

## ABSTRACT

**Objective:** To identify which age-specific caries risk assessment (CRA) factors are most predictive of caries progression over time in a pediatric population with an established dental home.

**Methods:** A retrospective longitudinal analysis was conducted using electronic health record data from children followed for a minimum of two years (n = 767). Bivariate analyses (Chi-square) were used to screen candidate variables. A multivariable logistic regression model was constructed to evaluate independent predictors of change in caries status. A secondary model examined associations between preventive fluoride application and neurological condition to explore patterns of care delivery.

**Results:** The caries model was statistically significant (p < 0.001), with moderate explanatory power (Nagelkerke R<sup>2</sup> = 0.309). Snacking behavior (OR = 2.497; p < 0.001) and age at last visit (OR = 1.478; p < 0.001) were the strongest predictors of caries progression. Fluoridated water exposure (OR = 0.684; p = 0.045) and private insurance (OR = 0.530; p = 0.009) were associated with lower odds of progression. Musculoskeletal conditions were also associated with reduced odds (OR = 0.591; p = 0.019). Professionally applied fluoride was not associated with caries progression. In the secondary model (n = 779), fluoride application was strongly associated with neurological condition (OR = 0.253; p < 0.001), although the model demonstrated low explanatory power (Nagelkerke R<sup>2</sup> = 0.075).

**Conclusions:** Caries progression is primarily driven by behavioral, temporal, and socioeconomic factors. Environmental fluoride provides modest protection, while preventive treatments alone do not offset risk. Associations between fluoride application and neurological condition reflect differences in care delivery rather than causation.

## INTRODUCTION

Children with established dental homes receive regular caries risk assessments (CRA), but the predictive value of individual CRA factors over time has not been thoroughly characterized (3). While community water fluoridation, professional applications, and toothpaste are the gold standards for caries prevention, the relative impact of specific interventions versus broader social determinants in clinical settings remains understudied (2). This study identifies which behavioral, socioeconomic, environmental, and clinical variables most strongly predict caries progression, with the goal of refining risk-based preventive protocols in pediatric dental setting.

## AIM

Identify which caries risk assessment factors are most predictive of caries progression over time within a pediatric population with an established dental home.

## METHODS

### Study Design & Population

- Retrospective longitudinal analysis using de-identified EHR data
- Setting: UTHealth Houston School of Dentistry
- Inclusion criterion: (1) children aged 1-6 years with an established dental home, (2) minimum of 2 years of follow-up
- Of approximately 1,000 eligible patients, 767 met inclusion criteria and had complete dataset

### Primary Outcome Measure

- Change in caries status (caries progression) assessed at first and last dental visit

Domain	Variable	Association Tested	p-value	Included in Regression
Behavioral	Snacking (last visit)	Caries progression	<b>0.001</b>	Yes
	Snacking (first visit)	Caries progression	<b>0.001</b> (collinear)	
Socioeconomic	Caregiver LSS (last visit)	Caries progression	<b>0.002</b>	Yes
	Caregiver LSS (first visit)	Caries progression	<b>0.018</b> (collinear)	
	Insurance type	Caries progression	<b>0.013</b>	
Environmental	Fluoridated water (OFDW)	Caries progression	<b>0.049</b>	Yes
Demographic	Ethnicity (Hispanic vs Non-Hispanic)	Caries progression	0.052	Yes (covariate)
	Sex	Caries progression	> <b>0.05</b>	
Behavioral/Clinical	Brushing frequency	Caries progression	0.490	No
	Maternal caregiver caries	Caries progression	0.294	
	Special Health Care Needs	Caries progression	0.497	
Fluoride Exposure	D1206 (topical fluoride)	Caries progression	0.961	No
	Combined fluoride exposure	Caries progression	0.864	
Health Conditions	Neurological condition	Caries progression	> <b>0.05</b>	Yes
	Behavioral/developmental condition	Caries progression	> <b>0.05</b>	
	Musculoskeletal/skin condition	Caries progression	> <b>0.05</b>	
Health vs Fluoride	Neurological condition	D1206 receipt	<b>0.003</b>	Yes
	Musculoskeletal/skin condition	D1206 receipt	<b>0.044</b>	
	Behavioral/developmental condition	D1206 receipt	0.085	

**Table 1.** Bivariate associations of candidate variables with caries progression and selection for multivariable analysis

### Predictor Variables

- Behavioral factors: Snacking frequency, Brushing habits
- Socioeconomic indicators: Caregiver LSS, Insurance type
- Environmental exposures: Fluoridated water, Professionally applied fluoride
- Demographics: Age, sex, ethnicity
- General Health conditions/diseases

### RESULTS-Table 1

We used Chi-square tests to select variables for multivariable modeling based on their association with caries progression. Significant factors included snacking, caregiver socioeconomic status, insurance type, and water fluoridation. While fluoride treatments were not directly linked to caries outcomes, health conditions (neurological, behavioral, musculoskeletal) were included in the model due to their impact on preventive care habits. Finally, a multivariable logistic regression was used to determine the independent risk factors for caries

### RESULTS-Table 2

Older age at last visit

- Each additional year of age was associated with 1.48 times higher odds of caries progression (p < 0.001)

Snacking

- Children with snacking habits had 2.5 times higher odds of caries progression (p < 0.001)

Oral fluoridated water

- Exposure to fluoridated water was associated with 32% lower odds of caries progression (OR = 0.68, p = 0.045)

Private insurance (vs. reference group)

- Children with private insurance had 47% lower odds of caries progression (OR = 0.53, p = 0.009)

Musculoskeletal conditions

- Children with musculoskeletal conditions had 41% lower odds of caries progression (OR = 0.59, p = 0.019)

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% CI (Lower–Upper)
Sex	.142	.178	.633	1	.426	1.152	0.813–1.633
Ethnicity	-.040	.182	.048	1	.826	.961	0.673–1.372
Oral Fluoridated Water	-.379	.189	4.028	1	.045	.684	0.473–0.991
Age at Last Visit	.391	.037	112.332	1	<.001	1.478	1.375–1.588
Insurance: Private	-.635	.243	6.808	1	.009	.530	0.329–0.854
Insurance: Cash-Pay	-.370	.363	1.039	1	.308	.691	0.339–1.407
Snacks	.915	.179	26.019	1	<.001	2.497	1.757–3.549
Musculoskeletal Conditions	-.526	.225	5.491	1	.019	.591	0.380–0.917
Behavioral/Development	.028	.207	.018	1	.894	1.028	0.685–1.543
Constant	-2.378	.319	55.606	1	<.001	.093	

**Table 2.** Multivariable logistic regression model predicting change in caries status in children with an established dental home (n = 767)

### RESULTS-Table 3

- Because neurological conditions were associated with professionally applied fluoride in bivariate analysis (p = 0.003), a secondary logistic regression was performed to assess this relationship after adjustment and to explore preventive care patterns in this subgroup (n = 779). The model was statistically significant (p < 0.001) with good fit (Hosmer–Lemeshow p = 0.759), but low explanatory power (Nagelkerke R<sup>2</sup> = 0.075).

Among the variables included in the model:

Professionally applied fluoride

- Children who received professionally applied fluoride had 75% lower odds of having a neurological condition (OR = 0.25, p < 0.001)

Age at last clinical assessment

- Each additional year of age was associated with 1.12 times higher odds of having a neurological condition (p = 0.001)

Sex (female vs. male)

- Females had 40% lower odds of having a neurological condition compared to males (OR = 0.60, p = 0.015)

Cash-pay insurance (vs. Medicaid)

- Children in the cash-pay category had 87% lower odds of having a neurological condition compared to those with Medicaid (OR = 0.13, p = 0.044)

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% CI (Lower–Upper)
Sex	-.504	.208	5.873	1	.015	.604	0.402–0.908
Ethnicity	.126	.214	.345	1	.557	1.134	0.745–1.726
Fluoridated Water Exposure	-.120	.223	.290	1	.590	.887	0.573–1.373
Age at Last Visit	.115	.036	10.133	1	.001	1.122	1.045–1.205
Insurance: Private	-.218	.277	.620	1	.431	1.244	0.723–2.140
Insurance: Cash-Pay	-2.061	1.022	4.063	1	.044	.127	0.017–0.945
Topical Fluoride (D1206)	-1.373	.363	14.301	1	<.001	.253	0.124–0.516
Constant	-1.144	.429	7.122	1	.008	.318	

**Table 3.** Multivariable logistic regression model evaluating factors associated with neurological condition (n = 779). Reference category for insurance type: Medicaid.

## Conclusion

In the present study caries progression was mainly predicted by behavioral, temporal, and socioeconomic factors. Frequent snacking was the strongest modifiable risk factor (~2.5x higher odds), while increasing age reflected cumulative risk. Fluoridated water and private insurance were protective. Notably, even in children with an established dental home, dietary behavior remained the dominant driver, highlighting that access to care alone does not prevent disease progression.

## References

