Disparity in Orthodontic Utilization and Treatment Need Among High School Students

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Abstract

Objectives: *The aim of this cross-sectional study was to assess the disparity in utilization of orthodontic services among high school students and to measure and characterize the extent of unmet treatment needs among untreated students at the time of examination.* ***Methods:*** *The sample consisted of 2,808 tenth grade students enrolled in different public and private high schools. All subjects completed a dental survey that included questions on demographic, dental health, and orthodontic services, and assessment of smile using the visual analog scale. A subsample of dental study casts that were available for 561 untreated subjects were scored using the Dental Aesthetic Index (DAI) to estimate unmet treatment need.* ***Results:*** *The orthodontic utilization rate was 37 percent. The odds of being orthodontically treated were 8.7 times greater among those with dental visits within the past year than among those without, and three times greater among Caucasians than among other ethnic groups. The DAI indicated that the unmet treatment need was 29 percent, with ethnic minority groups having 2.6 greater odds of needing treatment than Caucasians.* ***Conclusion:*** *Minority groups and infrequent dental attenders may experience disparities in unmet orthodontic treatment need. [J Public Health Dent 2004;64(1):26-30]*

Key Words: dental care, orthodontics, health services accessibility, adolescents, dental esthetics.

The Third National Health and Nutrition Examination Survey (NHANES III) found that the overall orthodontic utilization rate in 12- to 17-year-olds was 25 percent (1). However, there was a disparity in that 31 percent of Caucasians, 11 percent of Mexican Americans, and 8 percent of African Americans received orthodontic treatment. As a result of the lower level of treatment in African Americans, severe malocclusion was also observed in that survey as assessed by using the Index of Treatment Need (IOTN) (2). Approximately 5 percent of the lowest income group and 10 percent to 15 percent of those in intermediate income groups reported being treated, with the highest frequency observed in the higher income groups (2).

The unmet orthodontic treatment need in other studies ranged from 24 percent to 38 percent, depending on the orthodontic index, age group, and study population (3-7). Children who were in need of treatment came from a range of socioeconomic groups, were more likely to be male, and were less likely to be satisfied with their appearance than their unaffected peers. Thus, while a majority of adolescents requiring orthodontic treatment were being identified, there was still a large proportion (30%) who were not being treated, and more than half of these were not being advised that they required treatment (5). The objectives of the present study were (1) to compare the disparity between those students who received or were receiving orthodontic care compared to those who did not receive care; and (2) to assess and evaluate the unmet treatment need among students who did not receive treatment.

Methods

Study Sample. All private and public schools in Cuyahoga County, OH, were invited to participate in a dental health survey of tenth grade students. Twenty high schools that agreed to participate were included for the present study, and were representative of schools in Cuyahoga County. A consent form was signed by both the participating student and their legal guardian before data were collected. All tenth grade students were eligible to participate in this study. The specifics of the sample selection have been published previously (8).

Data Collection. *Questionnaire.* A survey was administered to the students after detailed instructions were given by the study personnel as to the proper method of filling out the questionnaire. The survey questions included items on demographic characteristics (age, sex, ethnicity, parent/guardian education, and occupation), dental health (dental visit within the past year and the reason for the visit, and satisfaction of their dental appearance), and orthodontics (had ever worn braces, provider who placed the braces—general dentist or orthodontist—when they finished treatment, whether they were still wearing retainers, and how they felt about their teeth/smile now). Most questions required dichotomous, yes/no responses.

From the responses to parent/guardian education and occupation, socioeconomic status (SES) was computed using Hollingshead's Index (9). Because the index was originally designed to evaluate the head of the household, the higher of the mother's score or the father's score was utilized for classification of SES. The Hollings-

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head index classifies subjects into five categories, with class 1 being the highest and class 5 being the lowest socioeconomic group. The index scores were later dichotomized to either low (class 4 and 5) or middle/high SES (classes 1, 2, and 3).

The questions relating to satisfaction of dental appearance and current feelings about their teeth/smile were rated using the visual analog scale (VAS) with the students instructed to place a single mark on a line that measured 100 mm in length, with a score close to 0 indicated "feeling awful" and a score close to 100 indicated "feeling great."

Impression and Scoring of Teeth. A subsample of students from the first 11 schools that were visited were requested to provide impressions of their teeth. The reasons for not including all schools for the impression taking were: first, inclusion of the remaining nine schools would have entailed resources in terms of personnel, time, and funds beyond the scope of this study; second, a fairly large sample of subjects were accrued from the first 11 schools to estimate unmet treatment need, thus enabling us to restrict the sample for this part of the project.

The students were asked to take an impression of their own teeth using the President™ impression material (Coltene/Whaledent Inc., Mahwah, NJ) after completion of the questionnaire. Specific instructions were given to the subjects prior to impression taking and at least two dentists monitored the impression procedure. The impressions were then transported to the orthodontic clinic and poured up with either buff stone or orthodontic white stone in a two-step process by trained participants. Dental stone was poured into one side of the impression and allowed to set for a period of 30 minutes. Once set, the impression was turned over and the opposing arch was poured up. When this side had set, the stone models were removed and trimmed on a Wehmer model trimmer and hand-articulated in maximum intercuspation position rather than centric relation. In addition, when there was any doubt as to the "best fit" of the teeth in maximum intercuspation, the casts were articulated in class I position.

The study models were then scored using the Dental Aesthetic Index (DAI) (10) to estimate the unmet orthodontic treatment need. A calibrated observer (VA) scored all the models. The DAI comprises 10 components (missing teeth, incisal crowding, incisal spacing, midline diastema, largest maxillary anterior irregularity, largest mandibular anterior irregularity, anterior maxillary overjet, anterior mandibular overjet, vertical anterior openbite, antero-posterior molar relation), each weighed by a factor to reflect importance in determining treatment need. The weighted scores of the DAI were categorized into two groups: no treatment needed/elective (DAI≤30) and treatment recommended/mandatory (DAI≥31).

TABLE 1
Demographic, Dental Access, and Appearance Satisfaction Characteristics Among Orthodontically Treated and Untreated Subjects

Variable*	% (*n*) Treated	Untreated	*P*-value
Sex			
Male	35 (490)	65 (916)	<.05
Female	40 (556)	60 (845)	
Socioeconomic status			
High	42 (892)	58 (1,227)	<.001
Low	23 (55)	77 (189)	
Ethnicity			
Caucasian	48 (286)	52 (307)	<.001
Hispanic	28 (8)	72 (21)	
African-American	12 (36)	88 (271)	
Other	39 (25)	61 (40)	
Visit to dentist in past year			
Yes	43 (1,008)	57 (1,363)	<.001
No	8 (32)	92 (369)	
Visual Analog Scale (mean ± SD)	73±21 (880)	68±23 (1,469)	<.001

*Due to missing information, the sample size for each variable may not always add up to the total sample of 2,808.

Data Analysis. For objective 1, the demographic (sex, ethnicity, socioeconomic status) and dental care access (whether visited a dentist in the past year) and VAS differences between the orthodontically treated and nontreated groups were compared using the chi-square and *t*-tests. Prediction of the utilization of orthodontic services was computed using logistic regression. Only variables that were related to orthodontic utilization were considered for the regression model and included demographic and dental access variables. For objective 2, frequencies and means were used to describe the unmet treatment need in the untreated sample according to the two DAI categories. Further, chi-square analysis was used to test the differences in DAI categories for sex, ethnicity, SES, and dental care access. The *t*-test was utilized to evaluate the differences between the VAS scores of the DAI categories. Logistic regression was used to predict the unmet treatment need (DAI) from the demographic and dental access variables. Significance was assessed at $P<.05$.

Results

The present cross-sectional study surveyed a total of 2,808 students (orthodontically treated: n=1,047; untreated: n=1,761) from 20 schools, with a mean age of 15.5±0.8 years. Of the 1,761 who were untreated from the 20 schools, only 633 had dental impressions taken because only the first 11 schools were included for the impression taking. A sample size of 561 was available for the second study aim because approximately 11 percent of the dental impressions could not be used due to poor quality. To assess selection bias, untreated subjects who had impressions taken were compared with untreated subjects who did not elect to have impressions taken. Sex, ethnicity, and SES were similar between the impression and no impression group.

TABLE 2
Factors Predicting Orthodontic Utilization, Logistic Regression

Variables	Odds Ratio (95% CI)	P-value
Sex (female)	1.25 (0.92, 1.69)	.154
Visit to dentist (yes)	8.67 (4.12, 18.23)	<.001
Socioeconomic status (low)	0.58 (0.32, 1.04)	.069
Ethnicity (nonwhite)*	0.33 (0.23, 0.46)	<.001

*Due to small numbers of Hispanic and other groups, ethnicity was collapsed into two groups (white vs nonwhite).

TABLE 3
Demographic, Dental Access, and Appearance Satisfaction Characteristics of Dental Aesthetic Index (DAI) Categories

	DAI Categories % (*n*)		
Variable*	No Treatment Required	Treatment Required	*P*-value
Sex			
Male	71 (190)	29 (77)	.994
Female	71 (210)	29 (84)	
Socioeconomic status			
High	73 (232)	27 (88)	
Low	78 (65)	22 (18)	.284
Ethnicity			
White	84 (41)	16 (8)	
Nonwhite	69 (100)	31 (46)	<.05
Visit to dentist in past year			
Yes	73 (284)	27 (107)	.271
No	68 (115)	32 (54)	
Visual Analog Scale (mean ± SD)	70±22 (391)	62±25 (154)	<.001

*Due to missing information, the sample size for each variable may not always add up to the total sample of 561.

TABLE 4
Factors Predicting Unmet Treatment Need (DAI), Logistic Regression Model

Variables	Odds Ratio (95% CI)	*P*-value
Sex (female)	1.35 (0.60, 3.04)	.466
Visit to dentist (yes)	0.97 (0.42, 2.26)	.949
Socioeconomic status (high)	1.80 (0.56, 5.78)	.327
Ethnicity (white)*	0.38 (0.14, 1.02)	.054

*Due to small numbers of Hispanic and other groups, ethnicity was collapsed into two groups (white vs nonwhite)

However, a significantly greater proportion of individuals who had visited a dentist in the past year did not opt to have impressions taken.

The overall orthodontic utilization rate in the schools surveyed was 37 percent (1,047/2,808) (Table 1). A significantly greater proportion of males, African Americans, and lower SES group were orthodontically untreated. Similarly, the orthodontic utilization rate was significantly lower in subjects who had not visited a dentist in the past year. The current mean satisfaction with appearance (VAS) was significantly greater among subjects who were treated. Due to the smaller number of responses to the question of ethnicity, the groups were collapsed as white (Caucasian) or nonwhite (African-American, Hispanic, or other ethnicity) for the multivariate analysis. Logistic regression indicated that the significant variables predicting orthodontic utilization were dental visits within the past year and ethnicity (Table 2). The odds of having received orthodontic treatment were 8.7 times greater among those with dental visits, and three times greater among the Caucasian group (or .33 times lower among nonwhites).

For the untreated group who had dental impressions taken, the unmet orthodontic treatment need was calculated using the DAI. The results indicate that 71 percent of the untreated sample had no or elective need for treatment and 29 percent had recommended or mandatory need for treatment, indicating unmet treatment need. Table 3 indicates that a significantly greater proportion of nonwhites and those with lower appearance satisfaction had greater unmet treatment need. Logistic regression (Table 4) indicated that there was a trend toward significance for whites to have 0.38 times lower unmet treatment need. Conversely, the odds of unmet treatment need were 2.6 times greater among nonwhites.

Discussion

The orthodontic utilization rate in this study of tenth grade schoolchildren was 37 percent, higher than the national average of 25 percent reported by the NHANES III survey of children 12–17 years old. (1) The present study identified a more accurate utilization rate for orthodontic treatment by utilizing an older (mean age=15 years) sample. Approximately 90 percent of those who had started orthodontic treatment had done so by age 14 to 15 years (11). Previous studies (6,12) of children aged 15 to 16 years in the United Kingdom indicated that the orthodontic treatment experience was 30 percent to 38 percent. Therefore, the utilization of orthodontic services in the present sample of high school children closely parallels the rates reported from other studies.

The present study also demonstrates that certain factors such as being of minority status and having de-

creased frequency of dental visits contributed toward a significant disparity for underutilization of orthodontic treatment services in a multivariate model. NHANES III reported similar results regarding ethnicity, in that significantly more non-Hispanic whites and Mexican Americans had received orthodontic treatment than non-Hispanic blacks (1). In this study, only 35 percent (984 out of 2,808) of the total sample had responded to the question of ethnicity, suggesting that while our results may be consistent with prior national estimates, they may have been affected by selection bias.

A visit to the dentist in the past year was associated with a significantly greater odds of orthodontic utilization. In a cross-sectional study, it is difficult to ascertain whether the children who visit the dentist regularly get referred to orthodontists more often or whether the visits are a consequence of the treatment. Approximately 65 percent of the US population aged 2 years and older reported in 1997 that they had visited a dentist in the preceding year, and utilization varied by sex and ethnicity (13). Therefore, factors such as socioeconomic status, insurance type, dental accessibility, and education are all likely correlated with a dental visit in the past year. In this study, we found dental visits to be significantly correlated with SES and ethnicity.

There was also a nonsignificant trend for lower SES groups to underutilize orthodontic services after controlling for other factors. These results are consistent with prior studies (14-17) that found differences in utilization rate based on social class. Utilization rates calculated individually for the 20 schools revealed that the rates in the most affluent suburban schools was greater than 50 percent, while in the inner city public schools the rates were less than 10 percent (8). Besides education and income that deter lower SES groups to seek care, ready accessibility to an orthodontist is another factor. The farther patients had to travel to receive treatment, the less likely they were to initiate treatment (18). However, an investigation of the number of orthodontists practicing within the neighborhoods surrounding the schools revealed a substantial number of providers practicing near the inner city schools, mainly due to the presence of the school's orthodontic clinic. Therefore, most lower SES groups either were not aware of the clinic or they could not afford the treatment. Perhaps better awareness and education of orthodontic problems and inventive fee scheduling may help increase utilization of orthodontic services among lower SES groups.

The comparison of untreated subjects who had impressions to those who did not have impressions was necessary to identify selection bias. A greater proportion of those who had visited a dentist in the past year did not opt to have impressions taken. It can be speculated that having an impression taken was a negative stimulus for some who did not volunteer for this study. Therefore, generalizations regarding our study results can only be made to a similar group of subjects. The unmet treatment need in the present study was 29 percent. In prior studies (3-7), treatment needs were estimated at 24 percent to 38 percent. Our estimate of treatment need, although within the range of other studies differs slightly, due to reasons such as different treatment need indices, younger ages, and non-US populations used for estimating the need.

Minority status (predominantly African-American) was associated with a greater odds of requiring orthodontic treatment according to the DAI. Even though not all subjects in our sample responded to the question of ethnicity, our results were similar to a previous study conducted on a younger sample (14). The question of whether minority groups have a greater preponderance of malocclusions requiring correction or have dental access issues must be investigated further. Interestingly, children who required treatment rated themselves significantly lower on the VAS scale than the ones who did not require treatment. Although the VAS is a subjective rating of one's esthetic appearance, it did show that the children who required treatment were not as pleased with their smile. Therefore, minority status and teeth/smile self-perception were both related to unmet treatment need.

Methodologic limitations of the study include the following: First, the accuracy of the impressions could have been affected by the subjects not biting down into a full occlusion and the trays being left in the mouth for an inadequate length of time despite the specific instructions given to the students prior to impression taking. Second, the DAI in a previous study (19) underestimated treatment need in cases with displaced canine teeth, incisor crowding or rotations, and increased overbite. The DAI overestimated treatment need in cases with increased overjet and crowded arches. Despite these disadvantages, the DAI was chosen for the present study because of its validity and reliability, and based on a prior study's (20) rating of several treatment need indices that ranked the DAI highest. Third, due to the smaller sample size in the untreated sample and missing information for some variables, generalization on unmet treatment need has to be reported with caution. We suggest future studies with a larger sample size.

In conclusion, it has been suggested that a variety of factors act on the individual, and it is the final equilibrium of dependency needs and social forces such as parental, peer, or interpersonal factors that determines who seeks treatment and who does not (21). The present study seems to support this model, in that several factors contribute toward disparity in the utilization and need characteristics of orthodontic services.

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