



Published in final edited form as:

Soc Work Public Health. 2011 ; 26(7): 695–707. doi:10.1080/19371918.2010.525152.

Factors Associated with Toothache among African American Adolescents Living in Rural South Carolina

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Abstract

Objective—The aim of this study is to explore behavioral factors associated with toothache among African American adolescents living in rural South Carolina.

Methods—Using a self-administered questionnaire, data were collected on toothache experience in the past 12 months, oral hygiene behavior, dental care utilization, and cariogenic snack and non-diet soft drink consumption in a convenience sample of 156 African American adolescents aged 10-18 years old living in rural South Carolina. Univariable and multivariable logistic regression analyses were used to assess the associations between reported toothache experience and socio-demographic variables, oral health behavior, and snack consumption.

Results—Thirty-four percent of adolescents reported having toothache in the past 12 months. In univariable modeling, age, dental visit in the last two years, quantity and frequency of cariogenic snack consumption, and quantity of non-diet soft drink consumption were each significantly associated with experiencing toothache in the past 12 months (all p-values < 0.05). Multivariable logistic regression analysis indicated that younger age, frequent consumption of cariogenic snacks, and number of cans of non-diet soft drink consumed during the weekend significantly increased the odds of experiencing toothache in the past 12 months (all p-values = 0.01).

Conclusion—Findings indicate age, frequent consumption of cariogenic snacks and number of cans of non-diet soft drinks are related to toothache in this group. Public policy implications related to selling cariogenic snacks and soft drink that targeting children and adolescents especially those from low income families are discussed.

Keywords

Dental pain; carbonated beverages; dietary sucrose; rural health; questionnaire

The prevalence of toothache among children and adolescents in developed countries ranges from 5 to 33% (Slade, 2001). In the United States, about 12-20% of children (5-13 years old) and 24% of adolescents (14-17 years old) experienced toothache in the past 12 months (Bailit, 1987; Vargas, Macek, Goodman, & Wagner, 2005). Not only is the prevalence of toothache in children and adolescents high, but the impact of toothache is substantial. Toothache has a marked impact on the psychosocial well-being of both children and their parents, and its consequences can have a negative effect on children's health and learning (Locker et al., 2002; Shepherd, Nadanovsky, Sheiham, 1999). Furthermore, toothache can interfere with a child's daily life by disrupting eating, sleeping, playing, attending school, as well as oral hygiene (Edelstein, Vargas, Candelaria, & Vemuri, 2006; Pau, Baxevanos, & Croucher, 2007).

Based on a critical review of the literature on toothache in children and adolescents, Slade (2001) concluded toothache is consistently associated with caries. Vargas et al. (2005) found 28.2% of children who had caries experienced toothache, and the prevalence of toothache among them was about 10 times that of children without caries. Although the principal cause of toothache is caries and its sequelae, other factors such as dental erosion, trauma to teeth, having dental braces, eruption of permanent teeth, exfoliating primary teeth, or loose teeth can give rise to toothache (Linnett & Seow, 2001; Shepherd et al., 1999).

A recent epidemiological oral health study conducted in South Carolina with over 21,000 kindergarteners and third graders found 51.6% of the children have a history of caries and 32.2% have untreated caries on either primary or permanent teeth (Ali & Lala, 2003). In addition, untreated caries and urgent dental care were more common among African American children living in rural South Carolina (Ali & Lala, 2003), whose families constitute a high percentage of low income families. Studies (Honkala, Honkala, Rimpela, & Rimpela, 2001; Slade, 2001; Vargas et al., 2005) conducted in developed countries indicate children and adolescents from families of low socio-economic status are more likely to experience toothache. Slade (2001) suggested inadequate dental care and poor access to care are the major contributing factors to the high prevalence of toothache in this population; however, Vargas et al. (2005) found toothache among children was not related to dental utilization variables. Other studies (Normura, Bastos, Peres, 2004; Pau, et al., 2007; Ratnayake & Ekanayake, 2005) found toothache was also associated with family structure (i.e., children living with single parent), low education level of parent/mother, and less frequent toothbrushing habit.

Given that toothache is consistently associated with caries, significant factors known to be associated with caries in children and adolescents -- such as poor oral hygiene (Mathiesen, Ogaard, & Rolla, 1996) and frequency and amount of cariogenic snack and non-diet soft drink consumption (Moynihan & Petersen, 2004; Sohn, Burt, & Sowers, 2006)--are likely to contribute to toothache. The purpose of the present study was to explore the association of toothache with oral hygiene behavior, dental care utilization, and cariogenic snack and non-diet soft drink consumption among African American adolescents living in rural South Carolina.

Methods

Subjects

The respondents in this study comprised a convenience sample of 156 African American adolescents aged 10 to 18 years old living in the rural coastal areas surrounding Charleston, South Carolina. These adolescents were recruited through churches and YMCAs. Verbal informed consent was obtained from these adolescents and their parents following an explanation of the study's purpose. The study proposal was reviewed and approved by the Institutional Review Board at the Medical University of South Carolina.

Procedure

Data were collected via a self-completed anonymous questionnaire containing a combination of open- and closed-response options. Administration of the questionnaire was conducted in small groups. To enhance the validity of the questions, the questionnaire was pilot-tested on 35 African American adolescents (in a series of small groups) from the same geographic area before administering it to study participants. Subsequent language modifications were made accordingly. Results of the pilot testing were not included in the main study. The questionnaire used in this study was part of a larger study surveying the oral health knowledge, attitudes, and behaviors among African American adolescents living in rural South Carolina.

Questionnaire items

The questionnaire consisted of questions asking about toothache experience. In addition to socio-demographic characteristics (e.g., age, gender, family structure, and permanent teeth eruption), we included several sets of questions related to: existence and frequency of oral hygiene behavior (e.g., toothbrushing and flossing), dental care utilization, and consumption (amount and frequency) of cariogenic snacks (e.g., sweets and chips) and non-diet soft drinks either in a week or in a day.

Dependent Variable

The dependent variable, toothache in the last 12 months, was constructed based on five questions related to toothache experience. Adolescents were asked about their recent toothache experience (within the past week) and severe toothache (in the past 12 months). The two questions on recent toothache were: (1) "Have your teeth hurt while drinking cold water in the past week?" and (2) "Do your teeth or gums hurt right now?" For severe toothache, three questions were used: (1) "In the last 12 months, have you missed school because your teeth hurt?"; (2) "In the last 12 months, have you gone to the hospital emergency room because your teeth hurt?"; and (3) "In the last 12 months, have you gone to the dentist because your teeth hurt?". The rationale for classifying these toothache experiences as severe was based on the assumption these toothaches resulted in significant consequences such as missing school or visiting the emergency room or dentist. Affirmative response to any one of the five questions was coded as positive for having toothache in the past 12 months. Any combination of negative responses and a missing response in one or more of the five questions was coded as missing data.

Independent Variables

The independent variables include age, gender, family structure (i.e., single parent vs. both parents), presence of permanent teeth eruption, presence of daily oral hygiene habit (toothbrushing and dental flossing), frequency of oral hygiene performance on a daily basis, frequency of professional dental cleaning in the past year, presence of dental visits in the last two years, quantity of cariogenic snacks (candy bars, candy, and chips) consumed last week,

number of days last week cariogenic snacks (sweets and chips) were consumed, and number of cans of non-diet soft drink consumed per day during weekdays and during weekends. The number of cans of non-diet soft drink consumed per day was created as a weighted average of the responses on the two questions: the number of cans of non-diet soft drink per day consumed on weekdays and on the weekend.

Data analysis

Independent variables were grouped into six categories: socio-demographics, oral hygiene behavior, dental care utilization, and sweet snack, chips, and non-diet soft drink consumption. Associations among independent variables were assessed using Spearman rank-order correlation. A univariable logistic regression of the dependent variable with each independent variable was then performed. Predictors with a p-value less than 0.25 in univariable models were considered as candidates for multivariable modeling (Mickey & Greenland, 1989). From each category, the predictor with the strongest association with toothache was included in a multivariable logistic regression with consideration also given to collinearity among predictors. All p-values reported are two-sided, and the type I error rate was set at 0.05. All analyses were performed using SAS software.

Results

Socio-Demographics

The mean age of the sample was 13.2 ± 2.3 years; slightly more than half (52.9%) of the respondents were female. In this sample, 21.8% of adolescents lived with both parents, and 39.5% reported having permanent teeth coming in. As expected, age was significantly greater among those reporting having teeth coming in ($p = 0.01$).

Toothache

Table 1 reports the frequencies for toothache in the last 12 months and the responses for each of the 5 questions comprising this outcome. As seen in Table 1, 34.0% of adolescents reported experiencing toothache in the past 12 months; 20.9% reported having recent toothache within the past week, and 22.6% reported having severe toothache resulting in missed school, a dental emergency visit, or a dental visit in the last 12 months.

Oral Hygiene Behavior and Dental Care Utilization

The vast majority (90.1%) of the adolescents in our sample reported brushing their teeth daily, and 73.9% reported brushing at least twice daily. Almost all (98.5%) reported using toothpaste to brush their teeth. In addition, 47.4% reported flossing daily. About ninety percent (88.4%) reported that they had at least one dental visit within the past two years.

Cariogenic Snack and Non-diet Soft Drink Consumption

In regard to cariogenic snack consumption, 67.6% of adolescents reported eating sweet snacks in the last week, and 60.4% reported eating chips in the last week. In terms of frequency of cariogenic snack consumption, adolescents consumed sweet snacks an average of 2.0 days in the previous week, and consumed chips an average of 1.4 days in the previous week; and the average number of candy bars consumed in a week was 1.6.

In regard to non-diet soft drink consumption, 82.6% of the adolescents reported drinking soft drinks. They consumed an average of 2.9 ± 2.8 cans (about 34.8 fl. oz.) per day, with an average of 3.6 ± 3.3 cans (43.2 fl. oz.) for boys, and 2.4 ± 2.3 cans (28.8 fl. oz.) for girls ($p = 0.09$). Respondents consumed an average of 3.2 ± 3.4 cans (38.4 fl. oz) per day during weekdays, and 2.3 ± 2.4 cans (about 27.6 fl. oz.) per day during weekends. A significant

difference ($p = 0.00$) was found in the amount of soft drink consumption per day between weekdays and weekends.

Factors Associated with Toothache in the Past 12 Months

Results from univariable logistic regression models with toothache are shown in Table 2. These univariable models indicated gender, family structure, tooth eruption, and oral hygiene behavior were not associated with toothache in the past 12 months. Younger adolescents tended to experience toothache more often, with a 23% increase in the odds of experiencing toothache for each year younger in age (OR = 1.23, 95% CI = 1.05 to 1.45, $p = 0.01$). The odds of experiencing toothache were 4.8 times higher for those who visited the dentist in the last two years compared with those who did not (OR = 4.76, 95% CI = 1.05 to 21.58, $p = 0.04$). Sweet snacks and chips also were significantly related to toothache. An additional day of consuming sweet snacks between meals resulted in a 21% increase in the odds of experiencing toothache (OR = 1.21, 95% CI = 1.01 to 1.47, $p = 0.04$), and an additional day of chip consumption resulted in a 33% increase in the odds of experiencing toothache (OR = 1.33, 95% CI = 1.03 to 1.73, $p = 0.03$). An additional candy bar per week consumed resulted in 31% increase in the odds of experiencing toothache (OR = 1.31, 95% CI = 1.02 to 1.67, $p = 0.03$). Similarly, an additional can of non-diet soft drink consumed during the weekend resulted in a 26% increase in the odds of experiencing toothache (OR = 1.26, 95% CI = 1.04 to 1.52, $p = 0.02$); whereas, an additional can of non-diet soft drink consumed per day resulted in a 16% increase in the odds of experiencing toothache (OR = 1.16, 95% CI = 1.01 to 1.33, $p = 0.03$).

From our univariable analyses, we included five variables in our multivariable model: age, reported a dental visit in the last two years, days of sweet snack consumption between meals, days of chip consumption between meals, and cans of non-diet soft drink consumed during the weekend. However, we discovered that days of sweet snack consumption between meals and days of chip consumption between meals were highly collinear ($N=109$, $\rho = 0.64$, $p < 0.00$). Hence, two multivariable models are presented in Table 3, one with days of sweet snack consumption between meals as a predictor (model 1) and the other with days of chip consumption between meals (model 2). Also, the predictor in the sweet snack consumption category possessing the strongest association with toothache (number of candy bars consumed last week) held no explanatory power when included in multivariable models. Thus, the number of days last week of sweet snacks between meals was used as predictor, which contributed significantly to the model.

For model 1, the multiple logistic regression indicated an additional day per week of eating sweet snacks resulted in a 38% increase in the odds of experiencing toothache (OR = 1.38, 95% CI = 1.07 to 1.73, $p = 0.01$), and an additional can of non-diet soft drink consumed during the weekend increased the odds of experiencing toothache by 45% (OR = 1.45, 95% CI = 1.12 to 1.88, 0.01). Younger adolescents were more likely to have a toothache, with a 43% increase in the odds of experiencing toothache for each year less in age (OR = 1.43, 95% CI = 1.10 to 1.85, $p = 0.01$). For model 2, the multiple logistic regression indicated an additional day per week of eating chips resulted in a 54% increase in the odds of experiencing toothache (OR = 1.54, 95% CI = 1.12 to 2.12, $p = 0.01$), and an additional can of non-diet soft drink consumed during the weekend increased the odds of experiencing toothache by 30% (OR = 1.30, 95% CI = 1.07 to 1.58, $p = 0.01$). A younger adolescent was more likely to have a toothache, with a 39% increase in the odds of experiencing toothache for each year less in age (OR = 1.39, 95% CI = 1.10 to 1.75, $p = 0.01$).

Discussion

The proportion of African American adolescents in this study reporting toothache is higher (1.4 to 2.8 times) than that reported by adolescents in the United States (Bailit, 1987; Vargas et al., 2005). This preponderance of toothache is paralleled by the high prevalence of untreated caries and urgent dental care among African American children and adolescents living in rural South Carolina (Ali & Lala, 2003). Findings indicate toothache among adolescents in this sample is associated with heavy consumption of cariogenic snacks and non-diet soft drinks.

Adolescents in this sample consumed added sugars at levels in excess of recommendations. Compared to the data from the 1994-1996 Continuing Survey of Food Intake by Individuals (CSFII) for adolescents ages 12–19 (Enns, Mickle, & Goldman, 2003), the average daily consumption of soft drinks in this sample is twice as high for both boys and girls. These findings parallel the alarmingly high incidence of obesity and Type II diabetes among African American adolescents living in rural South Carolina, to which a high level of sugar intake is a contributing factor (Davy, Harrell, Stewart, & King, 2004; Felton et al., 1998; Oeltmann, Liese, Heinze, Addy, & Mayer-Davis, 2003).

Consistent with Vargas' study (2005), no significant association between dental visits in the past two years and toothache was found. One possible explanation is that some adolescents may receive regular dental care while some only go when they have pain. Also, as Vargas proposed, adolescents may learn to live with pain. All these factors may exert positive and negative impacts resulting in no association between dental care utilization and toothache.

The oral hygiene behavior of the adolescents in this study was reasonably good with almost all participants claiming to brush frequently and use toothpaste when brushing. The oral hygiene behavior of this group of adolescents was similar to that found in several population studies in which adolescents claimed to have good oral health habits, but experienced high rates of caries (Hamilton & Coulby, 1991; Oliveira, Narendran, & Williamson, 2000). One possible explanation is that the excessive amount of sweet snack consumption and sugared soft drinks may override the beneficial effects of toothbrushing. For example, the acidity of soft drinks is capable of dissolving considerable amounts of calcium fluoride in a short period of time (Larsen, 2001). Findings concur with the suggestion of Reisine and Psoter (2001) that basic oral hygiene is a necessary but insufficient factor to prevent caries and toothache especially for children like this study group in which heavy consumption of cariogenic snacks and non-diet soft drinks is common.

Although respondents reported they drank more cans of non-diet soft drink during weekdays than during weekends, the weekend consumption was more strongly associated with toothache experience in our data. One possible explanation is that some of the respondents who reported consuming an extremely high amount of soft drinks (such as ten cans) during weekdays did not report experiencing toothache.

Limitations

This pilot study provides a starting point to understanding the multiple factors associated with toothache and particularly the combination of high consumption of cariogenic snacks and highly sweetened soft drinks. However, several limitations may affect the interpretation and generalizability of this study. First, the present sample of adolescents was selected as a convenience sample and recruited from one county in South Carolina. Thus, one should be cautious when attempting to generalize these results to larger populations of rural African American adolescents. Population-based (i.e., large sample size) studies are recommended. Second, including variables that have 30% missing values of the sample, namely days last

week of sweet snack consumption between meals and days last week of chip consumption between meals, may affect the validity in determination of the final model in predicting toothache in the last 12 months among this group. Third, self-reported data are subjective and potentially limited by recall bias. Recall bias may also have resulted in under- or over-reporting. Although memorable events such as missing school, going to the emergency room, and dental visits may improve the recall accuracy for the toothache experience, the prevalence may be underestimated since some adolescents may endure the pain without taking any action. The utilization of more sophisticated data collection methods such as frequent electronic self-charting of toothache across a full year could improve study validity. Finally, structured 24-hour dietary recall interviews, obtained on several occasions throughout the year on randomly sampled days spanning the week, would provide more accurate information on the frequency and amount of cariogenic snack and soft drink.

Public Policy Implications

Information gathered from this preliminary study may help professional health-care providers to better design dental health promotion programs for African American adolescents living in rural areas. In addition to traditional oral health programs, which mainly encourage adolescents to perform daily oral hygiene, content should be added that emphasizes avoiding non-diet soft drinks and snacks that contain large amounts of sugars and carbohydrates (like chips), and selecting appropriate snacks that are *not harmful* to teeth and are also nutritional. Parental education on limiting the availability of non-diet soft drinks, sweet snacks, and chips in the house is also important. Dietary and nutritional (healthy foods) counseling with individualized meal planning (including snacks) that is within the budget of each family should be integrated into a comprehensive (oral) health program for this population. School subsidies of healthy foods (to make them less costly to students) should be considered. Finally, at a societal level, the enactment of school nutrition bills that ban the sale of soft drinks and junk food (such as chips) in cafeterias and on school grounds (including vending machines and school stores) will bolster other oral health promotion efforts.

Acknowledgments

This study was supported by NIH Grant Number P20 RR-017696 from the National Center for Research Resources. This study was presented (March 10, 2006) as a poster at the 35th Annual Meeting & Exhibition of the American Association for Dental Research, Orlando, FL.

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Table 1
Frequencies of Adolescents Who Reported Toothache with Breakdown into Recent and Severe Toothache

Toothache Experience	N	Yes (%)	No (%)
Toothache			
Toothache in the last 12 months	153	52 (34.0)	101 (66.0)
Recent Toothache			
Q1: Teeth hurt while drinking something cold water	154	25 (16.2)	129 (83.8)
Q2: Teeth or gums hurt right now	155	13 (8.4)	142 (91.6)
Recent Toothache (combined variable)	153	32 (20.9)	121 (79.1)
Severe Toothache			
Q1: Missed school because your teeth hurt	155	5 (3.2)	150 (96.8)
Q2: Gone to the hospital emergency room because your teeth hurt	155	7 (4.5)	148 (95.5)
Q3: Gone to the dentist because your teeth hurt	155	28 (18.1)	127 (81.9)
Severe Toothache (combined variable)	155	35 (22.6)	120 (77.5)

Note: Respondents could report more than one type of recent or severe toothache experience.

Table 2
 Summary of Independent Variables by Toothache Status and Results of Univariable Logistic Regressions of Toothache on Each Predictor.

Predictors	Toothache status = Yes		Toothache status = No		p-value		
	Total No.	N	Value*	N		Value*	Odds Ratio
Demographics							
Age (years)	153	52	12.5±2.2	101	13.6±2.3	1.23 (1.05, 1.45)	0.01 ††
Dental Care Utilization							
Visited dentist in last two years †	152	52	96.2	100	84.0	4.76 (1.05, 21.58)	0.04 ††
Sweet Snack Consumption							
No. of candy bars consumed last week	112	35	2.1±1.8	77	1.4±1.6	1.31 (1.02, 1.67)	0.03
Days last week of sweet snacks between meals	108	34	2.6±2.3	74	1.7±2.0	1.21 (1.01, 1.47)	0.04 ††
Chip consumption							
Days last week of chips between meals	108	34	1.9±1.7	74	1.1±1.5	1.33 (1.03, 1.73)	0.03 ††
Non-diet Soft Drink Consumption							
No. of cans of soft drink consumed, weekday	115	35	4.0±3.7	80	2.8±3.2	1.10 (0.99, 1.24)	0.09
No. of cans of soft drink consumed, weekend	114	34	3.2±2.6	80	1.9±2.1	1.26 (1.04, 1.52)	0.02 ††
No. of cans of soft drink consumed, per day	113	34	3.8±3.2	79	2.5±2.7	1.16 (1.01, 1.33)	0.03

Note:

* Plus-minus values are means ± SD. All remaining values are percents.

† Indicates binary variable.

†† Included in multivariable models.

Table 3

Results of Multivariable Logistic Regressions.

Predictor	Odds Ratio (95% CI)	Wald χ^2 value (df = 1)	p-value
Model 1 with Sweet Snack Consumption			
Age	1.43 (1.10, 1.85)	7.05	0.008
Visited dentist in last two years*	2.59 (0.40, 16.63)	1.00	0.317
Cans of non-diet soft drink consumed, weekend	1.45 (1.12, 1.88)	7.75	0.005
Days last week of sweet snacks between meals	1.38 (1.08, 1.77)	6.43	0.011
Model 2 with Chip consumption			
Age	1.39 (1.10, 1.75)	7.54	0.006
Visited dentist in last two years*	2.10 (0.33, 13.31)	0.62	0.430
Cans of non-diet soft drink consumed, weekend	1.30 (1.07, 1.58)	6.85	0.009
Days last week of chips between meals	1.54 (1.12, 2.12)	7.02	0.008

Note:

* Indicates binary variable. For both models, N = 99.