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# Racial/Ethnic Disparities in Receipt of Dental Procedures amongst Children Enrolled in Delta Dental Insurance in Milwaukee, Wisconsin

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## Abstract

**Objectives:** Most studies on the provision of dental procedures have focused on Medicaid enrollees known to have inadequate access to dental care. Little information on private insurance enrollees exists. This study documents the rates of preventive, restorative, endodontic, and surgical dental procedures provided to children enrolled in Delta Dental of Wisconsin (DDWI) in Milwaukee.

**Methods:** We analyzed DDWI claims data for Milwaukee children aged 0–18 years between 2002 and 2008. We linked the ZIP-codes of enrollees to the 2000 US Census information to derive racial/ethnic estimates in the different ZIP- codes. We estimated the rates of preventive, restorative, endodontic, and surgical procedures provided to children in different racial/ethnic groups based on the population estimates derived from the US Census data. Descriptive and multivariable analysis was done using Poisson regression modeling on dental procedures per year.

**Results:** In seven years, a total of 266,380 enrollees were covered in 46 ZIP-codes in the database. Approximately, 64%, 44% and 49 % of White, African American and Hispanic children had at least one dental visit during the study period, respectively. The rates of preventive procedures increased up to the age of 9 years and decreased thereafter among children in all three racial groups included in the analysis. African American and Hispanic children received half as many preventive procedures as White children.

**Conclusions:** Our study shows that substantial racial disparities may exist in the types of dental procedures that were received by children.

**Keywords:** Dental procedures, healthcare disparities, race, dental insurance, dental care utilization, children, adolescents

## Introduction

Dental caries prevalence and incidence among specific groups of children in the United States and other industrialized nations have decreased, but the disease continues to be the single most prevalent condition of childhood in the United States of America with a large portion of this disease remaining untreated (1). Kaste *et al.* reported that 25% of 5 to 17-year-old children experience 80% of all dental caries in the United States.(2). Another study based on the 2007 National Survey of Children's Health (NSCH) reported that children from racial and ethnic minority groups and low socioeconomic status (SES) have fewer preventive dental visits (3, 4). Regular dental visits combined with the provision of preventive dental procedures are

effective in preventing dental caries (5). However, studies on the provision of common dental procedures in different population groups and payer types are limited.

Studies on the provision of dental procedures have reached similar conclusions that African Americans are significantly less likely to have preventive or restorative procedures and more likely to have their teeth extracted compared to Whites (6, 7, 8). However, Gilbert *et al.* study was restricted to adults (6), Okunseri *et al.* analyzed data from a single dental school (7), and Manski *et al.* used self-reported data from a nationally representative sample without validating the information with dental records (8). Findings from these studies have profound limitations given that approximately fifty percent of children are enrolled in private dental insurance in the United States (3). Therefore, documenting the rates and patterns of use of different dental procedures in this population is important for program planning and policy development.

Our study is focused on children enrolled in private dental insurance in Milwaukee, Wisconsin, a racially/ethnically diverse population. Milwaukee, the largest city in the state, has a large income disparity between inner-city and suburban neighborhoods and is cited as one of the most racially segregated cities in the United States (9). In addition, the 2000 US census reported that 45–47% of individuals living in inner-city Milwaukee are below the federal poverty level. The median family income ranged from \$18,936 in one of the inner-city ZIP-codes to \$106,681 in a suburban ZIP-code selected in this study (10). These differences have persisted through to the 2010 Census (11). We examined rates and patterns for different dental procedures provided to children living in the inner-city and suburban Milwaukee neighborhoods enrolled in Delta Dental of Wisconsin (DDWI)

## Methods

We analyzed DDWI claims and enrollment data for children aged 0–18 years living in 46 ZIP- codes in Milwaukee and its suburbs from 2002 through 2008. The claims dataset contained information on age, ZIP- code of residence, date of treatment delivery, and procedure code for the treatment provided. The enrollment dataset had information on the number of insured children for each year broken down by ZIP-

codes, gender, and age. Children were categorized into one of five age groups; 0–3 years, 4–6 years, 7–9 years, 10–14 years, and 15–18 years. When a child's ZIP- code changed during the year, we used the ZIP- code of residence from the last dental visit. The age at the last dental visit was used as the age of the child for that year. Per-capita annual income for ZIP- codes was recorded in units of \$10,000 and was used as one of the predictor variables in the models.

We grouped dental treatment procedure codes, based on Current Dental Terminology codes, into four major treatment categories: preventive, restorative, endodontic, and surgical. Preventive procedures included oral prophylaxis (D1120), fluoride varnish (D1206), fluoride gel applications (D1203), and dental sealant placement (D1351). Restorative and endodontic procedures included all the billing codes for those procedures (D2000–D2999 and D3000–D3999) respectively. Surgical procedures included extraction of deciduous teeth (D7111), extraction of erupted teeth (D7140) and extraction of erupted teeth requiring elevation of mucoperiosteal flap (D7210). The claims data was aggregated to obtain the number of procedures of each type performed during a calendar year for each enrollee. The number of enrollees without any dental visit during a year was inferred by subtracting the number of children with at least one claim for each year/ ZIP- code and age-group category from the total enrollment. These enrollees were counted as having zero procedures of any type during that year.

### *Estimation of Race/Ethnicity from US Census Data*

Person-level race or income information was not available in the claims dataset, so we estimated race and imputed per-capita income based on census data. We used information from the 2000 U.S. census data to estimate racial/ethnic compositions within ZIP- codes for enrollees. The proportions of Whites, African Americans, and Hispanics or Latino of any race living in each of the ZIP-codes were obtained from census data. The racial/ethnic composition of a ZIP-code based on the U.S. census information was regarded as the same for all enrollees within that ZIP- code in the data set. We also assumed that the racial proportions in the ZIP-codes were constant throughout the study period. Weighted averages were used to estimate the number of

preventive, restorative, endodontic, and surgical dental procedures received by children of each race. Regression models were used to assess the affect of the predictors, including race, on the number of procedures of a given type.

## *Statistical Analysis*

We calculated the rate ratios for the dental procedures received by White children in various age categories using the 7–9 year category as the reference group. To compare the average number of dental procedures that were provided to children across racial groups, we used White children from a particular age group as the reference group and calculated the rate ratios for procedures that were provided.

Multivariable analysis was performed using Poisson regression modeling on the number of procedures per year. The final multivariate model included income, age, race (as two variables giving the proportion of Black and Hispanic residents within the ZIP- code), year when the treatment was delivered and the interaction between race and age. All analyses were performed using SAS version 9.2 (SAS Institute Inc Cary, NC). A statistical significance level (alpha) of 0.05 was used throughout. This study was approved by the Marquette University's Institutional Review Board.

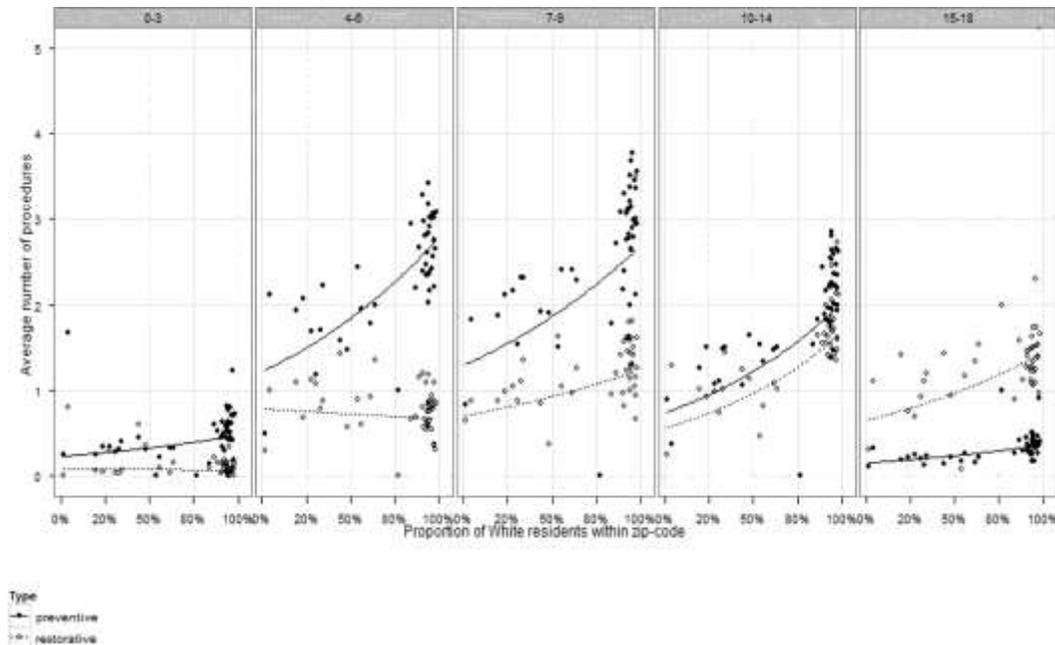
## **Results**

The total number of enrollees over the seven year study period was 266, 380 and yearly enrollment ranged from 37,824 in 2002 to 41,000 in 2008. [Table 1](#) shows the characteristics of the study population including estimates derived from statistical models for each of the different racial/ethnic groups. Approximately, 64%, 44% and 49 % of White, African American and Hispanic children, respectively, had at least one dental visit during the study period.

**Table 1** Characteristics of Study Populations and Estimates Derived from Statistical Models for Each of the Racial/Ethnic Groups and Overall Utilization

	Total number of enrollees from 2002-2008	Estimates derived from statistical models		
		White	African American	Hispanic
Gender				
Female	128,918	101,685	18,141	7,173
Male	133,231	105,168	18,767	7,298
Age				
0-3	47,258	38,246	5,774	2,535
4-6	38,626	30,756	5,130	2,186
7-9	42,271	33,325	5,928	2,410
10-14	77,563	60,600	11,483	4,296
15-18	60,662	47,588	8,943	3,158
Total number of procedures				
Preventive	375,603	318,789	34,437	16,259
Restorative	110,200	88,303	13,900	6,561
Endodontic	6,764	5,120	1,043	540
Extractions	18,337	14,915	2,127	1,047
Dental care utilization rates	60.9%	64.6%	44.4%	49.4%

Figure 1 shows the correlation between the average number of preventive and restorative procedures received by children and the proportion of Whites within the ZIP- codes for the year 2008. The average number of preventive procedures per child increased in all age groups with an increasing proportion of White children in a ZIP- code. The slope of this relationship, which could be interpreted as a relative degree of racial disparity, was greatest for the age groups 4–6 and 7–9 and smallest for ages 0–3 and 15–18. These last two age groups also had much lower average numbers of preventive procedures per child. The average number of restorative procedures per child appeared similar across all age groups with the exception of the 0–3 age group where there was a much lower average. The slope of restorative procedures to proportion of White children was positive for the three age groups above age 7 and slightly negative for age groups 0–3 and 4–6. The average number of restorative procedures received increased with age while the number of preventive procedures decreased with increasing age across all age groups except the 0–3 group, which had a very low average.



**Figure 1:** Relationship between average number of Preventive and Restorative procedures and Racial Proportions in ZIP- codes by age group. The lines are based on a linear fit of the log-transformed averages.

The results from multivariable analyses are presented in a series of tables, each concentrating on a particular factor. [Table 2](#) concentrates on the effect of age: the rate ratios for the different procedures received by White children from different age groups. Preventive procedures were significantly more likely to be received by children aged 7–9 years (reference group), compared to other age groups. Children aged 0–3 years were 20% as likely and 15–18 year olds were 13% as likely to receive preventive dental procedures compared to children in the reference group. The odds of having a restorative procedure were higher for children in older age groups with the exception of children in 10–14 year age group, who were less likely to receive a restorative procedure than the 7–9 year olds. Children 4–6 years of age had the highest odds of having an endodontic procedure followed by the 7–9 year old children. The groups with the highest odds of having a tooth extracted were children in 10–14 year age group followed by 7–9 year old children.

**Table 2** Rate Ratios of Dental Procedures among White Children of Different Age Groups as Determined from Multivariate Analysis

	0-3 years	4-6 years	7-9 years	10-14 years	15-18 years
Preventive	0.208* (0.204-0.211)	0.947 (0.936-0.957)	1.000 reference	0.740* (0.733-0.748)†	0.133* (0.131-0.136)
Restorative	0.129* (0.123-0.135)	0.969* (0.945-0.993)	1.000 reference	0.779* (0.762-0.797)	1.229* (1.203-1.256)
Endodontic	0.176* (0.151-0.207)	1.357* (1.237-1.487)	1.000 reference	0.567* (0.513-0.626)	0.897* (0.817-0.984)
Extractions	0.026* (0.022-0.031)	0.359* (0.336-0.385)	1.000 reference	1.145* (1.096-1.196)	0.316* (0.297-0.337)

\* Indicates significance at 0.005 alpha level.

† Indicates significance at 0.05 alpha level.

**Table 3** shows results from the multivariable analyses for determining the patterns of dental procedures received by Whites, compared to African Americans and Hispanics. African American and Hispanic children were significantly less likely to have preventive procedures than did White children in the same age group. For most age groups, minority children were less than half as likely to receive a preventive procedure compared to White children. African American and Hispanic children in younger age groups were more likely to have restorative, endodontic, and extraction procedures than White children. This discrepancy decreases with age and in older age groups, minority children receive fewer procedures than Whites. The exact age of crossover varies by procedure type and race, but it is usually around the ages 7–9.

**Table 3** Rate Ratios from Multivariate Analysis for Comparing Dental Procedures across Racial/Ethnic Groups

	0-3 years	4-6 years	7-9 years	10-14 years	15-18 years
Whites (reference)	1.000	1.000	1.000	1.000	1.000
Preventive procedures					
African Americans	0.494* (0.458-0.533)	0.471* (0.451-0.493)	0.542† (0.52-0.564)	0.463† (0.446-0.481)	0.343† (0.316-0.373)
Hispanics	0.544† (0.459-0.644)	0.478† (0.433-0.527)	0.547† (0.489-0.6)	0.416† (0.38-0.455)	0.317† (0.256-0.392)
Restorative procedures					
African Americans	1.248† (1.078-1.444)	0.769† (0.712-0.831)	0.652† (0.605-0.703)	0.635† (0.594-0.68)	0.538† (0.504-0.573)
Hispanics	8.058† (5.515-9.965)	1.941† (1.691-2.228)	1.085 (0.939-1.254)	0.831† (0.724-0.954)	0.548† (0.475-0.632)
Endodontic procedures					
African Americans	3.770† (2.528-5.623)	1.506† (1.178-1.925)	1.074 (0.82-1.407)	0.741† (0.558-0.983)	0.690† (0.531-0.896)
Hispanics	14.461† (7.818-26.749)	4.616† (3.09-6.895)	2.981† (1.952-4.674)	1.001 (0.579-1.73)	1.710† (1.058-2.764)
Extractions					
African Americans	3.741† (2.223-6.296)	1.942† (1.589-2.374)	0.892 (0.763-1.043)	0.379† (0.328-0.438)	1.119 (0.926-1.352)
Hispanics	43.903† (22.725-84.817)	7.609† (5.464-10.595)	1.730† (1.29-2.319)	0.469† (0.348-0.632)	1.431 (0.93-2.201)

\* Indicates significance at 0.005 alpha level.

† Indicates significance at 0.05 alpha level.

**Table 4** examines the effect of calendar year, and socio-economic status: the rate ratios for changes in dental procedure patterns over the study period and across various per-capita income groups. Over the course of the seven year study period, there was an increase in the average number of preventive procedures provided to children from all racial/ethnic groups. The average number of restorative and endodontic procedures increased among African

American and Hispanic children, and decreased among White children. There was an increase in the number of teeth extracted among children from all racial/ ethnic groups. [Table 4](#) also illustrates that as the per-capita income within a ZIP- code increased, children were more likely to receive preventive services and less likely to receive restorative, endodontic and extraction procedures.

**Table 4** Rate Ratios from Multivariable Analysis for Comparing Dental Procedures across Racial/Ethnic Groups

	Preventive	Restorative	Endodontic	Extractions
Odds ratios for change in the mean number of procedures per calendar year for racial groups				
Whites	1.010* (1.008-1.012)	0.979* (0.975-0.983)	0.972* (0.957-0.988)	1.145* (1.134-1.156)
African Americans	1.034* (1.026-1.043)	1.015† (1.002-1.029)	1.075* (1.024-1.128)	1.106* (1.068-1.146)
Hispanics	1.11* (1.089-1.133)	1.021 (0.995-1.048)	1.067 (0.982-1.159)	1.119* (1.042-1.201)
Impact of per capita income on procedures (increase in annual income in increments of \$10,000)				
All racial groups	1.11* (1.106-1.116)	0.912* (0.903-0.921)	0.803* (0.769-0.838)	0.973† (0.951-0.995)

\* Indicates significance at 0.005 alpha level.

† Indicates significance at 0.05 alpha level.

## Discussion

This study expands existing information on the receipt of dental procedures and service utilization among children enrolled in a private dental plan. Certain study limitations must be acknowledged. Individual race/ethnicity information was extrapolated from ZIP- code level data and not self-reported. This method could lead to under- or over-estimation of racial/ethnic proportions in the different ZIP- codes. However, geocode measures that use ZIP codes are useful in inferring characteristics about persons living in those areas such as their race/ethnicity and socioeconomic status ([12](#)). Similarly, using average number of procedures based on the aggregate for all children who received care could potentially lead to under or overestimation of the rates of procedures. Parental education, socioeconomic status, and certain neighborhood characteristics shown to influence either dental caries experience or ability to access dental services were not included in our study ([13–16](#)) due to the complexity of disaggregating this information from ZIP codes. In addition, due to the small sample of Hispanic children there is a potential for high error rates with estimates of dental procedures.

In this study approximately 60% of the children had at least one dental visit in a given year. This result is slightly lower (67.2%) than what was reported based on data from the National Health and Nutrition Examination Survey (NHANES) 1999–2004 ([17](#)), but higher

(45%) than what was reported based on data from the 2004 Medical Expenditure Panel Survey (MEPS) ([18](#)). However, in the MEPS, children with private insurance had a utilization rate of 57.5%. In addition, utilization rates for children from racial and ethnic minority populations in this study were 44% for African American and 49% for Hispanic children. The results based on NHANES (1999–2004) show rates of approximately 64% and 56% for African American and Mexican American children, and the 2004 MEPS show 34% and 33% for these same groups ([17](#), [18](#)). The discrepancy in utilization rates between all studies for all groups could be attributed to the differences sampling methodology.

Furthermore, we found that African American children above 7 years were less likely to receive most procedures. Lewis *et al.* reported that, even when they had private insurance, Black children were less likely to have a dental visit than White children. This pattern was seen even after adjusting for household income indicating that perceptions of dental care may be an important factor governing utilization patterns ([4](#)). Also, some of the racial differences identified by us in this study may have been due to complex interactions and associations between race and other variables. Such variables include parental perception of oral health and need ([19](#)), cultural beliefs on efficacy of prevention ([20](#)), as well as education and health literacy. These are some of the independent predictors of dental care utilization that tend to be associated with race. The ZIP- codes used in our study included a high proportion of minorities living in regions with lower SES, lower education levels and lower dentist to population ratios. Hence, we suspect that both person/family level and community level factors may have had a significant impact on the patterns of utilization and disparities identified by us. Our findings do show a need for educational and policy initiatives that can help increase dental utilization in this population to help improve oral health of the children.

### *Trends and Disparities in Receipt of Dental Procedures*

Eklund (2010) analyzed trends in dental procedures provided to enrollees of Delta Dental insurance and reported a decrease in restorative, endodontic and extraction procedures from 1992–2007 ([21](#)). These findings are consistent with our results for White children

with decreased restorative and endodontic procedures, but different for racial and ethnic minorities with increased rates of receipt of these same procedures. In addition, there was an increase in the number of preventive and extraction procedures provided to children from all racial groups.

In our analysis of preventive dental procedures, we found that African-American and Hispanic children of all ages were significantly less likely to have a preventive procedure when compared to White children of the same age, despite being enrolled in the same private dental insurance plan. Our findings are consistent with previous studies on dental and medical procedures which confirmed the existence of racial disparities in preventive procedure utilization among insured populations (4, 22–24). We found that for most age groups, children from minority groups were less likely to have a restorative procedure compared to White children of the same age group similar to what was reported by studies on dental procedures among adult populations (6, 7, and 8).

Few studies have examined racial disparities in endodontic procedures and extractions among children. Studies on adults reported that people from minority groups were more likely to have their teeth extracted than to follow through with a root canal treatment (25, 26). In our study, we found that Hispanic children were more likely to have an extraction or an endodontic procedure when compared to White children. However, African American children in younger age groups (0–6 years) were more likely and those in older age groups (7–18 years) less likely to have endodontic procedures and extractions when compared to White children. We suspect that fewer dental visits among African American children in this study could be the primary reason for fewer treatment procedures in this group. The differences in number of visits may partially explain the apparent higher odds for receiving restorative, endodontic or extraction procedures among White children. Previous studies have shown that people from minority groups seek dental services when they experience symptoms such as pain (6, 19). Endodontic treatment, as opposed to simple restorations, may be the indicated choice of treatment by the time services are sought. We think this could be a reason for fewer restorative procedures in this group.

We found that White children in the 10–14 year old age group were significantly more likely to have a tooth extracted when comparisons were made across racial groups, and also across various age groups of White children. In order to ascertain the reason for higher odds of extraction in this group, we performed additional analyses to examine if the extractions were related to orthodontic treatment, but found no such relation (data not shown). We also examined the frequencies of each of the surgical treatment codes that we used and found that the odds of extraction of deciduous teeth (D7111) and erupted teeth (D7140) was higher for White children in the 10–14 year age group (data not shown).

## Conclusions

Children from racial/ ethnic minority groups were less likely to have dental visits and preventive dental procedures despite being enrolled in private dental insurance. Fewer dental visits and procedures can lead to untreated tooth decay which could have an adverse effect on general health and wellbeing of these children. Further studies that would collect primary data through interviews or surveys among the privately insured are needed to ascertain factors affecting dental procedure use. Policies and strategies such as health promotion and parental education that can increase utilization and improve oral health among these vulnerable populations are also required.

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