMMUNICATIONS

Association of Denture Use with Sleep-disordered Breathing Among Older Adults

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Abstract

Objective: *This study investigates the relationship between sleep-disordered breathing and denture use.* ***Methods:*** *This was a cross-sectional study of community-dwelling older adults. Information about denture use was obtained using a questionnaire. Ambulatory sleep recording in subjects' homes was performed using Embletta PDS (Medcare, Iceland). Chi-square tests and logistic regression analysis were used for statistical analysis.* ***Results:*** *A total of 58 subjects completed the study. The mean apnea hypopnea (AHI) index was 15.1±16.1. Twenty-two subjects (38%) used dentures and most removed them before sleep. There was significant association between denture use and AHI≥15 per hour of sleep (odds ratio [OR]=6.29; 95% confidence interval [CI]=1.71, 23.22; P=.006).* ***Conclusions:*** *This preliminary study found an association between sleep-disordered breathing and denture use, which may represent a proxy for a relationship between sleep-disordered breathing and edentulism. Given the common occurrence of both conditions among older adults, the observed relationship warrants a more detailed investigation of the mechanisms whereby loss of teeth leads to upper airway closure during sleep. [J Public Health Dent 2004;64(3):181-83]*

Key Words: sleep apnea syndrome, dentures, edentulous mouth.

Edentulism (loss of all natural permanent teeth) is a common problem affecting close to 25 percent of older adults in the United States (1). The anatomical changes of the face associated with edentulism include decrease in the vertical dimension of occlusion (2), change in the position of the mandible (3) and the hyoid bone (4), and possible impaired function of the oropharyngeal muscles (5,6). Loss of posterior teeth may also decrease the vertical dimension of occlusion (7).

Sleep-disordered breathing is also a prevalent condition among older adults with reported prevalence between 20 percent to 50 percent (8,9), based on specific definitions used. Obstructive sleep-disordered breathing is caused by partial or complete obstruction of the upper airway and reported risk factors include obesity, increased neck circumference, male sex, and anatomical abnormalities of the face (10-17). Although edentulism is reported to change the anatomy and also impair the function of the upper airway as described above, it has not been typically recognized as a risk factor for sleep-disordered breathing. This preliminary study was undertaken to examine the relationship between sleep-disordered breathing and denture use among community-dwelling older adults.

Methods

This was a cross sectional study of a convenience sample of community-dwelling older adults. Subjects were recruited, using a protocol approved by the Institutional Review Board of Emory University, from retirement living and senior housing facilities, and adult learning centers in Atlanta, GA. Individuals older than 64 years of age who were independent in their activities of daily living were included in the study. Individuals who were not capable of following instructions due to physical disability or cognitive impairment were excluded from the study. Subjects who volunteered to participate in the study gave written consent.

Medical history including denture use ("removable dental prosthesis") was obtained using a questionnaire. Questions included denture location (upper, lower, or both), type (partial or full), and removal during sleep. Body mass index (BMI) was calculated as: (weight in kilograms)/(height in meters)^2.

An overnight ambulatory sleep recording was performed for one night in the subjects' homes using Embletta PDS (Medcare, Iceland) sleep recording equipment to determine sleep-disordered breathing. The system records abdominal and chest movement, airflow through the nose and mouth, and pulse oximetry. Ambulatory recording systems similar to the Embletta PDS have been validated against polysomnography (18,19). The subjects were given both oral and written instructions on how to use the sleep recording equipment on the day of the sleep study. The sleep equipment was returned the next morning, and the data were downloaded and scored by the first author. The first author did not have any information about denture use by the subjects at the time the sleep studies were scored. At least five hours of technically adequate recordings were required for the record to be scored. The following conventional definitions were used to score the sleep recordings: (1) apnea

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was defined as the cessation of airflow through the mouth and nose for at least 10 seconds; (2) hypopnea was defined as the reduction in airflow by 50 percent or more associated with a decrease in the pulse oximetry reading by at least 3 percent (20). Apnea hypopnea index (AHI) was defined as the number of apneas and/or hypopneas per hour of sleep. Total sleep time was estimated based on the clock time recorded by the subject for initiation of sleep and wake up time. The result of the sleep study was reported to the subjects, and with the subjects' permission, a copy of the report was sent to their physician.

T-tests for independent samples and chi-square tests were used to compare the demographic characteristics between those who completed and those who did not complete the study. A chi square test was used for comparing AHI categories between those who did and did not use dentures. Logistic regression analysis was performed with AHI ≥15 as the dependent variable and denture use, and known risk factors for sleep-disordered breathing—including age, sex, and body mass index—as covariates included in the model.

Results

Seventy-two subjects were enrolled and 58 subjects (81%) completed the study. There were 5 inadequate initial ambulatory sleep recordings (9%) requiring repeated evaluation.

Of the 14 subjects who did not complete the study, three moved to other locations, two were hospitalized, one had exacerbation of an illness, and eight declined further participation. The characteristics of subjects who completed and did not complete the study is shown in Table 1. There were no statistically significant differences in sex, age, marital status, educational status, and denture use between those who completed and did not complete the study. Of the 58 subjects who completed the study, 22 (38%) used dentures while 36 (62%) did not. Of the 22, 9 used both upper and lower, 10 used upper or lower, and 3 subjects did not specify denture location. Seven subjects used full dentures, 13 subjects used partial dentures, and 2 subjects did not specify the type of dentures they used. Eighteen of the 22 subjects who used dentures (82%) removed them before going to bed.

The mean standard deviation (SD) AHI for the 58 subjects who completed the study was 15.1±16.1. The number of subjects with AHI ≥15 was significantly higher in the group who used dentures (Pearson's chi-square= 11.157; degree of freedom=1; *P*=.001). Table 2 shows denture use by AHI category.

By logistic regression analysis, denture use was significantly associated with AHI ≥15 per hour of sleep (OR=6.29; 95% CI=1.71, 23.22; *P*=.006) even after controlling for other risk factors including age, sex, and body mass index. There was no significant association between AHI ≥15 and age or sex. Body mass index was marginally associated with AHI ≥15 (OR= 1.15; 95% CI=0.97, 1.37; *P* =.103).

There was no statistically significant difference in AHI between those who used partial versus full dentures (Fisher's exact test *P*=.32), or those who used either upper or lower versus both upper and lower dentures (Fisher's exact test *P*=.34). But due to the limited sample size, our study did not have enough statistical power to detect a difference in AHI between these groups. Only four subjects (18%) reported not removing their dentures before going to bed, thus preventing an evaluation of this practice.

TABLE 1
Characteristics of Subjects Who Completed and Did Not Complete Study

Characteristics	Completed Study (*N*=58)	Did Not Complete Study (*n*=14)	*P*-value
Sex: female	44 (76%)	13 (93%)	.27*
Age mean (SD)	77.7 (6.7%)	78.43 (3.78%)	.75†
Years of education			
<12	2%	7%	
12	23%	36%	.11*
13–15	28%	28%	
≥16	47%	29%	
Living facility			
Home	50%	7%	.003*
Independent	50%	93%	.41*
Denture use while sleeping	38%	50%	

*Chi-square test.
†Independent sampe *T*-test.

TABLE 2
Denture Use by Apnea Hypopnea Index (AHI) Category

Denture Use	AHI 0–4 (%)	AHI 5–14 (%)	AHI ≥15 (%)	Total (%)
Yes	6 (27)	3 (14)	13 (59)	22 (100)
No	8 (22)	22 (61)	6 (17)	36 (100)
Total	14 (24)	25 (43)	19 (33)	58 (100)

Discussion

This study found a significant association between sleep-disordered breathing and denture use. As 82 percent of the study subjects removed their dentures before they went to sleep, we believe the association between sleep-disordered breathing and denture use may serve as a proxy for the relationship between sleep-disordered breathing and teeth loss, rather than a specific cause for sleep-disordered breathing. This is consistent with a previous note, where subjects were found to have worsening of the AHI and decrease in their antero-posterior oropharyngeal wall distance when examined without their dentures (21). Other studies have also noted associations between denture use and sleep-disordered breathing (8,22,23). Because only four of the 22 subjects (28%) reported not removing their dentures before going to sleep, there was insufficient statistical power to detect any significant difference in this regard.

The mechanism underlying the relationship between teeth loss and sleep-disordered breathing likely involves changes in the upper airway anatomy and function. Reduction in the retropharyngeal space associated with impaired function of the genioglossus and other upper airway dilating muscles results in increase in the upper airway resistance (24), predisposing the subjects to apnea, hypopnea, or the upper airway resistance syndrome.

Of note was that there was no difference in AHI between those who used full and those who used partial dentures. Impaired oral function in subjects who lack their posterior teeth have been reported previously (7), which may suggest the importance of the posterior occlusion in maintaining the vertical dimension of occlusion. Unfortunately, because information on the types of partial dentures used by the subjects was not collected and the vertical dimension of occlusion was not measured, we must be circumspect regarding the mechanisms that may underlie the observed relationships. Future studies will need to evaluate such additional information.

The use of dentures may be associated with chronic inflammatory changes leading to papillary hyperplasia and other complications (24). To minimize these complications, subjects who use dentures are advised to remove their dentures before going to bed. As subjects who remove their dentures at night may be at increased risk of sleep-disordered breathing, clinical investigations are needed to determine if wearing dentures during sleep improves the upper airway patency and reduces sleep-disordered breathing. If indeed this is the case, the advice to remove dentures while going to bed may have to be modified (e.g., avoiding dentures for several hours during the daytime rather than at night), depending upon the individual's risk for sleep-disordered breathing and the risk of cardiovascular complications associated with this sleep disorder (25-28). Given this apparent association between teeth loss and sleep-disordered breathing, it would also be prudent for denture wearers to be asked routinely about snoring and other related sleep problems associated with sleep-disordered breathing during clinic visits.

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The Association Between Environmental Tobacco Smoke and Primary Tooth Caries

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Abstract

Objective: *Environmental tobacco smoke (ETS) has been associated with a number of negative health outcomes for exposed children. The goal of this study was to assess the association between ETS and dental caries in a pediatric population.* ***Methods:*** *This study included 637 Iowa Fluoride Study children whose parents provided socioeconomic information, completed at least three questionnaires during the first year of life, and had a primary dentition exam at age 4–7 years. Households reporting in all questionnaires that someone smoked in the home were categorized as regularly smoking homes. Socioeconomic status (SES) was divided into three groups (low, middle, and high) based on family income and mother's education. Children were classified as having caries if any of the primary teeth had fillings or cavitated lesions at the primary dentition exam.* ***Results:*** *Overall, children residing in regularly smoking homes had a higher prevalence of caries. For the middle SES group and overall, the children from smoking homes had a significantly higher prevalence of caries compared to nonregular/nonsmoking homes (52% vs 24%, P=.05 and 44% vs 25%, P=.002, respectively). After adjusting for age, SES, toothbrushing frequency, total ingested fluoride, and combined intake of soda pop and powdered drink beverages, the relationship of smoking and caries still remained significant (odds ratio [OR]=3.38; P=.001).* ***Conclusions:*** *Environmental tobacco smoke was associated with an increased risk of caries among children. [J Public Health Dent 2004;64(3):184-86]*

Key Words: environmental tobacco smoke, dental caries, children, socioeconomic factors, smoking.

Environmental tobacco smoke (ETS) and maternal smoking have been associated with a number of negative health outcomes for children. Smoking during pregnancy has been associated with an increased incidence of low birth weight, as well as higher rates of mothers' not initiating breastfeeding (1,2). ETS reportedly is associated with increased rates of asthma, otitis media and subsequent absenteeism among children, increased rates of hospitalization, and compromised nutrition (3-6). Recently, exposure to ETS by children has also been associated with an increased risk of dental caries (7,8).

An association between ETS and caries is important because researchers have been attempting to further refine caries risk assessment tools by investigating behavioral indicators that are strongly predictive of current or future caries potential (9). The two studies that evaluated associations between parental tobacco use and caries risk hypothesized that there were behaviors associated with tobacco use that might result in other unhealthy behaviors, independent of socioeconomic status, such as poor oral hygiene and diet (7,8).

The purpose of this paper is to report on assessment of the association between primary tooth caries and environmental tobacco smoking status among a birth cohort in the Iowa Fluoride Study.

Methods

Subjects in the study were participants in the Iowa Fluoride Study, an ongoing longitudinal investigation of dietary, dental, and health-related behaviors among subjects recruited from eight Iowa hospitals at birth during 1992–95. Questionnaires were sent out five times during the first year of life. Examination of the primary dentition was conducted by two trained examiners (10) when the children were between the ages of 4 and 7 years. The present report is based on results for 637 subjects whose parents provided socioeconomic information, returned at least three questionnaires during the first year, and also had a dental exam of the primary dentition. Subjects were primarily white (98% of mothers were white), and 49 percent were boys and 51 percent were girls.

Questionnaires asked about smoking in the home on a regular basis for mothers, partners, and others. If someone in the home was reported as being a regular smoker on each questionnaire returned during the first year, then the home was categorized as being a regularly smoking household. If any of the returned questionnaires reported that nobody smoked at home, then the home was categorized as not being a regularly smoking household.

Three levels of socioeconomic status (SES) were defined as (1) low—families with less than $30,000 income per year and in which mothers did not have a four-year college degree; (2) middle—families with an annual income of $30,000–$49,999 but excluding those with mothers having graduate or professional degrees, or less than

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$30,000 income but having mothers with a four-year college or graduate/professional degree; and (3) high—mothers with a graduate/professional degree and $30,000 or more annual family income or $50,000 or more in income regardless of mother's educational level. The combination of income and educational level was deemed necessary because of the study's central base in Iowa City, a university town with many student families who may temporarily have low incomes, but should not be considered as having low SES.

Subjects were classified as having dental caries if one or more of the primary tooth surfaces had cavitated lesions or fillings. All others were classified as not having caries. Subjects also received a score indicating the total number of tooth surfaces with cavitated lesions or fillings.

Comparisons of caries rates for each SES group were completed using Fisher's exact test, and overall with a Cochran-Mantel-Haenszel test for differences in smoking/nonsmoking prevalence, stratified by SES level. Multiple logistic regression analysis was adjusted for: the child's age at the time of the dental exam; average brushing frequency per day from 16 to 60 months of age; average total ingested fluoride per day (16 to 60 months) from water, other beverages and selected foods, ingested dentifrice, and fluoride supplements; and average amount (oz) of combined intake from beverages made from powder and soda pop (aged 16 to 60 months); SES; and household smoking status. Differences in the number of carious surfaces were tested using the Wilcoxon rank sum test. *P*-values below .05 were considered statistically significant.

TABLE 1
Caries Prevalence Stratified by SES and Household Smoking Status in Iowa Fluoride Study Cohort

SES	*N*	Reg. Smoker at Home (Birth–12 Months)	Caries Prevalence (%)*	Relative Risk (95% CI)†	*P*-value‡
Low	121	No	32	1.50 (0.95, 2.37)	.13
	29	Yes	48		
Middle	218	No	24	2.15 (1.35, 3.45)	.01
	21	Yes	52		
High	239	No	20	1.66 (0.64, 4.33)	.40
	9	Yes	33		
Combined	578	No	25	1.74 (1.27, 2.37)	.002
	59	Yes	44		

*Simple caries rates, except for the combined row, which reports standardized rates that adjust for differences in the proportion of smokers for each of the three SES levels.
†Simple relative risk, except for the combined row, which reports the common relative risk using stratification by SES level.
‡*P*-value from Fisher's Exact Test, except for the combined row, which stratifies by SES level and uses the Cochran-Mantel-Haenszel test for differences in row prevalence.

TABLE 2
Final Logistic Regression Model Predicting Occurrence of Primary Caries in Iowa Fluoride Study Cohort

Predictor*	DF	Wald Chi-square	*P*-value	OddsRatio	Odds Ratio 95% CI
SES	2	0.65	.73	1.28 (low vs high)	0.70, 2.32
				1.11 (middle vs high)	0.66, 1.86
Regular smoker at home	1	11.69	.001	3.38	1.68, 6.79

*Covariates (not listed) included: age, brushing frequency per day (area-under-the-curve (AUC) for ages 16–60 months), total ingested fluoride AUC (mgF per day from water, other beverages and selected foods, dentifrice and fluoride supplements) for ages 16–60 months, and combined intake AUC of beverages made from powder and soda pop (ounces per day) from ages 16–60 months.
SES * smoking interaction was not significant (*P*=.87).

Results

The prevalence of caries at each SES level and household smoking status are presented in Table 1. While children in regularly smoking households had caries more frequently overall (44% vs 25%, *P*<.002), only the middle SES group had significantly more children with caries for regularly smoking households than for nonregular/nonsmoking households (52% vs 24%, *P*<.01). Presence of caries did not differ significantly by smoking status for either low SES or high SES children. Logistic regression analysis that adjusted for the child's age at the time of the dental exam, toothbrushing frequency, total ingested fluoride, and soda pop/powdered beverage intake revealed similar results (Table 2), with significant differences between prevalence of caries for regularly smoking households vs nonregular/nonsmoking (*P*<.001). Nonregularly smoking/nonsmoking household children in the middle SES group also exhibited fewer carious surfaces (d_2fs) than did regularly smoking household children (0.8 surfaces vs 3.9 surfaces, *P*<.002).

Discussion

Individuals who use tobacco products are likely to have other health behaviors that put them at increased risk for developing systemic disease. These increased risks include more alcohol use, poor nutrition, and a sedentary lifestyle (11). Poor oral health behaviors are also associated with individuals who use tobacco (12). This study showed that children are at increased risk for developing dental caries in homes that have individuals who smoke. It is possible that ETS at home is an indicator of poor oral hygiene development among children, patterned after parental habits. ETS could also be associated with poor dietary habits, low fluoride exposures, or other unknown factors that may influence children's oral health. Increased glucose consumption appears to reduce the impact of abstinence from tobacco, which could result in increased consumption of cariogenic substances in between tobacco use (13). Tobacco users may also have lower overall values of healthy behaviors, which is then translated into lower values of healthy behaviors for their children.

The ability to determine if ETS exposure and dental caries in children is due to a behavioral or physiologic mechanism cannot be ascertained with this study. The small sample size of smokers in this study could yield results that might not be found if a larger sample size had been used.

In addition, based on the evidence that parental tobacco use influences future tobacco use by offspring (14), dentists should improve their ability to address the use of tobacco products by parents and ultimately help to prevent the initiation of tobacco use by children. Dental professionals should pose the question of parental tobacco use at initial and recall visits of children, along with providing parents and children with complete information regarding the health risks of current and future tobacco use.

Conclusions

This study showed an association between exposure of children to environmental tobacco smoke and dental caries in the primary dentition. The etiology of this association is not clear and requires further research to develop appropriate interventions for parental and pediatric dental settings.

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