Development of a Theoretical Screening Tool to Assess Caries Risk in Nevada Youth

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Abstract

Objectives: *One objective of this study was to determine the prevalence and severity of caries among Nevada youth, subsequently comparing these data with national statistics. A second objective was to identify the risk factors associated with caries prevalence and severity in order to develop and tailor a theoretical screening tool for this cohort for future validation.* ***Methods:*** *Researchers computed the prevalence rates of dental caries (D-score) and severity rates of decayed, missing, and filled teeth indices in a cohort of 9,202 students, 13 to 18 years of age, attending public/private schools in the 2005/2006 academic year. Multiple regression established which of the 13 variables significantly contributed to caries risk, subsequently using logistic regression to ascertain the weight of contribution and odds ratios of significant variables.* ***Results:*** *Living in counties with no municipal water fluoridation, increased exposure to environmental smoke, minority race, living in rural communities, and increasing age were the largest significant contributors (respectively). Exposure to tobacco, being female, lack of dental insurance, increased body mass index risk, and lack of dental sealants were also significant, but to a lesser extent. Nonsignificant factors included socioeconomic status, ethnicity, and family history of diabetes.* ***Conclusions:*** *This study confirmed high caries prevalence and severity and identified significant risk factors for inclusion in a theoretical risk screening tool for future validation and translation for use in the early detection of caries risk in Nevada youth.*

Key Words: dental caries; oral health status; decayed, missing, filled teeth index; socioeconomic status; body mass index; sealants

Introduction

The World Health Organization (WHO) reported that oral disease, including dental caries, remains a major public health challenge (1). In the 1970s, significant advances were made in oral health; however, oral health disparities continue to be reported (2,3). In 2004, 60 to 90 percent of children worldwide ages 10 to 19 had dental caries (1). Dental caries has been described as the most common childhood disease, occurring five times more frequently than asthma and seven times more than hay fever (2). The prevalence of caries in children persists in both developed and underdeveloped countries, particularly among underprivileged groups (1).

Studies have identified associations between numerous factors and dental caries, supporting the agreement that dental caries is a multifactorial disease modulated by genetics, behavior, and environment (1,4). Studies have linked poor oral health with chronic, systemic diseases (e.g., cardiovascular disease and diabetes), lifestyle, and social conditions (2,3). Low levels of education and lack of access to dental care have been associated with the unequal distribution of dental caries among different races/ethnicities (4,5). Markers of obesity have been correlated with untreated dental caries (6). Understanding the influence of lifestyle, ethnicity, health status, and social conditions will contribute to the development of improved prevention and treatment approaches (1,3). Thus, identifying significant associations and strength of contribution of selected factors with dental caries provided a rationale for this study.

The purpose of this study was twofold. First, to determine the prevalence (untreated and restored lesions and untreated dental caries) and severity [decayed, missing, and filled teeth (DMFT) indices] among Nevada youth assessed during a statewide, school-based oral health screening initiative, comparing these data with similar National Health and Examination Survey (NHANES) data. Secondly, to develop a theoretical caries risk screening tool that could be validated in future studies involving Nevada youth. Because caries affects individuals disproportionately, it is essential to identify those at highest caries risk early to initiate targeted preventive measures (4,5).

Methods

Selection and Description of Participants. Researchers have been conducting an ongoing statewide, school-based oral health screening initiative annually since 2001 in public/private middle and high schools in Nevada. Data used for this retrospective cohort study collected during the 2005/2006

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DOI: 10.1111/j.1752-7325.2007.00066.x

academic school year included 9,202 adolescents between ages 13 and 18. Inclusion criteria for participation were parental consent and student assent. The University of Nevada Las Vegas Institutional Review Board approved this initiative to assure student confidentiality.

Oral Health Screening. Examinations were conducted in dedicated mobile dental clinics (one each in northern and southern Nevada). Trained and calibrated licensed dental examiners performed oral health screenings to assess caries prevalence and severity. Interrater and intrarater reliability between examiners were validated with the intraclass correlation coefficient (ICC) (0.81, $P < 0.001$ and 0.98, $P < 0.001$, respectively) (7).

Examiners following the Radike criteria with modifications established prevalence (untreated and restored lesions and untreated dental caries) (8). Artificial light and nonmagnifying mirrors were used to perform visual assessments similar to methods used in the NHANES (3). Unlike the NHANES, restrictions placed by the funding agency disallowed the use of compressed air and explorers. However, when comparing studies using visual methods without probe and drying with studies using visual/tactile methods with explorers and compressed air, only in groups with low caries prevalence were statistical differences observed (9). As with the NHANES, severity was determined using DMFT indices developed by Klein et al. (10). Prevalence and severity of caries, along with prevalence of dental sealants, were compared with the NHANES data (3). The oral screening initiative procedural manual detailed all diagnostic and coding criteria.

Face-to-Face Interviews. Trained interviewers collected demographic and oral health status information through face-to-face interviews in the privacy of the mobile clinic setting. Selected self-reported information identified behaviors, health history, and environmental factors of interest. Cronbach's alpha was used to assess the internal reliability of the questionnaire ($r = 0.79$, $P < 0.001$) (11).

Selection of Variables. Thirteen factors identified as variables of interest and those cited as significant modulators of dental caries in the dental literature comprised an initial exploratory analysis (1,4-6). These included sex, age, ethnicity, race, locale (metropolitan versus rural), family history of diabetes, dental insurance status, environmental smoke exposure, tobacco status (including cigarettes, cigars, smokeless tobacco, and marijuana), socioeconomic status (SES), living in an area with or without fluoridated water, applied dental sealants, and overweight status (1,4-6).

Operational Definitions of Select Variables. Body mass index (BMI) has been correlated with direct measures of body fat and considered an alternative for direct anthropometric measures of body composition for large group screenings of adolescents (12). Overweight status was assessed using a visual BMI risk assessment protocol previously validated by comparing visual assessment results with anthropometric measures in matched cohorts (M. Ditmyer et al., University of Nevada, Las Vegas School of Dental Medicine, unpublished observations).

SES was established using each school's percent eligibility for participation in the federally subsidized National School Lunch Program (NSLP) (13). Previous studies have reported this as an acceptable aggregate surrogate measure of SES (14). NSLP participation rates in schools ranged from 9 to 81 percent (15). For this study, SES was categorized as high SES (eligibility <20 percent), moderate SES (eligibility 21 to 60 percent), and low SES (eligibility >60 percent).

In 1999, the Nevada Legislature passed a bill requiring the Southern Nevada Water Authority to fluoridate the municipal water supply (16), subsequently establishing the fluoride range of 0.7 to 1.2 mg/L in Clark County (17). Consequently, the exposed group comprised students attending schools in Clark County versus those living in all other areas of Nevada.

Statistical Analysis. Calculated caries prevalence rates were compared with similar national data sets (3). An exploratory multiple regression (MR) analysis included 13 independent variables to establish which significantly contributed to severity of caries (DMFT indices) ($P < 0.05$) (18). The only previously established categories for children were established by the authors of the WHO's policy and practice paper on the global burden of oral health (1). As a starting point, and in an effort to standardize the DMFT categories, these same categories were used (low: ≤2.6; moderate: 2.7 to 4.4; high: ≥4.5) (1). Beta weight comparisons were used to establish the relative contribution of these variables; no presence of multicollinearity was found among significant variables (18). A second MR, including only significant variables using backward stepwise methods, was used to validate the exploratory analysis (18). Multivariate logistic regression was subsequently performed to formulate a theoretical caries risk screening tool using odds ratios (OR) (18). Data reported in this study were analyzed using SPSS 14.0 (SPSS, Inc., Chicago, IL, USA).

Results

Demographic Characteristics. This study included an equal proportion of males and females (49.2 percent male, 53.2 percent female), with the majority being non-Hispanic (62.4 percent), nonsmokers (87.9 percent), with dental insurance (68.24 percent), and who resided in metropolitan areas (75.7 percent). Each year, all middle and high schools located in the 17 Nevada school districts are invited to participate in this oral health screening initiative. In this 2005/2006 academic year, about one-fourth of all eligible schools ($n = 50$) participated. The majority of those schools represented children of moderate (55.6 percent) to high SES status (34.7 percent). Although invited, 9.1 percent of the

Table 1
Demographic and Mean DMFT Scores

	Demographic data	DMFT scores†
Variable	% (n = 9,202)	Mean (standard deviation)
Sex		
Male	52.8	2.67 (3.18)
Female	47.2	2.91 (3.23)
Age (years)		
13	1.5	2.92 (2.97)
14	39.3	2.41 (2.85)
15	30.3	2.51 (3.04)
16	15.0	3.26 (2.46)
17	10.4	3.84 (2.84)
18	3.6	4.36 (3.99)
Ethnicity		
Hispanic	27.8	2.59 (3.27)
Non-Hispanic	62.4	3.25 (3.14)
Race*		
Caucasian	53.2	2.47 (3.08)
African-American	9.2	2.99 (3.29)
Asian/Pacific Islander	7.2	2.84 (3.27)
Native American	2.2	3.74 (3.59)
Locale		
Metro	75.7	2.70 (3.11)
Rural	24.3	3.08 (3.50)
Insured		
Yes	68.2	2.75 (3.21)
No	13.6	3.23 (3.40)
Not sure	18.1	2.63 (3.02)
Self-reported diabetes history		
No	57.9	2.70 (3.157)
Yes	35.9	2.87 (3.27)
Not sure	5.8	3.09 (3.30)
Tobacco use		
Use tobacco	10.7	3.45 (3.60)
Do not use tobacco	87.9	2.70 (3.14)
Environmental smoke exposure		
Exposed	32.9	3.30 (3.50)
Not exposed	66.9	2.55 (3.03)
Municipal water fluoridation		
Clark County residents	52.8	2.53 (2.90)
Outside Clark County	47.2	3.09 (3.50)
Socioeconomic status		
High	34.7	2.65 (3.15)
Moderate	55.6	2.86 (3.26)
Low	9.1	2.91 (3.17)
Sealants		
Sealants applied	49.7	3.43 (3.57)
No sealants applied	50.3	2.15 (2.66)

Note: Some percentages do not equal 100% because of missing data.
* Race categories are those used within the oral health screening initiative.
† DMFT (decayed, missing, and filled permanent teeth) index according to Klein et al. (12).

schools located in lower-SES geographic areas participated, which represented a small portion of those eligible. Table 1 details the demographics.

Caries Prevalence and Severity. Participants had an overall mean DMFT of 2.79 [standard deviation (SD) = 3.21]. Study participants presented with higher prevalence of untreated decay (D-score) and greater mean DMFT indices than what was reported in NHANES 1999-2004 (3) (Table 2).

Ten of the 13 variables contributed significantly to DMFT indices ($F = 98.752$, $P = 0.0008$, $R^2 = 0.414$) (Table 3). After eliminating SES, ethnicity, and family history of diabetes, a second analysis confirmed these statistical findings ($F = 117.617$, $P < 0.0006$). The R^2 of 0.397 (adjusted $R^2 = 0.395$) indicated that approximately 40 percent of the variables combined contributed to DMFT indices. Beta coefficients placed water fluoridation, exposure to environmental smoke, race, age, and locale as the strongest contributors, respectively. Tobacco use, sex, dental insurance status, overweight status, and sealants were also significant, but to a lesser extent.

Multivariate logistic regression ($F = 72.699$, $P < 0.001$) was used to calculate the OR (referent: DMFT $\leq$2.6) for each of the 10 variables using the Wald statistic to confirm the significance of each variable and Chi-square to validate the model's goodness-of-fit ($\chi^2 = 17.2$, $P = 0.0009$) (Table 4) (18).

Discussion

This study confirmed that dental caries remains a common chronic disease among Nevada youth, presenting higher prevalence rates and greater mean DMFT indices than the national average (Table 2). Because this sample was assessed using a modified protocol, data for this study may be an underestimate of caries prevalence and severity compared with the NHANES (3). Ten factors combined contributed to 40 percent of the variance in DMFT indices in this state sample. These included (in hierarchal order) exposure to fluoridated water, exposure to environmental smoke, race, age, locale, smoking status, overweight status, dental insurance status, sex, and sealant score. Dental professionals should consider these factors when assessing patients' risk for future dental caries, when developing educational programs, and/or when designing and implementing oral health interventions.

The strongest contributor was exposure to municipal water

Table 2
Comparison of the Nevada Oral Health Screening Initiative Data with the NHANES (1999-2004)

Nevada oral health screening initiative				NHANES (1999-2004)			
Variable	Decay % (SE)	DMFT Mean (SE)	Sealants % (SE)	Variable	Decay† % (SE)	DMFT Mean (SE)	Sealants % (SE)
Age (years)				Age (years)			
13-15	28.4 (1.22)	2.46 (0.03)	49.6 (0.63)	12-15	16.91 (0.99)	1.78 (0.08)	41.04 (1.83)
16-18	38.0 (1.48)	3.60 (0.07)	50.0 (1.10)	16-19	22.24 (1.45)	3.31 (0.09)	34.28 (1.70)
Sex				Sex			
Male	29.2 (1.03)	2.67 (0.05)	51.1 (0.82)	Male	19.89 (1.22)	2.31 (0.09)	36.43 (1.65)
Female	31.0 (1.31)	2.91 (0.05)	48.3 (1.12)	Female	19.31 (1.30)	2.79 (0.08)	38.93 (1.51)
Race/ethnicity*				Race/ethnicity			
White, NH	26.4 (1.26)	2.64 (0.05)	58.4 (1.57)	White, NH	16.22 (1.45)	2.54 (0.10)	43.90 (1.81)
Black, NH	36.1 (1.74)	2.91 (0.12)	27.4 (1.22)	Black, NH	25.66 (1.39)	2.20 (0.10)	25.68 (2.01)
Hispanic	37.5 (1.42)	3.25 (0.06)	37.7 (1.85)	Hispanic	28.57 (1.54)	2.82 (0.13)	27.23 (2.34)

Note: Nevada data, $n = 9{,}202$.
* $n = 8{,}256$ because of missing data.
† Untreated caries NHANES (1999-2004) estimates are adjusted to the US 2000 standard population (3).
SE, standard error; NHANES, National Health and Examination Survey; DMFT, decayed, missing, and filled teeth, HN, non-Hispanic.

Table 3
Multiple Regression Analyses Results

	First multiple regression analysis		Second multiple regression analysis	
Variable	*t*-Value	*B*-value (95% CI)	*t*-Value	*B*-value (95% CI)
Fluoride in municipal water	−11.73**	−1.34 (−1.57, −1.12)	−12.35**	−1.31 (−1.45, −1.05)
Exposure to environmental smoke	9.71**	0.49 (0.32, 0.66)	8.44**	0.53 (0.37, 0.68)
Race	7.32**	0.38 (0.28, 0.49)	7.06**	0.33 (0.24, 0.42)
Age	7.43**	0.38 (0.20, 0.35)	5.13**	0.32 (0.24, 0.38)
Locale (metro versus rural)	2.81**	0.34 (0.10, 0.57)	2.99**	0.31 (0.03, 0.44)
Tobacco use	2.86**	0.35 (0.11, 0.59)	2.87**	0.29 (0.09, 0.52)
Body mass index risk	2.57**	0.30 (0.07, 0.53)	2.73**	0.25 (0.08, 0.50)
Insurance status	2.29*	0.25 (0.10, 0.40)	2.50**	0.23 (0.11, 0.39)
Sex	2.58*	0.20 (0.05, 0.35)	2.47**	0.18 (0.04, 0.32)
Sealant score	−27.18*	−2.20 (−2.21, −2.18)	−27.29**	−2.20 (−2.21, −2.19)
Ethnicity	0.50	0.14 (−0.41, 0.68)	–	–
Family history of diabetes	1.15	0.08 (−0.05, 0.20)	–	–
Socioeconomic status	1.18	0.07 (−0.05, 0.19)	–	–

Note: $n = 9{,}202$; multicollinearity was considered in interpreting results.
* $P \leq 0.05$; ** $P \leq 0.001$.
CI, confidence interval.

fluoridation, which has been documented as the most cost-effective, equitable, and safe community-based approach to improving oral health (19). Participants presenting with mean DMFT indices <4.4 were significantly more likely than those with mean DMFT indices ≥4.5 to live in areas without municipal water fluoridation. The benefits of water fluoridation are proportionally higher for people who do not have regular access to other sources of fluoride (19). Dental professionals should counsel patients who live in nonfluoridated geographic areas on the importance of using other sources of fluoride.

Secondhand smoke exposure has been reported to cause immediate harm (20). Nonsmokers living in a smoking environment have been shown to be at greatest risk for the negative health effects from secondhand smoke exposure. Investigators reported an association between environmental tobacco and risk of dental caries among children; suggesting that children exposed to secondhand smoke have significantly higher rates of dental caries (21). Participants exposed to environmental smoke were 60 to 70 percent more likely to present with mean DMFT indices ≥2.6 than those not exposed.

Race, age, and locale carried approximately the same contributing weight to the variance in DMFT indices. In the Nevada oral health screening initiative, race and ethnicity were recorded separately and subsequently combined for comparison with the NHANES data (Table 2). When the DMFT indices were exam-

Table 4
Multiple Logistic Regression Analysis Results

Variable	Wald statistic	Moderate: DMFT 2.7-4.4		High: >4.4	
		OR	95% CI	OR	95% CI
Fluoride in municipal water	90.19**				
Those living in Clark County		1.00	Referent	1.00	Referent
Those living outside Clark County‡		1.17	1.09-1.29	2.01	1.69-2.40
Exposure to environmental smoke	32.71**				
Those not exposed‡		1.00	Referent	1.00	Referent
Those exposed		1.68	1.64-1.85	1.73	1.59-1.77
Race	31.17**				
Caucasian		1.00	Referent	1.00	Referent
African-American‡		1.52	0.43-0.82	1.63	0.43-0.88
Asian/Pacific Islander‡		1.77	0.51-0.98	1.81	0.51-0.94
Native American‡		1.79	0.57-0.94	1.87	0.80-0.97
Age†	12.82*				
(Odds increase with age)		1.00	Referent	1.00	Referent
		1.44	1.35-1.47	1.44	1.28-1.55
Locale (metro versus rural)	15.41*				
Those living in metropolitan areas		1.00	Referent	1.00	Referent
Those living in rural areas‡		1.16	1.07-1.40	1.97	1.80-1.94
Tobacco use	23.41**				
Those who use tobacco‡		1.00	Referent	1.00	Referent
Those who do not use tobacco		0.48	0.28-0.54	0.88	0.69-0.99
Body mass index risk	7.34*				
Unlikely		1.00	Referent	1.00	Referent
Possible‡		1.27	1.18-1.37	1.61	1.37-2.43
High‡		1.43	1.24-1.55	1.77	1.48-2.95
Insurance status	6.34*				
Those with insurance		1.00	Referent	1.00	Referent
Those without insurance‡		1.27	1.17-1.38	1.44	1.11-1.84
Sex	8.98*				
Male		1.00	Referent	1.00	Referent
Female‡		1.82	1.50-1.99	1.84	1.50-1.91
Sealant score	−43.97**				
Those with sealants		1.00	Referent	1.00	Referent
Those without sealants‡		1.31	1.14-1.51	1.67	1.33-2.06

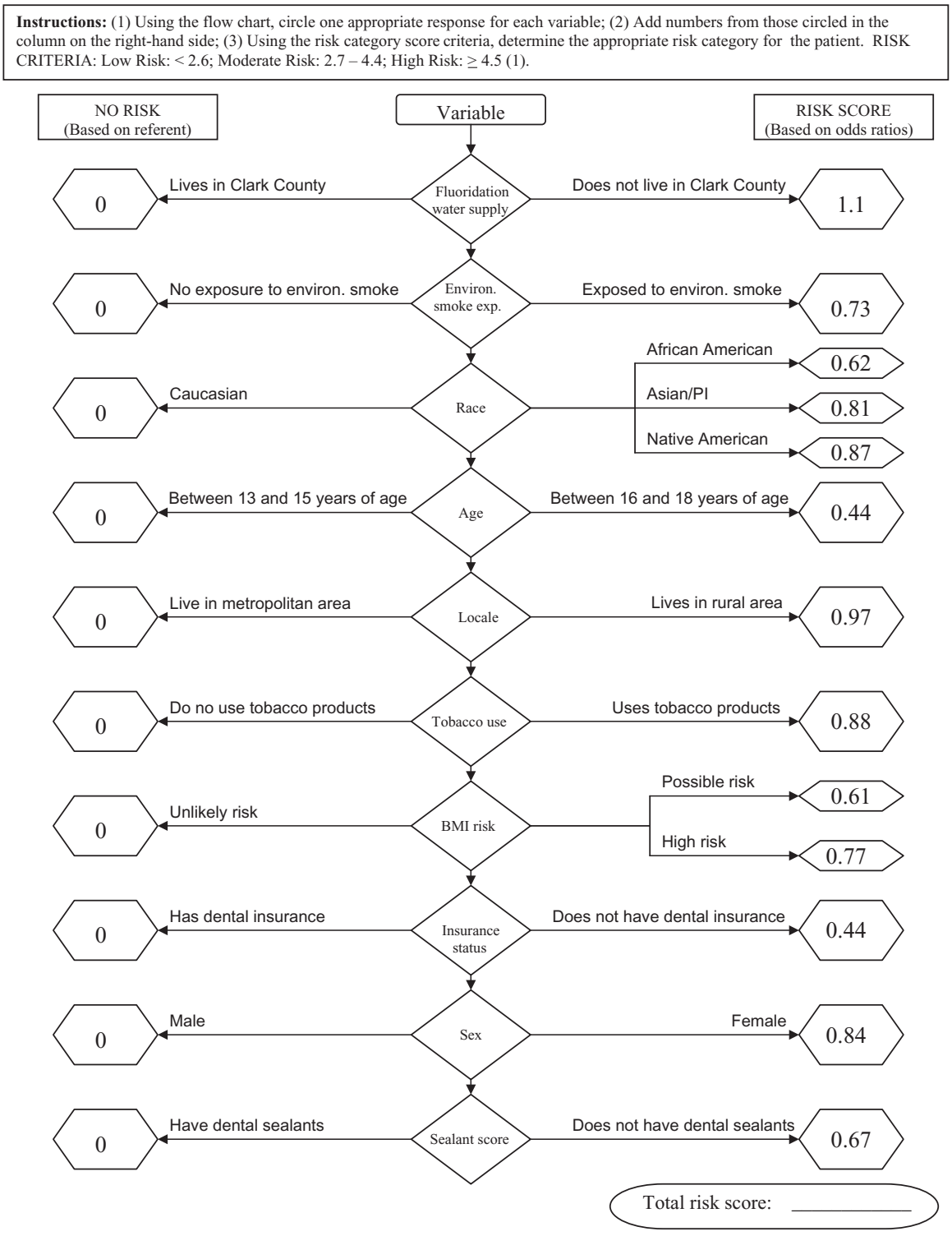
Note: $n = 9{,}202$.
* $P \leq 0.05$; ** $P \leq 0.001$.
† Continuous independent variable.
‡ Significantly different from referent: low DMFT ≤2.6.
DMFT, decayed, missing, and filled teeth; OR, odds ratio; CI, confidence interval.

ined across NHANES categories (non-Hispanic White, non-Hispanic Black, and Hispanic), the prevalence in Nevada was higher than the national average. In both the Nevada and national data, non-Hispanic Blacks and Hispanics presented with higher rates, respectively. African-Americans, Asian Americans, and Native Americans were between 50 and 90 percent more likely to present mean DMFT indices ≥2.6. Both microbiological and behavioral factors including income, education, and residence have been identified as reasons for racial disparities in oral health (5). The percent increase in diversity within the Nevada population overall from April 1, 2000, to July 1, 2006, was 24.9 percent as compared with the percent increase in the United States of 6.4 percent (22). The larger than national average increase may explain the oral health disparity seen between the various races in Nevada.

Comparisons of age categories revealed higher mean DMFT indices in both those between 13 and 15 years of age (2.46 versus 1.78, respectively) and those between 16 and 18 years of age (3.60 versus 3.31, respectively), indicating a significant increase with age (3). The ORs confirm these results. Although age is not a modifiable factor, dental professionals should educate parents and adolescents of the importance for good oral hygiene practices.

Those living in rural areas were almost two times more likely to present with mean DMFT indices of ≥4.5. Lack of municipal water fluoridation and reduced access to dental care rather than geographic location may explain these findings. Further research can aid in discovering the differences in rural and metropolitan

Figure 1
Theoretical screening tool to assess caries risk in Nevada youth (based on the odds ratios of high-risk participants). BMI, body mass index; PI, Pacific Islander



oral health needs and services in Nevada.

Tobacco has been linked to poor oral health, including smoker's palate and melanosis, oral candidosis, dental caries, periodontal disease, and oral cancers (23). Participants who did not use tobacco showed a 20 to 55 percent reduction in mean DMFT indices when compared with those using tobacco. These findings magnified the necessity to educate adolescents and parents/guardians about the negative effects of smoking on oral health.

An association between dental caries and obesity has been reported (24). Frequent consumption of fermentable carbohydrates accessible in food and drinks has been identified as one of the multiple contributing factors to the caries process (24). Participants in this study categorized with possible or high BMI risk were about 75 percent more likely to present with higher mean DMFT indices than those categorized with low BMI risk. The association between BMI, overweight, and dental caries strengthens the importance of nutrition counseling and weight management education within oral health prevention programs (24). Further research can aid in discovering the effect of weight on oral health status.

Inadequate access to dental care for children of low-income families may be largely caused by the lack of dental insurance (25). Participants without dental insurance were 20 to 40 percent more likely to present with higher mean DMFT indices than those with insurance. Despite improvements in children's oral health through prevention, more work needs to be done, with dental caries remaining the most common chronic childhood disease in the United States in the 20th century (25). Children, minorities, and the elderly have been found to experience negative oral health outcomes caused, in part, by a lack of dental insurance (2,25).

In a meta-analysis of more than 50 epidemiological studies, females had a higher prevalence and severity of dental caries than males (26). Findings in this study were similar; girls presented with greater prevalence (31 to 29.2 percent, respectively) and higher mean DMFT indices than boys (2.91 to 2.67, respectively). Girls were approximately 80 percent more likely to present with higher mean DMFT indices. Although sex is not a modifiable factor, dental professionals can target female patients for education and aggressive preventive measures (26).

Without dental sealants, caries prevalence and severity will continue to increase in children (27). Nevada's successful sealant program has demonstrated decreases in prevalence rates that are greater than the national average (Table 2).

Limitations and Future Recommendations

Self-reports warrant some caution in interpreting those data. However, data collection and entry protocols were well documented and quality control guidelines were implemented. Because of student confidentiality issues, students could not be tracked over time, preventing longitudinal data collection. Analysis of cross-sectional data across all years of the initiative will help strengthen these interpretations. This study did not include data regarding sources of fluoride other than that found in municipal water supplies. Inclusion of other potential sources of fluoride supplementation may influence these results. Although validated in a research study, the BMI measure used in the screening initiative was a visual assessment rather than anthropometric data. Data from the oral health screening initiative is likely to be an underestimate of similar data reported from the NHANES (3) because of the differences in study measures discussed in this paper. Further studies can help assess the association between SES and oral health. The majority of participants were from moderate- to higher-SES areas, including less than 10 percent from schools of lower SES. This likely contributed to the nonsignificant results found with this factor.

Conclusion

This study assessed the caries prevalence and severity in Nevada youth, subsequently developing a theoretical screening tool to assess caries risk in this cohort in future studies (Figure 1). Minority girls aged 16 to 18 years who were overweight, used tobacco products, were exposed to environmental smoke, and living in rural communities outside of Clark County, without the privilege of dental insurance and dental sealants were among those at the highest risk for future dental caries. Theoretical models can be useful in testing hypotheses leading to a better understanding of oral health needs in Nevada youth. The next step is to validate this theoretical screening tool using dental health professionals providing oral health care to Nevada youth.

Findings from this study can aid in creating educational programs and other primary and secondary interventions to help promote oral health in Nevada. Because dental professionals have frequent contact with adolescents and their parents/guardians, caries risk assessment based, in part, on the findings from this study can provide a framework to guide early detection, prevention, and treatment practices. A comprehensive preventive dental program should include protocols that lead to the use of dental sealants and patient education that includes guidance regarding fluoride, careful food choices, and regular dental care.

References

1. Peterson PE, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C. The global burden of oral diseases and risks to oral health. Bull World Health Organ. 2005; 83(9):661-9.
2. Office of the Surgeon General. Oral health 2000: facts and figures. [monograph on the Internet]. US Department of Health and Human Services' Resource Library; 2005 May [cited 2006 Jul 12]. Available from: http://www.cdc.gov/OralHealth/factsheets/sgr2000-fs1.htm
3. US Department of Health and Human Services. Trends in oral health status: United States, 1988-1994 and 1999 to 2004. Preliminary report. Vital Health Stat. 2007;11(248):1-104. DHHS Publication No. (PHS) 2007-1698.
4. Reisine ST, Psoter W. Socioeconomic status and selected behavioral determinants as risk factors for dental caries. J Dent Educ. 2001;65:1009-16.
5. Reid BC, Hyman JJ, Macek MD. Race/ethnicity and untreated dental caries: the impact of material and behavioral factors. Community Dent Oral Epidemiol. 2004; 32:329-36.
6. Kiess W, Galler A, Reich A, Müller G, Kapellen T, Deutscher J, Raile K, Kratzsch J. Clinical aspects of obesity in childhood and adolescence. Obes Rev. 2001 Feb;2(1):29.
7. Shrout PE, Fleiss JL. Intraclass correlations: uses in assessing rater reliability. Psychol Bull. 1979;86:420-8.
8. Radike AW. Criteria for diagnosing dental caries. In: American Dental Association,

editor. Proceedings of the Conference on the Clinical Testing of Cariostatic Agents. Chicago (IL): American Dental Association; 1968. p. 87-8.
9. Assaf AV, Meneghim MC, Zanin L, Mialhe FL, Pereira AC, Ambrosano GMB. Assessment of different methods for diagnosing dental caries in epidemiological surveys. Community Dent Oral Epidemiol. 2004; 32:418-25.
10. Klein H, Palmer CE, Knutson JW. Studies on dental caries. Dental status and dental needs of elementary school children. Public Health Rep. 1938;53:751-65.
11. Black T. Doing quantitative research in the social sciences. An integrated approach to research design, measurement and statistics. Thousand Oaks (CA): Sage Publications Ltd.; 2005.
12. Mei Z, Grummer-Strawn LM, Pietrobelli A, Goulding A, Goran MI, Dietz WH. Validity of body mass index compared with other body-composition screening indexes for the assessment of body fatness in children and adolescents. Am J Clin Nutr. 2002;7(6):978-85.
13. US Department of Agriculture, Food and Nutrition Service, Office of Analysis. Nutrition and evaluation, study of direct certification in the National School Lunch Program. Alexandria (VA): 2000. Report No.: CN-00-DC.
14. Ripa LW, Leske GS, Kaufman HW. Caries prevalence, treatment level, and sealant use related to school lunch program participation. J Public Health Dent. 1991 Spring;51(2):78-81.
15. Nevada Department of Education. Child nutrition and school health. [cited 2007 Jun 24]. Available from: http://www.nde.state.nv.us/edteam/ndeoffices/schoolhealth/school.html
16. Southern Nevada Water Authority. Fluoride. [cited 2007 Jun 24]. Available from: http://www.snwa.com/html/wq_facts_fluoride.html
17. Division of Oral Health, National Center for Chronic Disease Prevention and Health Promotion. Achievements in public health, 1900-1999: fluoridation of drinking water to prevent dental caries. MMWR. 1999 Oct 22;48(41):933-40.
18. Field A. Discovering statistics using SPSS. 2nd ed. Thousand Oaks (CA): Sage Publications; 2005.
19. Centers for Disease Control and Prevention. Surgeon General's statement on community water fluoridation, 2004. [cited 2007 Mar 30]. Available from: http://www.cdc.gov/fluoridation/fact_sheets/sg04.htm
20. US Department of Health and Human Services. The health consequences of involuntary exposure to tobacco smoke: a report of the Surgeon General. Rockville (MD): US Department of Health and Human Services; 2000.
21. Aligne CA, Moss ME, Auinger P, Weitzman M. Association of pediatric dental caries with passive smoking. JAMA. 2003 Mar 12;289(10):1258-64.
22. US Census Bureau. State & county quick facts. [cited 2007 May 20]. Available from: http://quickfacts.census.gov/qfd/states/32000.html
23. Reibel J. Tobacco and oral diseases. Update on the evidence, with recommendations. Med Princ Pract. 2003; 12(Suppl 1):22-32.
24. Kantovitz KR, Pascon RM, Rontani RM, Gaviao MB. Obesity and dental caries – a systematic review. Oral Health Prev Dent. 2006;4(2):137-44.
25. Mouradian WE, Wehr E, Crall JJ. Disparities in children's oral health and access to dental care. JAMA. 2000;284:2625-31.
26. Lukacs JR, Largaespada LL. Explaining sex differences in dental caries prevalence: saliva, hormones, and "life-history" etiologies. Am J Hum Biol. 2006; 18:540-55.
27. Swift EJ. The effect of sealants on dental caries: a review. J Am Dent Assoc. 1988; 116(6):700-4.