

Clinical Article

RETROSPECTIVE COHORT STUDY

Antenatal and Intrapartum Risk Factors for Use of Emergency and Restorative Medicaid Dental Services for Children

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Abstract: Purpose: To investigate the relationship between antenatal/intrapartum factors and Medicaid use. **Methods:** Three databases were used: (1) birth records; (2) Medicaid files; and (3) Medicaid dental claims. **Results:** Children of Caucasian mothers were 34 percent more likely to have more than one restorative claim versus children of African American mothers (odds ratio [OR] equals 1.34, 95 percent confidence interval [95% CI] equals 1.10 to 1.65, $P < .005$). Children born with low birth weight were 37 percent more likely to have emergency claims (OR equals 1.37, 95% CI equals 1.02 to 1.83, $P = .03$). The adjusted analysis found that Caucasian mothers had higher odds ratio of having a dental claim than African American mothers ($P < .001$): 33 percent for a restorative claim and 56 percent for an emergency claim. When race was analyzed, the odds of a restorative claim among African American mothers were 2.5 times higher in children delivered by C-section versus those vaginally delivered (OR equals 2.52, 95% CI equals 1.02-6.2, $P < .001$). **Conclusions:** This study found: an association between children of Caucasian mothers and the likelihood of experiencing claims; and a relationship between children born with low birth weight and C-section and the likelihood of use of Medicaid services. (*Pediatr Dent* 2014;36:405-10) Received July 22, 2013 | Last Revision January 24, 2014 | Accepted January 27, 2014

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The importance of oral health to the general well-being of individuals is well established. Studies have focused on the impact, association, and correlation of the mother's oral health, habits, attitudes, and knowledge of her child's dental health, as mothers are traditionally regarded as the main caregivers of their children. Maternal factors may play an important role in shaping the oral health, attitudes, and behavior of their children.

The role of mother-to-child transmission of *Streptococcus mutans* has been a topic of several studies in the past decade. During and shortly after delivery, the epithelial surfaces in the oral cavity of microbiologically naïve infants become colonized by different bacterial species.¹ As members of the indigenous biota, *Streptococcus oralis*, *Streptococcus mitis*, and *Streptococcus salivarius* are the predominant pioneer streptococci that colonize the oral cavity of infants during the first few days of life.² Factors influencing the acquisition of *S mutans* in infants include high maternal *S mutans* levels and caries status, low infant birth weight, early tooth emergence, and low salivary IgA antibody levels.³

Li et al.,¹ in a four-year follow-up study, observed a positive association between Caesarean section delivery and initial acquisition and transmission of *S mutans* in a mother-infant prospective cohort. Additionally, their analysis revealed that an infant delivered by C-section from a mother with a low socioeconomic status acquired *S mutans* earlier than did a vaginally delivered infant. Köhler et al.⁴ found that an early colonization of *S mutans* was associated with higher incidence and more severe dental caries in children.

To date, there have been no reported studies that have investigated the relationship between antenatal and intrapartum maternal factors and dental claims that indirectly reflect early childhood caries. Therefore, the purpose of this study was to determine the influence of antenatal and intrapartum risk factors on subsequent use of Medicaid dental services.

Methods

Data and sample selection. A retrospective cohort study was completed subsequent to approval by the Institutional Review Board of the University of Kentucky, Lexington, Ky. Medicaid-enrolled children born in Kentucky in 2000, and who had been monitored longitudinally until their fifth birthday in 2005, were included in the analysis. The study was based on the following Kentucky databases: composite birth records (from Vital Health Statistics) from the 2000 calendar year; individual Medicaid eligibility files for all children born in 2000 and enrolled continuously in the Medicaid program from 2000 to 2005; and Medicaid dental claims data covering 2000 to 2005. Children were excluded if there was more than one Medicaid identification number or if they were not enrolled continuously from 2000 to 2005.

Variable definition. The present study focused on claims filed through Medicaid for oral health services. Outcome variables were categorized according to type of dental visit (restorative or emergency care). Dental terminology codes from the Medicaid dental claims allowed determination of the type of visit. The dental codes used to reflect emergency visits and restorative treatment are presented in Table 1. Antenatal and intrapartum risk factors were obtained from the composite birth records. Mode of delivery (vaginal versus C-section), mother's race (Caucasian versus African American), birth weight status (less than 2,500 g versus equal to or greater than 2,500 g), and age at the first dental claim were the variables included in the analysis. The major outcome variables were the dental claims (restorative or emergency) filed

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with Medicaid from 2000 to 2005. Dental claims were assumed as an indirect or surrogate assessment of early childhood caries.

Statistical analysis. The study's outcome measures were the number of claims filed through Medicaid for oral health services. The treatment codes were divided into restorative or emergency dental claims (Table 1). Each variable was dichotomized into "no claim" or "equal to or greater than one claim." All the risk factors were treated as categorical variables and summarized using frequencies and percentages. The relationships between risk factors and dental claims were assessed using both adjusted and unadjusted odds ratios. Unadjusted odds ratios were computed for type of delivery, mother's race, and whether the child had low birth weight against the outcome variable in each type of dental visit. Chi-square tests

of independence were used to compare the categorical variables. Adjusted odds ratios were computed using multivariable logistic regression for the same set of risk factors while adjusting for the child's age at first visit. Data were analyzed using SAS 9.2 software (SAS Institute, Cary, N.C., USA), and a significance level of $P \leq .05$ was used for all statistical tests.

Results

There were 55,978 live births in Kentucky in 2000, with 26,456 of these children being enrolled in Medicaid. Among the 26,456 Medicaid-enrolled children born in 2000, 5,342 were continuously enrolled in Medicaid for five years and generated a dental claim during the study period (2000-2005). At birth, the mothers' (N equals 5,342) mean age was 22.7 years old (standard deviation equals ± 5.2 years old). Eighty-three percent of the mothers were Caucasian, and 96 percent of the children were born with normal weight. A total of 5,051 infants were delivered vaginally, and 291 were delivered by C-section. The number of dental claims generated during the study period was 21,780.

Bivariate analysis

Restorative claims by antenatal/intrapartum factors. Counts, percentages, and crude odds ratios were calculated using more than one claim for restorative treatment as the outcome variable (Table 2). While no difference was found between the type of delivery and whether the child had low birth weight, mother's race was found to be an important antenatal factor. The odds of having more than one restorative claim for children whose mothers were Caucasian was 1.34 times the odds of those whose mothers were African American (95 percent confidence interval [95% CI] equals 1.10 to 1.65, $P < .05$).

Emergency dental claims by antenatal/intrapartum factors. Children born with low birth weight had higher odds of more than one emergency dental claim during the five-year period (OR equals 1.37, 95% CI equals 1.02 to 1.83, $P < .05$). Mother's race was also related to increased odds of having more than one emergency dental claim. Children of Caucasian mothers were 58 percent more likely to have more than one emergency dental claim versus children from African American mothers (OR equals 1.58, 95% CI equals 1.28 to 1.96, $P < .05$; Table 3).

Logistic regression analysis

Restorative/emergency claims and antenatal/intrapartum risk factors. Binary logistic regression was utilized to investigate the relationship between multiple variables with the restorative and emergency claim outcomes. After adjusting for variables, the odds of experiencing a restorative claim was 33 percent higher in children of Caucasian mothers compared to children of African American mothers (OR equals 1.33, 95% CI equals 1.07 to 1.63, $P < .05$; Table 4). Similarly, the adjusted odds of experiencing an emergency dental claim were 56 percent higher for children of Caucasian mothers versus children of African American mothers (OR equals 1.56, 95% CI equals 1.26 to 1.96, $P < .05$). When adjusted for the child's age at the first dental visit, the association between whether the child had a low birth

TABLE 1. EMERGENCY AND RESTORATIVE DENTAL CODES

Emergency dental codes		Restorative dental codes	
D0140	Limited oral evaluation	D2140	Amalgam-1 surface
D9110	Emergency palliative	D2330	Composite-1 surface anterior
D7140	Extraction: erupted tooth	D2391	Composite-1 surface posterior
		D2150	Amalgam-2 surfaces
		D2331	Composite-2 surfaces anterior
		D2392	Composite-2 surfaces posterior
		D2160	Amalgam-3 surfaces
		D2332	Composite-3 surfaces anterior
		D2393	Composite-3 surfaces posterior
		D2161	Amalgam-4 or more surfaces
		D2335	Composite incisal angle
		D2390	Composite crown anterior
		D2394	Composite-4 or more posterior
		D2933	Crown prefabricated with resin
		D2930	Stainless steel crown primary
		D3220	Pulpotomy
		D3240	Pulp therapy
		D3120	Indirect pulp cap

TABLE 2. RESTORATIVE CLAIMS

	Total participants (N=5,342)	No claim (N=2,804)	>1 claim (N=2,538)	Odds ratio (95% confidence interval)	P-value
Delivery type					>.83
Vaginal delivery	5,051 (95%)	2,653 (95%)	2,398 (94%)		
C-section	291 (5%)	151 (5%)	140 (6%)	1.03 (0.81-1.30)	
Mother's race*					<.005
African American	451 (17%)	264 (19%)	187 (15%)		
Caucasian	2,177 (83%)	1,115 (81%)	1,062 (85%)	1.34 (1.10-1.65)	
Birth weight (g)					<.10
$\geq 2,500$	5,153 (96%)	2,716 (97%)	2,437 (96%)		
<2,500	189 (4%)	88 (3%)	101 (4%)	1.28 (0.96-1.71)	

* Fifty percent of the information on mother's race is missing (N=2,628), where 2,177 (83%) are Caucasian and 451 (17%) are African American.

weight was not related with having more than one emergency dental claim. In addition, it was found that the odds of having a restorative dental claim and an emergency dental claim were reduced by 29 percent and 34 percent, respectively, for every unit increase in age. In other words, an early dental visit was associated with an increased number of subsequent dental claims.

Whether age at first dental visit and race were effect modifiers was investigated. There was an interaction between mother's race and type of delivery for caries. Specifically, among African American mothers, the odds of having a restorative claim experience for children born via C-section was 2.52 times (OR equals 2.52, 95% CI equals 1.02 to 6.21, $P < .05$) that of children born via vaginal delivery after adjusting for low birth weight and age at first dental visit (Table 5). The delivery type did not demonstrate a strong effect on restorative claims as a main effect due to the difference between the numbers of Caucasian mothers versus African American mothers (N equals 2,177 versus N equals 451). Race was not an effect modifier for emergency dental claims.

Discussion

Race and dental claims. Children born from African American mothers were less likely to use Medicaid dental services. The odds of having more than one dental claim for restorative dentistry and emergency care was higher for children born to Caucasian mothers compared with children born to African American mothers. The lower utilization of services by minority children on Medicaid was studied previously by Dasanayake et al.,⁵ who found that, among Alabama children on Medicaid, fewer African Americans than Caucasians received dental care.

Several factors might have influenced the low utilization rates among children born from African American mothers. Lack of transportation and limited appointment availabilities were reported by caregivers as two reasons they felt discouraged from seeking dental care for their children covered by Medicaid.⁶ In addition, it has been reported that dental patients feel more comfortable with a provider of their own race.⁷ This could have influenced minority utilization in this study, because less than five percent of the practicing dentists in Kentucky represent minorities.⁸ A different approach to analyzing the results is to assume that children born from African American mothers interact less with Medicaid dental services, as they have a better oral health status. However, this assumption is unlikely in Kentucky, where previous studies found poor oral health conditions among children from minority ethnic groups compared with Caucasians.^{9,10}

Low birth weight and dental claims. Preterm birth (delivery at less than 37 weeks of gestation) and low birth weight (less than 2,500 g) are the leading causes of neonatal morbidity and mortality in the United States.^{11,12} Several factors are associated with preterm birth and low birth weight, such as low maternal body mass index, maternal smoking, and maternal infection.¹³ In this study, children born with low birth weight were more likely to have emergency (37 percent) and restorative (28 percent) dental claims versus children born at normal weight. The association was significant in the bivariate analysis but not significant in the logistic regression

TABLE 3. EMERGENCY CLAIMS

	Total participants (N=5,342)	No emergency claim (N=2,948)	≥1 emergency claim (N=2,394)	Odds ratio (95% confidence interval)	P-value
Delivery type					<.30
Vaginal delivery	5,051 (95%)	2,796 (95%)	2,255 (94%)		
C-section	291 (5%)	152 (5%)	139 (6%)	1.13 (0.90-1.44)	
Mother's race*					<.001
African American	451 (17%)	295 (20%)	156 (14%)		
Caucasian	2,177 (83%)	1,185 (80%)	992 (86%)	1.58 (1.28-1.96)	
Birth weight (g)					>.03
≥2,500	5,153 (96%)	2,858 (97%)	2,295 (96%)		
<2,500	189 (4%)	90 (3%)	99 (4%)	1.37 (1.02-1.83)	

* Fifty percent of the information on mother's race is missing (N=2,628), where 2,177 (83%) are Caucasian and 451 (17 percent) are African American.

TABLE 4. LINEAR REGRESSION MODEL DETERMINING FACTORS ASSOCIATED WITH RESTORATIVE AND EMERGENCY CLAIMS

	Restorative claims (N=2,538) OR (95% CI)*	Emergency claims (N=2,255) OR (95% CI)
Mother's race		
African American	Reference	Reference
Caucasian	1.33 (1.07-1.63)†	1.56 (1.26-1.96)†
Birth weight		
Normal	Reference	Reference
Low	1.42 (0.8-2.27)	1.42 (0.86-2.3)
Delivery mode		
Vaginal	Reference	Reference
C-section	1.25 (0.86-1.66)	1.25 (0.9-1.66)
Age of first visit	0.71 (0.63-0.8)†	0.66 (0.63-0.7)†

* OR=odds ratio; 95% CI=95 percent confidence interval.

† Statistically significant ($P < .05$).

TABLE 5. LOGISTIC REGRESSION MODEL DETERMINING WHETHER AGE AT FIRST VISIT AND RACE WERE EFFECT MODIFIERS FOR AFRICAN AMERICAN MOTHERS

	Restorative claims OR (95% CI)*
Birth weight	
Normal	Reference
Low	0.96 (0.3-2.7)
Delivery mode	
Vaginal	Reference
C-section	2.52 (1.02-6.2)
Age of first dental visit	0.69 (0.57-0.84)†

* OR=odds ratio; 95% CI=95 percent confidence interval.

† Statistically significant ($P < .05$).

model. However, the analysis showed a potential trend that merits further investigation.

The relationship between low birth weight and dental caries has been studied extensively in the last 10 years.¹⁴⁻¹⁶ In a recent study, Rajshekar et al.¹⁷ studied the relationship between low birth weight with caries experience in 250 children. They found a significant relationship between caries and children born with low birth weight. Nelson et al.¹⁸ examined developmental enamel defects and dental caries among low birth weight adolescents compared with full-term adolescents. They found that low birth weight was a significant risk factor for increased enamel defects in the permanent incisors and first molars. These enamel defects are associated with an increase in caries. Albert and Nelson¹⁹ examined the effect of low birth weight (exposure) in dental caries (outcome) and assessed whether the exposure was a direct or indirect effect on the outcomes. They concluded that low birth weight had a direct negative effect on the prevalence of dental caries.

Despite these aforementioned studies, it is important to recognize that other studies have failed to demonstrate any association between low birth weight and dental caries. Berg²⁰ and Shulman²¹ published two systematic reviews, neither of which supported the association between low birth weight and dental caries. Using a unique design with Medicaid data in Kentucky, the present study found that children born with low birth weight were more likely to have restorative or emergency dental claims.

Mode of delivery and dental claims. The first exposure to micro-organisms in vaginally delivered infants occurs during the passage through the birth canal, while the first exposure to bacteria in infants born by C-section is from the skin of the parents and health providers. The concept of differences in the microbiology and health status between children born by C-section and vaginal delivery has been extensively reported in the literature. In a population-based study, Glass et al.²² found that infants delivered by C-section carried the highest risk of developing seizures later in life versus infants delivered vaginally. Furthermore, vaginally delivered children have been reported to have a more diverse gut microbiology environment, whereas children delivered by C-section had higher numbers of *Clostridium difficile* with delayed acquisition of bifidobacteria and *Escherichia coli*.²³⁻²⁵

Gibbons et al.²⁶ demonstrated that the initial pioneer bacteria entering the oral cavity influence the pattern of microbial succession and that succession is associated with the availability of colonization sites. Bacteria that subsequently attempt colonization must compete with other micro-organisms for colonization sites and essential nutrients. Additionally, they must survive in the presence of adverse metabolic end products that may be produced by other members of the environment. Once established, early colonization bacteria tend to persist in the mouth.^{27,28} It is reasonable to hypothesize that C-section-delivered infants may have experienced less exposure to maternal environmental microbial challenges at birth and that an atypical microbial environment may prevail, providing more potential biological binding for *S mutans*. A recent study by Holgerson et al.²⁹ compared the oral microbiology in infants delivered by C-section and vaginal delivery. The oral biofilm was assayed by the Human Oral Microbe Identification Microarray in

healthy three-month-old infants (38 delivered by C-section and 25 delivered vaginally). More bacteria were detected in the infants delivered vaginally than those delivered by C-section.

A previous study by Li et al.¹ explored the mode of delivery and other maternal factors in the acquisition of *S mutans* in infants. The study found that, among infants, those delivered by C-section acquired *S mutans* 12 months earlier than those delivered vaginally. The former had less exposure to the maternal microbiota at birth and perhaps a different environment for the colonization by *S Mutans*. The present study's design was significantly different from previous studies. Our study explored the association between mode of delivery (C-section versus vaginal delivery) and the subsequent use of Medicaid dental services. Using a retrospective cohort, we found an interesting trend. The likelihood of experiencing restorative and emergency claims was 25 percent higher for children born by C-section compared with vaginal delivery. These results add more evidence to the literature regarding the different oral environments based on the mode of delivery. They suggest potential additional risk factor for caries to be included by the dentist in the risk assessment for caries.

This study also found an interesting interaction between mother's race and type of delivery for restorative claims that merits future investigation. Specifically, among African American mothers, the odds of having a restorative claim experience for children delivered via C-section was 2.52 times (OR equals 2.52, 95% CI equals 1.02 to 6.21, $P < .05$) than that of children delivered vaginally after adjusting for low birth weight and age at the first dental visit. While the missing data on race (over 50 percent) is a major limitation, this preliminary finding may generate a new hypothesis suggesting differences between vaginal and C-section delivery in relation to dental caries.

Age of the first dental visit and dental claims. Children who had an early claim for restorative or emergency dental treatment were more likely to have subsequent dental claims. Savage et al.³⁰ found that children who had their first preventive dental visit by age one were more likely to have subsequent preventive visits but were not more likely to have subsequent restorative or emergency visits. Similarly, the present study confirms the importance of early anticipatory guidance and prevention. Also, prevention programs must prioritize specific designs and tools for the subpopulation of patients who had an early visit for restorative or emergency care.

Limitations. Although ours was a large population-based study that examined antenatal and intrapartum risk factors for caries, the data were limited in several ways. Treatment codes for the diagnosis of caries were relied upon rather than direct examination and detection of caries. First, on the basis of previous research among low-income children,^{31,32} it is possible to anticipate that this population would be at high risk for caries. However, specific disease rates for the population of interest were unknown. Second, as in any investigation that relies solely on administrative data, our study was susceptible to coding errors. The accuracy of coding dental claims in Kentucky is unknown. Third, because this was a retrospective cohort study, there was the potential for selection bias affecting interpretation of the results. Fourth, the amount of missing data in relation with race potentially could have affected the final results.

Conclusions

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

1. The odds of experiencing a restorative dental claim was 33 percent higher for children of Caucasian mothers versus children of African American mothers.
2. The odds of experiencing an emergency dental claim was 56 percent higher for children of Caucasian mothers compared to children of African American mothers. These two conclusions demonstrated a lower utilization of Medicaid dental services by minority children, assuming that the burden of disease was higher in the minority population.
3. Children born with low birth weight were more likely to use Medicaid dental services, suggesting a trend of more severe dental disease associated with low birth weight.
4. Children delivered by C-section were 25 percent more likely to have a restorative or emergency dental claim compared with vaginally delivered children. This result is based on extrapolated data and is affected by several confounders. However, this finding perhaps suggests different times of colonization by cariogenic bacteria in the oral cavity according to the mode of delivery.

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