Covariates of Tooth-brushing Frequency in Low-income African Americans From Grades 5 to 8

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Abstract

Purpose: The purpose of this study was to examine tooth-brushing frequency in 575 urban and nearby suburban African American children as part of a comprehensive risk-reduction study for students at high risk for violence, drugs, school delinquency, and unsafe sexual behaviors to determine which covariates predicted tooth-brushing frequency.

Methods: Students were surveyed 5 times, from the beginning of grade 5 and the end of each year through grade 8, and parents were surveyed at the beginning of grade 5. Peer influence, importance of being liked, self-esteem, attitudes towards tooth-brushing, oral health knowledge, self-efficacy, parental attitudes, and other covariates were examined for the ability to predict self-reporting of tooth-brushing frequency.

Results: In the fifth grade, peer influence, the importance of being liked, and physical self-esteem were the significant predictors, and peer influence continued to predict tooth-brushing in the eighth grade. Oral health knowledge and parental influence were not significant.

Conclusion: Peer influence is an important factor in tooth-brushing behavior in metropolitan African American preadolescent children. (Pediatr Dent 2006;28:524-530)

KEYWORDS: ORAL HYGIENE, TOOTH-BRUSHING, SELF-EFFICACY, INTERNAL/EXTERNAL CONTROL, AFRICAN AMERICANS, HEALTH BEHAVIOR

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Few American studies have examined correlates of tooth-brushing frequency in children, although adult American and European child tooth-brushing studies exist.[1-4] In part, this is because prevention of caries in children is more strongly related to fluoride exposure and sealants than to tooth-brushing frequency. Hence, large scale surveys of oral health behaviors are harder to justify. Since oral health habits in children are thought to be predictive of oral health habits in adults,[5] however, and since oral health habits are clearly related to periodontal disease in adults,[6] it is worthwhile to understand tooth-brushing behavior in children.

An opportunity for such a study was provided through the Aban Aya Youth Project,[7] a large randomized trial study that compared the effects of interventions to improve health habits with interventions to prevent violence, drug use, and unsafe sexual behaviors. As part of the main study, data were gathered on the self-reporting of tooth-brushing frequency and attitudes towards oral health in African American children from fifth through eighth grade. The aim of this substudy was to examine which covariates predict tooth-brushing frequency in that group.

The Surgeon General has identified the need to reduce oral health disparities among African Americans.[8] Since African American children in the United States have higher rates of untreated caries[9,10] and higher rates of early periodontal disease than their Caucasian counterparts,[11] the oral health behavior of African American children is significant. There is some evidence that African American children have better oral hygiene than others, but little information about what influences their tooth-brushing.[12] Two studies comparing tooth-brushing in African American and Caucasian adults found no differences in frequency, although African Americans reported brushing less thoroughly.[1,13]

Tooth-brushing frequency is usually greater among those with a higher education or social class.[1,14,15] Since adolescents' oral health habits are related to the mother's oral health habits,[16] the correlation between oral health behavior and social class may be due to families passing on oral care

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Table 1. Components, Medians, and Maximum Possible Scores of Covariates

	n	No. of questions	Median score/ maximum possible score
Social norms			
Peer influence scale	633	3	8/15
Do your best friends brush their teeth at least twice a day?			
How many of the students in your grade brush their teeth twice a day?			
Do your best friends want you to brush twice a day?			
Importance of being liked	630	1	Quite important
How important is being liked by everyone?			
Parent's influence	663	1	Definitely yes
Do your parents or guardians want you to brush your teeth at least twice a day?			
Parent's attitudes scale (asked of parents)	532	2	5/8
How often do you usually brush or clean your teeth?			
How many times a day should someone of your child's age brush their teeth?			
Parent efficacy scale (asked of parents)	532	2	8/10
Please tell us whether your child is capable of brushing his/her teeth at least twice a day?			
How sure or unsure are you that you can get your child to brush or clean his/her teeth at least twice a day?			
Attitudes and beliefs			
Attitude about brushing (good to brush)	652	1	Very good
Is it good or bad for you to brush your teeth at least twice a day?			
Keeping yourself healthy	637	1	Very important
How important is keeping yourself healthy by exercising and eating right?			
Oral health knowledge scale	644	4	12/20
Eating too much sugar causes cavities.			
Children should use dental floss 1x/week.			
Drinking water can help keep teeth healthy.			
Children should try to brush their teeth after every meal.			
Self-Efficacy			
Physical Self-Esteem Scale	620	2	4/6
I am good looking.			
I have a good looking body.			
Interpersonal Self-Esteem Scale	634	2	4/6
I make friends easily.			
I get alone with other kids easily.			

habits to their children. Certainly, families are seen to be important in the development of good oral care habits,[5] which have been found to be hard to change in adults.[17,18]

Cognitive and social learning theories confirm that social norms derived from family influence health behavior. In addition, these theories predict that social norms from peers and others affect health behavior. Other predictors of oral health behavior are attitudes and beliefs, which may affect health behavior individually, or may form an underlying orientation to a healthy lifestyle, presumably derived from social norms, attitudes, and beliefs.[13,19-23]

Self-efficacy is also considered an important predictor of health and oral health behavior.[21,24-27] Self-efficacy is defined as a perception that one has the ability to do a specific task in a specific context effectively. It has been shown to be related to oral health behavior and caries rates.[21,26] A similar concept, locus of control, may also predict dental health behavior. Locus of control is the degree to which an individual perceives that he or she can cause or change events. It is assessed as internal ("I can keep myself healthy") or external ("It is in the hands of God," or, "My doctors should take better care of me.").[22,28] Self-esteem is correlated with oral health behavior,[29] possibly by influencing self-efficacy.

The purpose of the present study was to examine which of these covariates predicted the tooth-brushing behavior of African American children. This study was nested in a larger study designed to understand the inter-relationships of beliefs, attitudes, and behaviors in tooth-brushing and other areas. Information on self-esteem, self-efficacy, locus of control, parental beliefs and behaviors, peer beliefs and behaviors, and student beliefs about health behaviors was all collected. This provided an opportunity to examine the relationships of these variables to tooth-brushing frequency in an African American preteen group.

Table 1 Cont.

Athletic Self-Esteem Scale	630	2	3/6
I am good at sports.			
I am a good athlete.			
General Self-Esteem Scale (Total of above self-esteem questions)	607	12	9/18
General locus of control scale	605	605	605
Good luck is important for getting ahead.			
I don't have enough control over the direction my life is taking			
What happens in my life is mostly luck.			
Child self-efficacy	647	1	Definitely can
How sure are you that you can brush your teeth at least twice a day?			
How sure are you that you can brush your teeth at least twice a day?			
Demographics			
Household income	484	1	$10,000-$15,000
Parent education	529	1	Vocational or Tecnical school grad
Gender	664	1	

Methods

The subjects in this study were those in the Aban Aya Youth Project, conducted by Flay, etal, in greater Metropolitan Chicago, Ill, which tested school-based interventions to reduce risky teen behaviors over time.[7] The data were analyzed by 2 methods:

1. The first method examined only students present at the initiation of the study in the fifth grade and determined which covariates were related to tooth-brushing frequency.
2. The second method was longitudinal and determined if the students changed tooth-brushing frequency over time.

Nine inner city and 3 nearby suburban schools were randomly selected from a pool of Chicago area schools that were greater than 80% African American, had less than 50% annual turnover in students, were not on probation or in a specially designated school, and were rated as risky, based on Illinois State Board of Education school report card data on: (1) family income; (2) attendance; (3) truancy; (4) achievement scores; and (5) other factors.

Data were collected from 1994 to 1998 and came from grades 5 through 8. The subjects were all African American fifth graders in these schools during the 1994-1995 school year and were followed until the eighth grade. Students who transferred out were not followed for data collection. Informed consent was obtained from a parent or legal guardian, with less than 1% denying consent, and students were allowed to refuse participation. The Institutional Review Board of the University of Illinois at Chicago, approved the overarching research and the nested tooth-brushing study. Survey completion rates were 88% to 91% for grades 5 to 6, declining to 85% by grade 8. Noncompletions were due primarily to normal student absenteeism from school.

A total of 663 students answered the questions of interest for this study and were present at the first wave (in fifth grade). Six hundred four were present for at least one other wave, making them eligible for the second, longitudinal part of the study. Of these, 575 had parents who responded to the parents' survey. The final sample included more girls than the original sample, due to boys being absent more often. No other demographic differences were found between the initial sample and the final sample. The final sample was 50% male, with an average age of 10.8 at the beginning of grade 5 and 14.3 at the end of grade 8. Approximately 79% of the students received federally subsidized school lunches, and 47% of the students lived in a 2-parent household.

The variables were drawn from self-report surveys answered by the students in the classroom. The survey questions were designed at a fourth-grade reading level and were tested prior to use for students' comprehension. The surveys were read to the students in class to avoid problems with literacy. Parents also answered a survey, requesting information about themselves and their child. Covariate data were drawn only from surveys administered at grade 5. Tooth-brushing frequency was gathered from the students at the beginning and end of grade 5 and in grades 6 through 8.

The self-report surveys assessed: (1) self-esteem; (2) locus of control; (3) attitudes about health and health behavior; (4) children's ratings of friends' attitudes about tooth-brushing; (5) oral health knowledge; and (6) tooth-brushing frequency. The parents were surveyed about their: (1) educational level; (2) income; (3) parents' tooth-brushing frequency; and (4) attitudes towards their child's tooth-brushing.

Tooth-brushing frequency was collapsed into a binary variable of less than twice a day (inadequate) and twice a day or more (adequate).

The covariates tested against tooth-brushing are described in Table 1. Parent norms were measured by the parent's influence scale, parent's attitudes scale, and parent's efficacy scale, which were all answered by the parents. The rest of the questions came from the children's surveys. The peer influence scale was created from the indicated questions

Table 2. Fifth- and Eighth-grade Odds Ratios of the Significant Covariates of Tooth-brushing Frequency, by Gender*

	Grade 5			Grade 8		
	Odds ratio	95% confidence interval	P	Odds ratio	95% confidence interval	P
Boys						
Peer influence	2.5	(1. 4, 4.3)	.001	2.3	(1.0, 5.5)	.06
Importance of being liked	1.7	(0.8, 3.4)	.16	1.0	(0.3, 3.0)	.94
Physical self-esteem	1.7	(1.2, 2.3)	.001	0.9	(0.5, 1.6)	.60
Self-efficacy	2.0	(0.8, 4.8)	.15	1.0	(0.2, 5.0)	1.00
Girls						
Peer influence	4.9	(2.4, 10.1)	<.001	2.10	(0.9, 5.0)	.09
Importance of being liked	1.8	(0.9, 3.6)	.10	1.3	(0.6, 3.2)	.54
Physical self-esteem	1.2	(0.8, 1.8)	.36	0.6	(0.4, 1.1)	.11
Self-efficacy	1.1	(0.4, 3.0)	.87	2.3	(0.7, 7.1)	.15
All						
Peer influence	3.5	(2.2, 5.6)	<.001	2.2	(1.2, 4.1)	.01
Importance of being liked	1.7	(1.1, 2.9)	.03	1.1	(0.5, 2.3)	.76
Physical self-esteem	1.4	(1.1, 1.8)	.007	0.7	(0.5, 1.1)	.15
Self-efficacy	1.5	(0.7, 2.9)	.28	1.5	(0.6, 4.1)	.41

*Odds ratios were derived from the fitted linear trend model with correlated intercept and slope (N=575). All ratios are calculated comparing the third quartile to the first quartile values (holding other covariates constant), except self-efficacy, which was calculated comparing the third quartile to the tenth percentile (to make the comparison groups similar in number).

as another measure of social norms. An additional measure of peer influence was the question, "How important is being liked by everyone?" Attitudes and beliefs were measured in 3 ways, using the attitude about brushing scale, keeping yourself healthy scale, and oral health knowledge scale. For ease of organization, self-esteem, general locus of control, and self-efficacy are discussed under the heading "self-efficacy." The general locus of control questions were adapted from Nowiki and Strickland's scale for children.[30] Self-esteem was measured using the physical, interpersonal, and athletic subscales of the self-description 1uestionnaire[31] developed for children (Table 1).

The data provided an opportunity to determine which variables collected in the first year were associated with tooth-brushing frequency and with change in tooth-brushing over the next 4 years. Thus, the design is longitudinal regarding the dependent measure of tooth-brushing frequency, but the independent variables were measured only at the beginning. Children's reports of tooth-brushing frequency were collected a maximum of 5 times: (1) between the fifth and eighth grades; (2) at the beginning and end of the fifth grade; and (3) once a year after that.

The intervention tested by the larger study had no effect on tooth-brushing frequency and was, therefore, not included in the models. For the initial cross-sectional analysis of the data collected in the fifth grade, the pool of covariates (listed in Table 1) was entered into a logistic regression model (SAS version 8.02 Proc Logistic, Cary, NC, for tooth-brushing frequency at the beginning of the fifth grade. Utilizing a backward selection procedure, covariates were removed sequentially, retaining only those significant at a level of $P<.10$. Gender was forced into the model to control for the gender differences in retention in the study. Interactions between covariates were tested.

In the next analysis step, covariates resulting from the cross-sectional analysis were included in a linear trend model (with correlated intercept and slope) for the longitudinal tooth-brushing data (Mixor version 2.0[33]), with time included as a covariate.

Results

Table 1 describes the variables used in the analysis. For each variable, the items summed for the scaled score are given, along with the median score and total possible score, to put the values in perspective for the reader. Overall, the intrascale reliabilities (Chronbach's alpha) ranged from 0.54 to 0.81 (data not shown).

Table 2 presents the results of the second, longitudinal analysis, using the linear trend of tooth-brushing between the fifth and eighth grades as the outcome measure. The results of the fifth-grade-only analysis are not presented separately, because they are similar to those presented for grade 5 in the longitudinal analysis. Interaction effects were not significant in either the longitudinal or the fifth-grade-only analyses.

At grade 5, peer influence ($P<.001$), importance of being liked ($P<.031$), and physical self-esteem ($P=.003$) were significant predictors of tooth-brushing adequacy ($P<.10$). Additionally, self-efficacy was significant ($P<.10$) when the fifth-grade-only data was used. Gender was not significant. Although there appears to be a difference in how physical self-esteem correlates with tooth-brushing by gender, the interaction was not significant. Peer Influence was the only covariate significant in the fifth grade that remained significant in the eighth grade. Overall tooth-brushing adequacy did not change with time, as measured by the self-reported dichotomous measure.

Discussion

This study identified covariates related to tooth-brushing over 4 years in low-income urban and suburban African Americans in grades 5 through 8. It was nested in a larger study, which allowed many variables to be examined with an adequate sample size, but limited the questions available for study. The covariates were not consistently measured across time, so the study was not able to see if changes in covariates were related to changes in tooth-brushing. No prior studies were found that examined this set of variables as predictors of tooth-brushing, particularly over time. Nor was any other study found that examined social learning constructs and tooth-brushing specifically in African American children. The predictors of tooth-brushing in low-income, African American, at-risk preadolescents found in this study were: (1) peer influence; (2) importance of being liked by everyone; and (3) physical self-esteem. Peer influence measured in the fifth grade continued to correlate with tooth-brushing measured into the eighth grade.

Social learning theories predict that parent influence, peer influence, attitudes, beliefs, and self-efficacy would be correlated with tooth-brushing frequency. Congruent with these theories, oral health knowledge had no effect on brushing frequency. Social learning suggests that knowledge is not enough to change health behavior, and reviews of the literature suggest that education has only a temporary effect on oral health behavior.[34,35]

The fact that many of the other covariates were not significant in this study does not necessarily indicate their lack of importance. The students endorsed the highest values in many measures, resulting in a ceiling effect. As shown in Table 1, nearly all students said:

1. their parents definitely wanted them to brush twice a day;
2. that it was "definitely" good to brush; and
3. they "definitely can" brush their teeth twice a day.

Likewise, keeping yourself healthy was seen as "very important" by nearly all students. Thus, these covariates may be important in tooth-brushing, but they were already achieved by these students and, thus, did not predict variance in tooth-brushing in this study.

Of great interest is that the covariates measuring parents' influence did not predict tooth-brushing frequency, even though no ceiling effect was present. Parental attitudes about how much children should brush, how often the parents themselves brushed, and whether the parents felt they could get their children to brush did not predict brushing frequency when the other covariates were controlled. The best predictors of tooth-brushing found in this study lay in peer influences. Ajzen and Fishbein recognized the importance of norms and relationships with peers in influencing behavior,[36] and others have recognized its importance in other teen health behavior.[37] Frequency in this group was related more strongly to peer norms than to parental norms, a finding not reported or studied elsewhere.

In this paper, locus of control, self-esteem, and self-efficacy were grouped into the same domain, because all these in various ways reveal whether a child feels that tooth-brushing is worthwhile or effective. Some of these covariates were related to brushing frequency and some were not. The question measuring the more strictly defined self-efficacy was only a marginal predictor in this study, in spite of the importance it is given by social psychologists in oral health behavior. As already indicated, this may be due in part to a ceiling effect. Other researchers, however, have used scales to measure oral health self-efficacy that might be more predictive of brushing, but which were not used here due to the different purpose of the primary study.[21,25,38] These marginal results generally support self-efficacy as a necessary but insufficient quality leading to adequate tooth-brushing behavior, but better measures may find it to be more important.

General locus of control is another measure that assesses a child's general sense of being able to control his or her environment. In this study, it showed no relationship to tooth-brushing frequency. This is consistent with earlier studies that found locus of control to be a domain-specific variable.[28,39] Future research should examine locus of control from a specifically dental point of view.[40]

The importance of self-esteem on tooth-brushing in this age group was noted in English and Swedish groups of similar age.[29,41] Self-esteem may possibly affect tooth-brushing by influencing a child's sense that he or she can improve some aspect of the self through tooth-brushing. In other words, if self-esteem is too low, the child will give up on brushing. In this study, only physical self-esteem was related to tooth-brushing, and this study's results suggest this might be true only in boys. It is possible that girls' motivation to comply is high regardless of self-esteem, while boys' low self-esteem might lower their motivation to comply with social norms and, thus, be correlated with lower tooth-brushing frequency.

Although females were found to brush more frequently in a prior study, this was not supported here.[23] It may be that gender differences in brushing frequency are related to differences in the importance of peer influence and the importance of being liked by everyone and, consequently, disappear when they are controlled.

Since the primary study was focused on risk reduction related to risky sexual behaviors, substance abuse, and violence, the substudy's measures were not always matched to measures in previous studies of oral health behavior.[21,25,40] The overall low values for Chronbach's alpha indicate that the scales used in this study were not ideal. Furthermore, the covariates of interest were not measured longitudinally, so it is unclear whether their decline in significance after the fifth grade means that the variables are no longer important or that their values changed over time.

Finally, it should be noted that the adequacy of removing plaque from the teeth via brushing was unknown in this study. Even adolescents who brush frequently may not be brushing thoroughly or effectively. They may over-report brushing frequency for social acceptability reasons. The use of fluoridated toothpaste was not measured, which is an

important factor in the efficacy of tooth-brushing to prevent caries. Thus, high self-report of tooth-brushing frequency may not translate directly into improved oral health. These results cannot be construed to link the studied covariates directly with oral health. That link would be important to establish in future studies.

The covariates that predict tooth-brushing are related to the child's: (1) view of norms (peer influence); (2) valuation of being liked by everyone; and (3) sense of physical self-esteem. Thus, the target group for tooth-brushing concerns should be the children who: (1) have different norms; (2) have low physical self-esteem; or (3) do not value being liked by others. Furthermore, this indicates that schools may be the best place to promote oral health behaviors since, by the fifth grade, parental influence is not a factor. The methods used to promote oral health in schools should appeal to the children's need for peer acceptance and should promote children's physical self-esteem. It is not clear that increasing knowledge of oral health issues would have any effect on brushing behavior. These findings are useful for future interventions to promote improved oral health for African American children.

Conclusions

Based on this study's results, the following conclusions can be made:

1. Peer influence, the value of being liked, and physical self-esteem were the best predictors of self-reported tooth-brushing behavior between fifth and eighth grade in preadolescent low-income at-risk urban and suburban African American children. Oral health knowledge and parental influence were not significant.
2. Future research should, when possible:
   a. use more complex, validated measures available to detect relationships between attitudes and oral health behaviors; and
   b. include peer influence/social norms and self-esteem as variables.

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References

1. Ronis DL, Lang P, Antonakos CL, Borgnakke WS. Preventative oral health behaviors among African Americans and whites in Detroit. J Public Health Dent 1998;58:234-40.
2. Astrom AN, Jakobsen R. Stability of dental health behavior: A 3-year prospective cohort study of 15-, 16-, and 18-year-old Norwegian adolescents. Community Dent Oral Epidemiol 1998;26:129-38.
3. Kuusela S, Honkala E, Rimpela A. Tooth-brushing frequency between the ages of 12 and 18 years: Longitudinal prospective studies of Finnish adolescents. Community Dent Health 1996;13:34-9.
4. Gift HC. Current utilization patterns of oral hygiene practices. State of the science review. In: Loe H, Kleinman DV, eds. *Dental Plaque Control Measures and Oral Hygiene Practices*. Oxford, England: IRL Press; 1986:39-71.
5. Inglehart MR, Tedesco LA. The role of the family in preventing oral diseases. In: Cohen L, Gift H, eds. *Disease Prevention and Oral Health Promotion: Socio-Dental Sciences in Action*. Copenhagen, Denmark: Munksgaard, Federation Dentaire International; 1995:271-305.
6. Loe H. Oral hygiene in the prevention of caries and periodontal disease. Int Dent J 2000;50:129-39.
7. Flay BR, Graumlich S, Segawa E, et al. Effects of 2 prevention programs on high-risk behaviors among African American youth: A randomized trial. Arch Pediatr Adolesc Med 2004;158:377-84.
8. US Department of Health and Human Services. *Oral Health in America: A Report of the Surgeon General*. Rockville, Md: US Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health; 2000.
9. Vargas CM, Crall JJ, Schneider DA. Sociodemographic distribution of pediatric dental caries: NHANES III, 1988-1994. J Am Dent Assoc 1998;129:1229-38.
10. Disney JA, Graves RC, Stamm JW, et al. The University of North Carolina Caries Risk Assessment Study II. Baseline caries prevalence. J Public Health Dent 1990;50:178-85.
11. Loe H, Brown LJ. Early onset periodontitis in the United States of America. J Periodontol 1991;62:608-16.
12. Cipes MH, Kegeles SS, Lund AK, Otradovec CL. Differences in dental experiences, practices, and beliefs of inner-city and suburban adolescents. Am J Public Health 1983;73:1305-7.
13. Davidson Pl, Rams TE, Andersen RM. Sociobehavioral determinants of oral hygiene practices among USA ethnic and age groups. Adv Dent Res 1997;11:245-53.
14. Nyyssonen V, Honkala E. Tooth-brushing frequency in 4 consecutive studies of Finnish adolescents. J Clin Periodontol 1984;11:682-688.
15. Koivusilta L, Honkala S, Honkala E, Rimpela A. Tooth-brushing as part of the adolescent lifestyle predicts education level. J Dent Res 2003;82:361-6.
16. Astrom AN. Parental influences on adolescents' oral health behavior: Two-year follow-up of the Norwegian Longitudinal Health Behavior Study participants. Eur J Oral Sci 1998;106:922-30.

17. Weinstein P, Milgrom P, Melnick S, et al. How effective is oral hygiene instruction? Results after 6 and 24 weeks. J Public Health Dent 1989;49:32-8.
18. Craig T, Montague JL. Family and oral health survey. J Am Dent Assoc 1976;92:326-32.
19. Bandura A. *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice Hall; 1986.
20. Ajzen I. *Attitudes, Personality, and Behavior*. Homewood, Ill: Dorsey Press; 1988.
21. Tedesco LA, Keffer MA, Fleck-Kandath C. Self-efficacy, reasoned action, and oral health behavior reports: A social cognitive approach to compliance. J Behav Med 1991;14:341-55.
22. Borkowska ED, Watts TLP, Weinman J. The relationship of health beliefs and psychological mood to patient adherence to oral hygiene behavior. J Clin Periodontol 1998;25:187-93.
23. Ostberg AL, Halling A, Lindblad U. Gender differences in knowledge, attitude, behavior and perceived oral health among adolescents. Acta Odontol Scand 1999;57:231-6.
24. Pajares F. Current directions in self-efficacy research. In: Maehr M, Pintrich PR, eds. *Advances in Motivation and Achievement*. Greenwich, Ct: JAI Press; 2002:1-49.
25. Kneckt MC, Syrjala AMH, Laukkanen P, Knuuttila MLE. Self-efficacy as a common variable in oral health behavior and diabetes adherence. Eur J Oral Sci 1999;107:89-96.
26. Syrjala AMH, Kneckt MC, Knuuttila MLE. Dental self-efficacy as a determinant to oral health behavior, oral hygiene, and HbA1C levels among diabetic patients. J Clin Periodontol 1999;26:616-21.
27. Bandura A. Self-efficacy: Toward a unifying theory of behavioral change. In: Baumeister RF, ed. *The Self in Social Psychology*. New York, NY: Psychology Press; 1999:285-98.
28. Williams AF. Personality characteristics associated with preventive dental health practices. J Am Coll Dent 1972;39:225-34.
29. Regis D, Macgregor DM, Balding JW. Differential prediction of dental health behaviour by self-esteem and health locus of control in young adolescents. J Clin Periodontol 1994;Vol 1:7-12.
30. Nowicki S, Strickland BR. A locus of control scale for children. J Consult Clin Psychol 1973;40:148-154.
31. Marsh HW, Relich JD, Smith ID. Self-concept: The construct validity of interpretations based upon the SDQ. J Pers Soc Psychol 1983;45:173-87.
32. SAS. Available at: "http://www.sas.com/technologies/analytics/statistics/stat/index.html". Accessed August 15, 2006.
33. Hedeker D, Gibbons RD. Mixor: A computer program for mixed-effects ordinal regression analysis. Comput Methods Programs Biomed 1996;49:157-76.
34. Kay EJ, Locker D. Is dental health education effective? A systematic review of current evidence. Community Dent Oral Epidemiol 1996;24:231-5.
35. Brown LF. Research in dental health education and health promotion: A review of the literature. Health Educ Q 1994;21:83-102.
36. Ajzen I, Fishbein M. *Understanding Attitudes and Predicting Social Behavior.* Englewood Cliffs, NJ: Prentice Hall; 1980.
37. Petraitis J, Flay BR, Miller TQ. Reviewing theories of adolescent substance use: Organizing pieces in the puzzle. Psychol Bul 1995;117:67-86.
38. Syrjala AMH, Knuuttila MLE, Syrjala LK. Self-efficacy perceptions in oral health behavior. Acta Odontol Scand 2001;59:1-6.
39. Ludenia K, Donham G. Dental outpatients: Health locus of control correlates. J Clin Psychol 1983;39:854-8.
40. Wolfe GR, Stewart JE, Maeder LA, Hartz GW. Use of dental coping beliefs scale to measure cognitive changes following oral hygiene interventions. Community Dent Oral Epidemiol 1996;24:37-41.
41. Kaellestal C, Dahlgren L, Stenlund H. Oral health behavior and self-esteem in Swedish children. Soc Sci Med 2000;51:1841-9.