

# Children's orthodontic utilization in the United States: Socioeconomic and surveillance considerations

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**Introduction:** There has been no epidemiologic study of malocclusion prevalence and treatment need in the United States since the Third National Health and Nutrition Examination Survey, conducted from 1988 to 1991. In this descriptive study, the authors sought to estimate orthodontic treatment prevalence by examining a nationally representative survey to assess current pediatric dental and orthodontic utilization. **Methods:** The 2009 and 2013 Medical Expenditure Panel Surveys were used to categorize and compare all types of pediatric dental and orthodontic procedures in children and adolescents up to 20 years old. Descriptive variables included dental insurance, poverty level, and racial/ethnic background. **Results:** Visits for orthodontic procedures constituted the third largest treatment category (14.5%) and were greatest among the uninsured and higher income populations. Children with public insurance had the fewest orthodontic visits (9.4%). Racial/ethnic disparities were most pronounced among orthodontic visits, with black and Hispanic children receiving the fewest orthodontic procedures (8.89% and 10.56%, respectively). **Conclusions:** Orthodontic treatment prevalence data suggest that significant disparities exist in orthodontic utilization based on race/ethnicity, poverty level, and insurance status. To establish the burden of malocclusion, describe populations in greatest need of interventions, and craft appropriate programs and policies, an active orthodontic surveillance system is essential. (Am J Orthod Dentofacial Orthop 2017;152:672-8)

Estimates of the magnitude of oral diseases and conditions, as well as the ability to monitor the effects of interventions, would not be possible without public health surveillance. Historically, the main focus of oral health surveillance has included dental caries, fluoride, and periodontal disease, conducted on a national level with the National Health and Nutrition Examination Survey. It was not until 1999 that the development of comprehensive state and local surveillance began with the establishment of the National Oral Health Surveillance System, which focuses on various oral health indicators for adults and children, as well as water fluoridation and oral cancer.<sup>1,2</sup>

However, current surveillance activities do not describe the burden of orthodontic conditions and needs in the United States.

The last national survey of orthodontic treatment needs was 25 years ago in the NHANES III conducted between 1988 and 1991.<sup>3</sup> In that study, approximately 7000 children and adults were sampled from 3 racial/ethnic groups: white, black, and Mexican American.<sup>4</sup> Twenty percent of the population had some deviations from an ideal bite, and only 35% of adults had well-aligned mandibular incisors. In 15% of the sample, the malocclusion was considered psychosocially unacceptable, with 2% severe enough to be disfiguring. Also, severe malocclusion was observed more frequently among black subjects.

There is currently a gap in our understanding of the burden of orthodontic care in the United States, and as a result, the effectiveness of current policy. The purposes of this study were 2-fold: (1) to update and describe all pediatric dental and orthodontic procedures in 2013 stratified by insurance, poverty level, and race/ethnicity; and (2) to estimate orthodontic treatment prevalence and examine the need for renewed orthodontic surveillance.

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All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and none were reported.

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## MATERIAL AND METHODS

We analyzed data from the Medical Expenditure Panel Survey (MEPS) in 2009 (as a baseline) and 2013 (released for public use in June 2015). This nationally representative longitudinal survey, sponsored by the Agency for Healthcare Research and Quality, collects detailed information on health care utilization and expenditures, payment source, as well as a wide variety of socioeconomic and demographic characteristics.<sup>5</sup> The survey data represent the civilian, noninstitutionalized household population of the United States. MEPS data are based on a self-reported survey questionnaire that asks which types of procedures were received during each dental visit. Sample households are selected annually, and data are collected for 2 calendar years in 5 rounds of interviews.

There are 3 components of the MEPS survey: the insurance component, the medical provider component, and the household component. Data from the household component of the MEPS survey are drawn from a nationally representative subsample of households that participated in the previous year's National Health Interview Survey and includes a dental section. The types of dental procedure categories are diagnostic (examinations and radiographs), preventive (cleanings, fluoride treatment, sealants, recall), restorative, prosthetic, oral surgery, orthodontic, and other (periodontic, endodontic).<sup>6</sup> Orthodontic visits are defined as "braces or retainers." The primary outcome variables for this report were dental and orthodontic services received by children and adolescents aged 0 to 20 years in 2009 and 2013. This age range was chosen because it is consistent with prior studies that examined children's dental utilization with the MEPS data set.<sup>7</sup>

### Statistical analysis

The MEPS uses a complex survey sample design to oversample certain population groups of interest. This survey design is accounted for using the Taylor linearization method to appropriately calculate the standard errors.<sup>8,9</sup> Frequency tables of dental services for 2009 and 2013 were computed incorporating the survey weights provided in the MEPS data. In our analysis, we replicated the statistical methodology of Manski et al<sup>7</sup> to confirm that we achieved identical results with the 2009 MEPS data set.

Rates indicating the percentages of total services for each procedure type were constructed comparing the number of services in each procedure category with the total number of services for the respective year. These percentages were then stratified by dental insurance status, poverty status, and race/ethnicity, with

standard errors generated for each group. Rates were also produced to determine the percentage of children who received services from each procedure category. These rates were similarly stratified, and standard errors were computed using the same procedure.

Services were categorized by procedure type (eg, diagnostic, preventive) and summed; thus 1 patient's dental visit could potentially yield multiple services across procedure types. For instance, if a patient had an examination, x-ray, and cleaning, these services would count as 2 diagnostic procedures and 1 preventive procedure. Therefore, the number of procedures will be greater than the number of visits.

To check for significant differences in proportions between 2009 and 2013, a 2-sample proportion test was performed for each calculated proportion. These tests aimed to identify differences in both the proportion of procedure type and the proportion of children who received a specific procedure. All analyses were performed using the R statistical programming language.<sup>10</sup> Two-sample proportion tests were performed using the function `prop.test`, and Taylor-series linearization was implemented using the "survey" package.<sup>11,12</sup>

The proposal was submitted to the institutional review board of Albert Einstein College of Medicine, Bronx, New York. The board designated the study to be exempt from review because it involved the collection and study of existing, publicly available data in which individuals could not be identified directly or through identifiers linked to them.

Dental insurance status was classified into 3 categories based on household responses to health insurance status questions. These categories were private insurance, public insurance (ie, Medicaid, CHIP), and uninsured. Persons with coverage for dental care only were not considered to be insured.

Income was expressed in terms of poverty status with classifications into 4 income groups based on the federal poverty level (FPL): poor (below 100% of the FPL), low income (100%-199% of the FPL), middle income (200%-399% of the FPL), and high income (at or above 400% of the FPL).

Classification by race/ethnicity was divided into 5 groups: (1) white, non-Hispanic; (2) black, non-Hispanic; (3) Asian, non-Hispanic; (4) other or multirace, non-Hispanic; and (5) Hispanic.

## RESULTS

There were 190 million dental procedures in 2013 for patients from 0 to 20 years old (an increase from 172 million in 2009). The weighted distribution of procedures in 2013 among these children by dental insurance, poverty

**Table I.** Percentage distribution of dental procedures among children from birth to 20 years of age with at least 1 dental service overall and by dental insurance status, poverty level, and race/ethnicity, in the United States, 2013

Characteristic	Diagnostic	Preventive	Restorative	Orthodontic	Prosthetic	Oral surgery	Other*
Overall	39.69	37.31	4.9	14.53	0.62	2.11	0.85
SE	0.44	0.49	0.25	0.78	0.09	0.16	0.11
Dental insurance status							
Private insurance	39.13	37.1	4.26	16.42	0.38	1.83	0.88
SE	0.57	0.65	0.32	1.03	0.08	0.18	0.15
Public insurance	41.15	38.29	6.48	9.41	1.26	2.67	0.73
SE	0.59	0.62	0.4	0.9	0.23	0.34	0.13
Uninsured	39.05	31.99	5.03	18.99	0.19	3.67	1.08
SE	3.05	2.27	1.05	3.72	0.19	1.18	0.74
Poverty status							
<100% FPL	41.01	37.98	6.56	9.31	1.02	3	1.12
SE	0.81	0.85	0.47	1.29	0.2	0.38	0.31
100%-199% FPL	39.8	37.51	5.68	12.99	0.64	2.43	0.95
SE	0.91	0.87	0.53	1.53	0.12	0.46	0.24
200%-399% FPL	39.74	36.92	5.02	15.52	0.59	1.55	0.67
SE	0.78	0.85	0.43	1.37	0.2	0.23	0.14
>400% FPL	39.13	37.27	3.82	16.43	0.5	2.04	0.83
SE	0.83	0.96	0.48	1.47	0.14	0.27	0.22
Race/ethnicity							
White, non-Hispanic	39.62	36.5	4.49	16.07	0.42	2.07	0.83
SE	0.64	0.69	0.36	1.13	0.11	0.24	0.16
Black, non-Hispanic	42.28	39.03	5.2	9.26	1.37	2.08	0.78
SE	0.81	0.97	0.5	1.46	0.34	0.33	0.18
Asian, non-Hispanic	37.84	38.29	4.45	16.07	0.9	2.26	0.2
SE	1.49	1.81	0.83	3.07	0.47	0.54	0.1
Other/multirace, non-Hispanic	37.1	39.04	5.97	12.6	1.15	2.65	1.49
SE	1.51	2.47	1.12	2.52	0.47	0.68	0.46
Hispanic	39.65	38.46	5.92	12.32	0.71	2.04	0.9
SE	0.68	0.68	0.41	1.13	0.1	0.21	0.23

Percentage estimates represent the proportion of each dental procedure against all dental services (not at the person level).

FPL, Federal poverty level; SE, standard error.

\*Endodontic, periodontic, and procedures not otherwise reported.

Source: 2013 Medical Expenditure Panel Survey.

status, and race/ethnicity is shown in [Table I](#). Overall, orthodontic procedures were the third largest category of dental procedures at 14.5%. Diagnostic procedures represented the largest category of procedures at 39.7%, and preventive procedures were the second largest at 37.3%. Restorative procedures accounted for 4.9% of all visits.

In 2013, children with public insurance and children who were uninsured showed the greatest disparity in percentage distributions of orthodontic procedures. Although children with public insurance had the greatest percentage of diagnostic (41.2%), preventive (38.3%), and restorative (6.5%) visits, they had the fewest orthodontic visits (9.4%). Uninsured children had the greatest percentage of orthodontic visits (18.99%).

Poverty level was inversely proportional to the percentage distribution of orthodontic procedures. In 2013, poor children, living at or below 100% of the FPL, had the greatest percentage of diagnostic, preventive, and restorative visits and the lowest percentage of

orthodontic visits (9.3%). Conversely, high-income children, living at or above 400% of the FPL, had the fewest diagnostic and restorative visits and the highest percentage of orthodontic visits (16.4%).

Overall, as shown in [Table I](#), with regard to racial/ethnic characteristics and distribution of dental procedures, black children had the greatest proportion of diagnostic visits (42.28%) and the fewest orthodontic visits (9.26%). White children and Asian children had the greatest proportion of orthodontic visits (16.07%).

[Table II](#) shows the distribution of specific types of dental procedures among subjects from birth to 20 years old who received at least 1 dental service in 2013. Children with private insurance had the largest percentage of orthodontic visits (18.13%) whereas children with public insurance had the smallest percentage of orthodontic visits (8.94%). The most pronounced gap between poverty levels was for orthodontic procedures; children

**Table II.** Percentages of children from birth to 20 years of age with at least 1 dental service overall and by dental insurance status, poverty status, and race/ethnicity, in the United States, 2013

Characteristic	Diagnostic	Preventive	Restorative	Orthodontic	Prosthetic	Oral surgery	Other*
Overall	85.45	84.3	16.53	15.1	2.22	7.49	2.79
SE	0.66	0.71	0.73	0.75	0.25	0.54	0.31
Dental insurance status							
Private insurance	87.32	86.4	15.45	18.13	1.54	7.23	2.98
SE	0.89	0.91	1	1.06	0.29	0.71	0.43
Public insurance	82.49	81.53	18.84	8.94	3.73	7.71	2.51
SE	0.91	1.05	0.99	0.81	0.49	0.81	0.4
Uninsured	75.98	67.72	15.23	14.99	0.66	11.19	1.56
SE	4.22	5.7	3.36	3.55	0.66	3.45	0.84
Poverty status							
<100% FPL	79.98	80.17	18.18	8.32	3.43	8.51	3
SE	1.31	1.34	1.23	0.99	0.57	0.99	0.65
100%–199% FPL	84.24	85.24	17.78	12.79	2.68	7.28	3.1
SE	1.2	1.21	1.47	1.42	0.49	1.1	0.66
200%–399% FPL	87.34	84.04	17.54	16.77	1.63	5.68	2.51
SE	1.17	1.36	1.37	1.37	0.42	0.82	0.53
>400% FPL	87.19	85.97	14.17	18.29	1.85	8.63	2.75
SE	1.35	1.41	1.43	1.55	0.47	1.14	0.61
Race/ethnicity							
White, non-Hispanic	87.38	84.81	16.44	18.14	1.53	8.02	2.81
SE	1	1.11	1.13	1.19	0.33	0.85	0.47
Black, non-Hispanic	85.02	83.78	15.22	8.89	4.04	5.82	2.83
SE	1.27	1.32	1.4	1.13	0.8	0.82	0.64
Asian, non-Hispanic	85.6	86.12	14.46	13.78	2.93	7.92	0.82
SE	2.3	2.28	2.42	2.56	1.4	1.71	0.43
Other/multirace, non-Hispanic	85.4	81.3	17.79	15	3.61	9.58	5.36
SE	3.2	2.91	2.83	2.84	1.35	2.29	1.72
Hispanic	80.37	83.61	17.59	10.56	2.58	6.36	2.46
SE	0.99	0.94	1	0.8	0.38	0.62	0.47

Percentage estimates represent likelihood that any single dental visit includes the listed dental procedure.

FPL, Federal poverty level; SE, standard error.

\*Endodontic, periodontic, and procedures not otherwise reported.

Source: 2013 Medical Expenditure Panel Survey.

at the highest income levels were more than twice as likely to have an orthodontic visit as were children in the lowest income level.

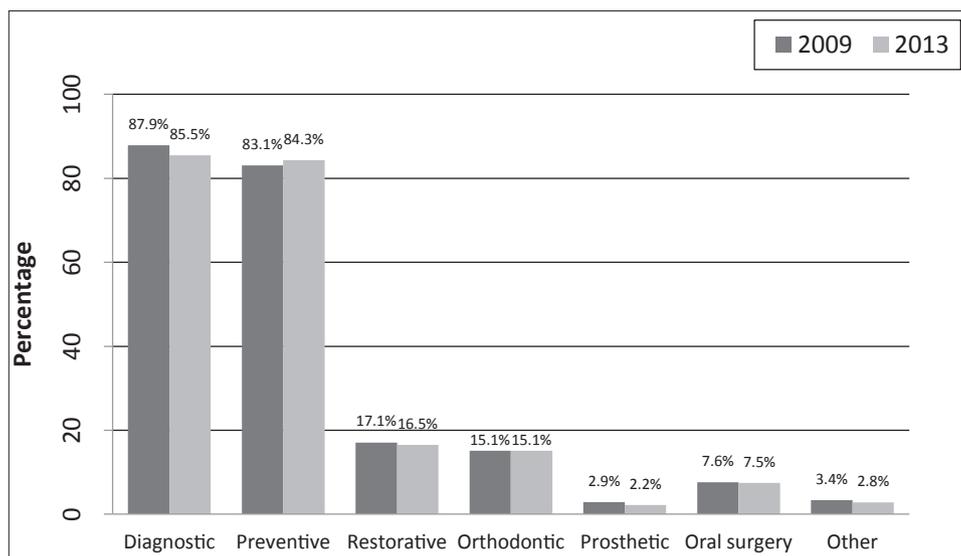
With regard to race/ethnicity, as illustrated in Table II, white children received the greatest percentage of diagnostic (87.38%) and orthodontic (18.14%) procedures. Black and Hispanic children received the fewest orthodontic procedures (8.89% and 10.56%, respectively). Hispanic children received the fewest (80.37%) diagnostic procedures.

The Figure shows a comparison between the weighted percentages of children receiving specific dental services in 2009 (Supplemental Table) and 2013 (Table II). In all categories, utilization has remained steady, although there was a slight decrease in diagnostic services and a slight increase in preventive services between 2009 and 2013. There was no change in the percentage of orthodontic services received (15.1%) between 2009 and 2013.

## DISCUSSION

There are approximately 74 million children (ages 0–18), representing 23% of the total population in the United States.<sup>13</sup> Furthermore, the demographics of the United States are rapidly changing, with a Hispanic population that will in a few decades no longer be considered a minority group.<sup>13</sup> It is therefore significant that, despite overall gains in children's access to care, our results are consistent with recent analyses indicating that socioeconomic and racial disparities still exist with regard to pediatric dental and especially orthodontic care.<sup>14–19</sup>

The magnitude of the utilization disparity is plainly evident with regard to orthodontic procedures. Not only is orthodontics the third largest treatment category in the MEPS analyses, but in 2012 the annual expenditures for orthodontic services in the United States were \$9.7 billion, similar to that for all other general



**Fig.** Weighted percentages of children 0 to 20 years with at least 1 dental service, United States, 2009 and 2013. Source: 2009 and 2013 Medical Expenditure Panel Survey.

(nonorthodontic) dental expenditures for children (\$9.1 billion).<sup>15</sup> Current pediatric oral health surveillance activities have driven successful programs and policies to increase access to care and reduce disparities. Yet despite the weight of orthodontic expenditures in our country, there is no ongoing orthodontic surveillance to assess malocclusion type, severity, or prevalence and plan effective health policies.

Unlike dental caries or periodontitis, a malocclusion is not a disease but a deviation from ideal occlusion. As a result, many orthodontic indexes have been and are used to define the severity of a malocclusion and prioritize services. These issues and the topic of what is considered medically necessary orthodontic care are beyond the scope of this study and are areas for future research. Nevertheless, orthodontic epidemiology is vital if we are to understand not only how malocclusions are distributed, but also how to provide efficient delivery systems whose structures, organizations, and performances satisfy our diverse population.

It is not surprising that the largest percentages of distribution of orthodontic procedures were in children with private insurance and those who were uninsured. The uninsured presumably are those without private or public insurance who can pay out of pocket for their children's orthodontic care. Those with private insurance likely have parents with a dental benefit that includes orthodontic care for minors. Proportionately, although children with public insurance receive the largest percentages of diagnostic and preventive procedures, they

receive the least orthodontic care, since these children must qualify for what is considered a "handicapping malocclusion" or "medically necessary orthodontic care." Many poor children with severe malocclusions are therefore unable to obtain needed orthodontic care because they do not meet the criteria established by their state (and which vary considerably between states).

There were several limitations to our study. First, as with all studies using MEPS data, only national data were reported, so examination on a state-level basis was not possible. Data were self-reported, so there was the possibility of overestimation or underestimation as well as misreporting in the form of recall bias. Treatment data are not provider specific; therefore, it is not known whether providers were general dentists, specialists (ie, orthodontists, endodontists, periodontists), or dental hygienists. MEPS did not include a measure of oral health status, which potentially influences dental care utilization. Finally, there was no distinction between "medically necessary" orthodontic care and all other orthodontic care in the survey.

The purpose of public health surveillance is to plan, implement, and evaluate public health practice. This requires regular and systematic collection and analysis of data. Population health is concerned with promoting health, preventing disease, and reducing disparities. One might ask why it is important to resume orthodontic surveillance on a national level. Without basic epidemiologic information regarding the type and distribution of malocclusion, we cannot target those with the

greatest needs, address financing for orthodontic care, or tackle workforce provider and distribution concerns.

The Fédération Dentaire Internationale recently revealed a new definition of oral health that reflects not only the absence of disease, pain, and discomfort, but also the physiological, social, and psychological attributes that are essential to the quality of life.<sup>20</sup> Orthodontists may not be addressing dental disease per se, but they are addressing oral health and quality of life measures.<sup>21-25</sup> When a person avoids smiling because of the appearance of his or her teeth, that indicates the psychosocial impact of a malocclusion. These persons may have not only poor oral function, but also issues related to speaking, working, communicating, socializing, and learning. To that end, orthodontic indexes are increasingly including both normative values that reflect the provider's evaluation as well as oral health quality of life measures that address the psychological and social impacts of the malocclusion on the patient.

It is understood that fiscal constraints affect the ability of our oral health surveillance activities to be comprehensive. Furthermore, there is uncertainty with regard to the effect of the possible repeal of the current health care policy on our ability to sustain government-funded programs and surveillance activities. However, on the bright side, with the continued development and implementation of both electronic dental health records and diagnostic codes, we will eventually be able to collect and analyze oral health data in a more comprehensive, equitable, and economic fashion.

## CONCLUSIONS

In this study, we set out to estimate orthodontic treatment prevalence in the United States based on dental utilization data from a nationally representative survey. This was not a substitute for orthodontic prevalence data; it was an estimate based on utilization because there is currently no orthodontic surveillance being conducted in the United States.

After diagnostic and preventive procedures, orthodontic procedures constituted the third largest category of procedures for children and adolescents. The orthodontic treatment prevalence data we analyzed suggest that significant disparities exist in orthodontic utilization based on race/ethnicity, poverty level, and insurance status. Children and adolescents with public insurance and at the lowest poverty level had the fewest orthodontic visits. In the context of understanding and reducing the burden of orthodontic conditions, public health initiatives designed to assess treatment needs (both objective and subjective), reduce disparities, and

improve orthodontic health are extremely relevant and timely.

## SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at <http://dx.doi.org/10.1016/j.ajodo.2017.03.027>.

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