



# Self-reported Awareness of Unrestored Dental Caries: Survey of the Oral Health Status of Maryland Schoolchildren, 2000-2001

Harold S. Goodman, DMD, MPH   Mark D. Macek, DDS, PhD   Mark L. Wagner, DMD  
Michael C. Manz, DDS, MPH   Ilise D. Marrazzo, MPH

*Dr. Goodman is associate professor, Department of Health Promotion and Policy, Program in Pediatric Dentistry, Dr. Macek is assistant professor, Department of Health Promotion and Policy, Program in Health Services Research, and Dr. Wagner is director, Health and Research, Special Olympics, Inc, and Professor Emeritus, Baltimore College of Dental Surgery Dental School, University of Maryland, Baltimore, Md; Dr. Manz is senior research associate in Health Sciences, Department of Cariology, Restorative Sciences and Endodontics, School of Dentistry, University of Michigan, Ann Arbor, Mich; Dr. Marrazzo is acting director, Office of Oral Health, Maryland Department of Health and Mental Hygiene, Baltimore, Md.*

*Correspond with Dr. Goodman at hsg001@dental.umaryland.edu*

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## Abstract

**Purpose:** The purpose of this study was to assess and compare parental awareness of unrestored dental caries needs in a schoolchildren population according to socioeconomic status.

**Methods:** Subjective and normative unrestored dental caries data of kindergarten and third-grade children were collected from parental awareness questionnaires and clinical examinations, respectively, used in a 2000-2001 statewide survey of Maryland schoolchildren. Descriptive, bivariate, and multivariate analyses were performed to assess awareness of unrestored dental caries. Parental perceived need also was compared to clinical findings of unrestored dental caries.

**Results:** Actual (clinically assessed) unrestored dental caries (21%) was found to be 2 times the level of self-reported awareness of dental caries (11%). Those most likely to have significantly incorrect awareness of unrestored dental caries were: (1) low-income populations; (2) residents of the Maryland Eastern Shore. Sensitivity was 34% and specificity 96% in comparing self-assessed, unrestored dental caries need with the clinical findings.

**Conclusions:** An incorrect perceived oral health need is high in poorer populations and may serve as a barrier to their achieving optimal oral health, given that disease prevalence is higher and access to oral health care services is lower in this population group. (*Pediatr Dent.* 2004;26:369-375)

**KEYWORDS:** SELF-AWARENESS, UNRESTORED DENTAL CARIES, CHILDREN, HEALTH SURVEY, MARYLAND

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The determinants for health and related behaviors that influence access to the health care delivery system have been conceptualized, developed, assessed, and revised over the past 35 years through a number of health behavioral models. Andersen's Behavioral Model of Health Services Use describes health outcomes as normative (clinical) and subjective (self-perceived) health status in tandem with patient satisfaction.<sup>1</sup> According to this model, these health outcomes are primarily influenced by external factors such as the health systems environment and

internal population factors such as predisposing, enabling, and need characteristics.<sup>1</sup>

Predisposing and enabling characteristics reflect personal socioeconomic and demographic information that influences the attainment of positive health outcomes, while need encompasses an awareness of both actual and perceived oral health treatment requirements. Lack of perceived oral health need can result from low knowledge and priority as well as the generally chronic nature of oral disease that, in lieu of an examination, is not readily apparent

unless visible on the anterior teeth.<sup>2-9</sup> Most of these studies addressed the elderly, younger adults, HIV-positive medical patients, and adolescents; they varied regarding the impact of perceived need on oral health services utilization.<sup>2-9</sup>

Parental perception of a child's oral health need has received only scant attention. An analysis of a national database of children's (ages 2-18) dental needs, as perceived by their parents, found that children with perceived oral health needs were more likely to have had either episodic or no dental visits.<sup>10</sup> The overall conclusion of the study was that the perception of oral health needs is not a primary factor in children's oral health services utilization. The study, however, did not evaluate the accuracy of the parents' perceived need as compared to a normative examination. A study of Texas schoolchildren conducted over 25 years ago compared perceived and actual dental needs from both the parent's and child's perspective, but predominately focused on respective attitudes toward oral hygiene and oral health.<sup>11</sup> Another study of WIC mothers found that their perception of their child's oral health status is a more important element in the timing of the child's first dental visit than the child's oral health status as determined through a normative evaluation.<sup>12</sup>

Studies that have evaluated the ability of subjective self-assessment questionnaires to validly assess oral health status when compared to a clinical examination found these questionnaires to be of low value.<sup>13-15</sup> Most of these studies were conducted over 15 years ago and assessed adults' periodontal disease. Two recent studies that assessed dental caries also concluded that subjective questionnaires were of little use. One study did conclude that communities rather than individuals may be better served by their use.<sup>6,16</sup> No studies, however, have assessed the ability of a parental questionnaire, when compared to an actual examination, to correctly document a child's oral health needs. Furthermore, among those studies that assessed perceived need by socioeconomic status (SES),<sup>3,4,8-10</sup> none compared the validity of the perceived need variable against a measure of normative need.

The purpose of this study was to describe the perceived oral health needs of Maryland public schoolchildren, as reported by their parents, and compare these perceptions to the clinical findings for these children. The sensitivity, specificity, and positive and negative predictive values of the self-assessment questionnaire were assessed comparing parental self-reported awareness of unrestored dental caries with the clinical findings of unrestored dental caries from the statewide schoolchildren survey.

## Methods

The Survey of the Oral Health Status of Maryland Schoolchildren, 2000-2001 (Maryland Survey 2000-2001) provided the cross-sectional data for this study. This study, which contained a clinical examination and questionnaire, was conducted by the University of Maryland Dental School.<sup>17</sup> The clinical examination was administered dur-

ing the 2000-2001 academic year to a representative sample of Maryland public schoolchildren from kindergarten, third, ninth, and 10th grades. It assessed dental caries status, treatment need (unrestored dental caries), presence of dental sealants, and fluorosis.

The questionnaire was completed by parents and contained 15 questions documenting perceived need for dental care, dental visit and tooth-cleaning histories, existence of a usual source of medical and dental care, tooth pain history, dental insurance, and a variety of sociodemographic factors. Although the Maryland Survey 2000-2001 was administered to children in all 4 grade levels, the authors restricted this analysis to children in kindergarten and third grade, because the response rates for sampled ninth-grade and 10th-grade schoolchildren were considerably lower.

## Sample design

A 2-stage sampling design was used to select the study sample. Fifty elementary schools were selected in the first stage of sampling from 5 geographic regions in the state. To ensure a good geographic distribution of sample schools by county within a geographic region and city (and zip code within larger cities), implicit stratification was employed. This stratification procedure incorporated a systematic probability-proportional-to-size (PPS) selection. This allowed schools with larger enrollments to have a greater probability of being selected for the study from a list of schools ordered geographically by region, county, and zip code in larger cities within counties. Having a set number of classrooms chosen in selected schools in the second selection stage offset differing probabilities from this initial selection stage.

During the second stage of sampling, 2 classrooms from each grade level were randomly selected from all such classrooms at the selected schools. Of the 24 counties in Maryland, 2 counties chose not to participate in the study, because they did not want to take time away from the curriculum. As a result of this refusal, the study sample was representative of kindergarten and third-grade public schoolchildren in 22 of 24 counties, across Maryland's 5 geographic regions.

## Data collection and management

Seven calibrated, licensed dentists conducted the Maryland Survey 2000-2001's oral screening component. Each dentist used a portable dental chair and standard light source during the examinations, as well as disposable, vinyl gloves and a mouth mask. A modification of established criteria for dental caries detection was used by each examining dentist.<sup>18</sup> The examiners used the tip of the periodontal probe to determine whether carious lesions were of sufficient size to warrant scoring as "caries," and did not use radiographs to identify dental caries.

## Study variables

The main outcome variables for this investigation were:

1. parent-reported awareness of unrestored dental caries;
2. actual (clinically determined) presence of unrestored dental caries in their children.

For this paper's purposes, the authors define "self-perceived awareness" as parents' awareness of unrestored dental caries in their children and "incorrect awareness" as the difference between parental self-perceived awareness and the normative clinical findings for unrestored caries. The self-reported awareness variable was derived from a health questionnaire item that asked, "In the past 12 months, did your child have a cavity that was not treated?" The actual (clinically determined) presence of unrestored dental caries variable came from the decayed primary and permanent teeth component of the oral examination.

An additional outcome variable combined the perceived and actual unrestored dental caries variables together into a single variable measuring whether parents/guardians had an incorrect awareness of unrestored dental caries in their child's mouth. Parents/guardians had an incorrect awareness of unrestored dental caries when:

1. unrestored dental caries was perceived present and unrestored dental caries was truly absent;
2. unrestored dental caries was perceived as absent and unrestored dental caries was truly present.

Descriptor variables included:

1. grade level (third-grade, kindergarten);
2. gender;
3. race/ethnicity (Hispanic, non-Hispanic other, non-Hispanic black, non-Hispanic white);
4. eligibility for free or reduced-cost meals at school (unknown, poor, not poor).

### Analysis

Dental caries data were entered directly into the Microsoft Access software program (2002, Microsoft, Redmond, Wash). Afterwards, the questionnaire data were transferred into an Epi-Info software program (6.0, Centers for Disease Control and Prevention, Atlanta, Ga).<sup>19</sup> The clinical examination and questionnaire data were merged via a unique personal identifier assigned to each sample child. Once the datasets were merged, personal identifiers were removed from the combined data.

**Table 1. Sample Size, Percentage, Weighted Population Size, and Weighted Percentage Among Public Kindergarten and Third-grade Schoolchildren, Maryland, 2000-2001 (N=2,255)\***

| Characteristic                            | Sample size | Weighted population | Weighted % |
|---|-------------|---------------------|------------|
| <b>Overall</b>                            | 2,255       | 103,115             | 100        |
| <b>Grade level</b>                        |             |                     |            |
| Third grade                               | 1,081       | 56,131              | 54         |
| Kindergarten                              | 1,174       | 46,984              | 46         |
| <b>Gender</b>                             |             |                     |            |
| Boys                                      | 1,139       | 51,495              | 50         |
| Girls                                     | 1,116       | 51,620              | 50         |
| <b>Race/ethnicity</b>                     |             |                     |            |
| Hispanic                                  | 158         | 6,622               | 6          |
| Non-Hispanic other                        | 125         | 5,546               | 5          |
| Non-Hispanic black                        | 663         | 37,802              | 37         |
| Non-Hispanic white                        | 1,309       | 53,145              | 52         |
| <b>Eligibility for free/reduced meals</b> |             |                     |            |
| Unknown                                   | 133         | 5,945               | 6          |
| Poor                                      | 629         | 35,144              | 34         |
| Not poor                                  | 1,493       | 62,026              | 60         |

\*Source: Survey of the Oral Health Status of Maryland School Children, 2000-2001. Note: Children with unknown self-reported awareness of unrestored dental caries and unknown race/ethnicity were excluded from the analysis.

The SAS statistical software program for Windows (release 8.0, SAS Institute, Inc, Cary, NC) was used to combine clinical examination and questionnaire data. The SAS-callable SUDAAN statistical software program for Windows (release 8.0, Research Triangle Institute, Research Triangle Park, NC) was used to produce bivariate and multivariate estimates.<sup>20,21</sup> SUDAAN accounted for the complex, multistage sample design when calculating population estimates, standard errors, and confidence intervals.

The parents of 2,337 kindergarten and third-grade sample schoolchildren answered the questionnaire's awareness of unrestored dental caries question. Children with unknown race/ethnicity (N=82) were excluded from the analysis. This investigation's final sample included 2,255 children, representing 103,115 kindergarten and third-grade public schoolchildren in Maryland. The overall response rate for the study sample, including both clinical examinations and questionnaires, was 48%, and a questionnaire was collected for every child who eventually received a clinical examination.

### Consent and confidentiality

Procedures, discomforts/risks, and benefits were explained to the parents/guardians, and their informed consent (and assent for children 13 years of age or older) was obtained prior to the investigation. The Institutional Review Boards for the University of Maryland Dental School and

**Table 2. Weighted Prevalence of Actual Presence of Unrestored Dental Caries and Incorrect Awareness of Unrestored Dental Caries Among Public Kindergarten and Third-grade Schoolchildren, Maryland, 2000-2001 (N=2,255)\***

| Characteristic                            | Actual presence of<br>unrestored dental caries | Incorrect awareness of<br>unrestored dental caries |
|---|--|--|
|   | % ( $\pm$ SD)                                  | % ( $\pm$ SD)                                      |
| <b>Overall</b>                            | 21 ( $\pm$ 1.8)                                | 17 ( $\pm$ 1.3)                                    |
| <b>Grade level</b>                        |  |  |
| Third grade                               | 23 ( $\pm$ 2.1)                                | 20 ( $\pm$ 1.7)                                    |
| Kindergarten                              | 19 ( $\pm$ 2.1)                                | 14 ( $\pm$ 1.5)                                    |
| <b>Gender</b>                             |  |  |
| Boys                                      | 23 ( $\pm$ 2.3)                                | 18 ( $\pm$ 1.9)                                    |
| Girls                                     | 20 ( $\pm$ 2.1)                                | 17 ( $\pm$ 1.4)                                    |
| <b>Race/ethnicity</b>                     |  |  |
| Hispanic                                  | 30 ( $\pm$ 5.7)                                | 21 ( $\pm$ 4.0)                                    |
| Non-Hispanic other                        | 21 ( $\pm$ 4.5)                                | 16 ( $\pm$ 4.0)                                    |
| Non-Hispanic black                        | 26 ( $\pm$ 2.7)                                | 20 ( $\pm$ 2.0)                                    |
| Non-Hispanic white                        | 17 ( $\pm$ 2.1)                                | 15 ( $\pm$ 1.6)                                    |
| <b>Eligibility for free/reduced meals</b> |  |  |
| Unknown                                   | 31 ( $\pm$ 4.5)                                | 16 ( $\pm$ 3.1)                                    |
| Poor                                      | 31 ( $\pm$ 2.8)                                | 25 ( $\pm$ 2.4)                                    |
| Not poor                                  | 15 ( $\pm$ 1.7)                                | 13 ( $\pm$ 1.1)                                    |

\*Source: Survey of the Oral Health Status of Maryland School Children, 2000-2001. Note: "Incorrect awareness" refers to parent/guardian believing that no unrestored dental caries exists, despite its true existence. Children with unknown self-reported awareness of unrestored dental caries and unknown race/ethnicity were excluded from the analysis.

Maryland Department of Health and Mental Hygiene reviewed and approved this investigation, as did the Maryland State Department of Education and individual school districts.

## Results

The sample size and weighted population characteristics are listed in Table 1. Most of the children represented in the sample are of non-Hispanic white and nonpoor backgrounds. Relatively equitable sample sizes are found for grade level and gender. Smaller population subgroups are Hispanics and residents from the eastern shore and southern regions. Though PPS sampling was employed to sample proportionately from the population, sample weights were used in the analysis to account for variations in sampling and response so that the weighted population more closely matched the actual population of the state by region, gender, and grade level.

The weighted prevalence of actual presence of unrestored dental caries and unrestored dental caries in the schoolchildren population, by demographic characteristic, is described in Table 2. Overall, 21% of kindergarten and third-grade schoolchildren had unrestored dental caries. In general, third graders, boys, Hispanic children, and poor children were most likely to have unrestored decay. Ap-

proximately 17% of parents had incorrect awareness of unrestored dental caries. Parents of third graders, boys, Hispanics, and poor children were also most likely to have incorrect awareness.

Table 3 lists adjusted odds ratios for incorrect awareness of unrestored caries in this sample population. Controlling for all variables in the model, grade level and eligibility for free/reduced meals were significantly associated with incorrect awareness of unrestored dental caries. Specifically, poor parents and parents of third graders were more likely to have incorrect awareness than their counterparts.

Table 4 shows weighted sensitivity, specificity, positive predictive value, and negative predictive value for comparison of perceived awareness with clinical findings of actual unrestored dental caries for kindergarten and third-grade children.

Overall, the specificity is high (96%), but the sensitivity is low (34%). Similarly, the positive predictive value (68%) is lower than the negative predictive value (84%).

## Discussion

The distinction between need, as clinically defined by a dental professional, and perceived need, as subjectively defined by a patient, can affect the utilization of oral health care services.<sup>22</sup> This study represents one of the first investigations to describe the association between perceived need, normative need, and SES. The authors found that incorrect awareness of unrestored dental caries was not evenly distributed across the population. When compared to a normative assessment of unrestored dental caries, parents of both economic strata were less successful in correctly identifying the presence of unrestored dental caries than correctly reporting no unrestored decay in their children. Furthermore, lower-income parents had significantly less correct awareness of unrestored dental caries in their children as compared to their higher-income peers.

This study also found that parental perceived awareness of unrestored dental caries was consistently lower than the actual clinically determined level of unrestored dental caries in their children for all demographic characteristics, including eligibility for free and reduced meals. Lower-income populations were

more likely to have perceived awareness of unrestored dental caries (60%) than their higher SES peers (36%). While this result is intuitively surprising, it may have stemmed from the higher prevalence of caries that this population experiences. Consequently, lower-income populations still may likely have less awareness than their higher-SES peers based on the percentage and actual number of total children.

Another possible explanation for this finding is that caries pathology and associated symptoms are more likely to be obvious in lower SES individuals because of the higher severity of disease generally evident in this population.<sup>17</sup> In contrast, the unrestored dental caries needs in higher-SES populations may be so small and free of symptoms that it would be less likely these individuals could be aware of this condition unless examined by a dental practitioner. Perceived need outcomes also may be the result of the prior receipt of dental treatment, which is more likely to be experienced by higher-SES populations.<sup>22,23</sup> Thus, individuals who perceived no oral health needs do so because they received a diagnosis and/or treatment from a dental practitioner in the past year.<sup>22</sup>

The percentage of actual unrestored dental caries (31%) was nearly 2 times that of the self-reported awareness (18%) for this unmet need in poor children. This awareness discrepancy is perhaps a more critical problem for low-SES populations than for their higher-income peers because poor families generally experience restricted access to the oral health care delivery system. Despite the lower level of perceived awareness in higher-SES populations, these groups are not as adversely affected as their lower-income peers because they have less severe and fewer oral health needs with a greater propensity to routinely visit a dentist.<sup>23,24</sup> This concern has been borne out by a recent study of Maryland Head Start children that found that 52% of children had untreated dental caries, with only 17% of their parents aware of the condition.<sup>25</sup>

Age is an important factor in this study because children are generally incapable of articulating and understanding oral disease problems unless there is an acute aspect present. Even children in pain may not report their problem because they:

1. understand there is a problem, but are fearful of the consequences (eg, going to the dentist); or

**Table 3. Adjusted Odds Ratios of Incorrect Awareness of Unrestored Dental Caries Among Public Kindergarten and Third-grade Schoolchildren, Maryland, 2000-2001 (N=2,255)\***

| Characteristic                            | Adjusted odds ratio | 95% confidence interval |
|---|---------------------|-------------------------|
| <b>Grade level</b>                        |                     |                         |
| Third grade                               | 1.5                 | 1.1, 2.0                |
| Kindergarten                              | Reference           | —                       |
| <b>Gender</b>                             |                     |                         |
| Boys                                      | 1.2                 | 0.9, 1.6                |
| Girls                                     | Reference           | —                       |
| <b>Race/ethnicity</b>                     |                     |                         |
| Hispanic                                  | 1.1                 | 0.7, 1.6                |
| Non-Hispanic other                        | 0.9                 | 0.5, 1.7                |
| Non-Hispanic black                        | 0.9                 | 0.6, 1.4                |
| Non-Hispanic white                        | Reference           | —                       |
| <b>Eligibility for free/reduced meals</b> |                     |                         |
| Unknown                                   | 1.4                 | 0.9, 2.2                |
| Poor                                      | 2.3                 | 1.6, 3.3                |
| Not poor                                  | Reference           | —                       |

\*Source: Survey of the Oral Health Status of Maryland School Children, 2000-2001. Note: "Incorrect awareness" refers to parent/guardian believing that no unrestored dental caries exists, despite its true existence. Children with unknown self-reported awareness of unrestored dental caries and unknown race/ethnicity were excluded from the analysis. Statistically significant odds ratios at the 0.05 alpha level are listed in **bold**.

2. follow certain social and cultural norms that promote enduring and living with the pain.

Furthermore, parents will likely be less aware of their children's oral health problem if they are not in pain unless they are routinely examining the child and/or facilitating timely professional oral health examinations.<sup>26</sup> Finally, parents who are aware of an oral health problem in their child may not openly acknowledge their awareness because of:

1. cultural norms;
2. perceived trauma to their child from a dental procedure;
3. cost of dental care services; and/or
4. anticipated frustration in accessing dental care services due to restrictive public and private health care delivery financial systems.<sup>11</sup>

This investigation used conservative dental caries scoring criteria, which could be considered by some an acknowledged weakness in this study.<sup>18</sup> Other important limitations include using data from a single state, making the results only generalizable to Maryland. Although this study's results are probably consistent with what one would expect to find in other locations, additional investigations should be conducted to account for the specific system-level and population-level characteristics existing in other parts of the United States.

Next, the response rate was relatively low and not evenly distributed across population subgroups. For example,



**Table 4. Weighted Sensitivity, Specificity, Positive Predictive Value, and Negative Predictive Value Calculations for Comparison of Self-reported Awareness of Unrestored Dental Caries and Actual Unrestored Dental Caries Among Public Kindergarten and Third-grade Schoolchildren, Maryland, 2000-2001 (N=2,255)\***

|  | Actual unrestored dental caries |              |         |
|--|---------------------------------|--------------|---------|
|  | Has decay                       | Has no decay | Total   |
| <b>Self-reported awareness of unrestored dental caries</b> |                                 |              |         |
| Has decay  | 7,437                           | 3,484        | 10,921  |
| Has no decay   | 14,422                          | 77,772       | 92,194  |
| Total  | 21,859                          | 81,256       | 103,115 |

Sensitivity=34%

Specificity=96%

Positive predictive value=68%

Negative predictive value=84%

\*Source: Survey of the Oral Health Status of Maryland School Children, 2000-2001. Note: Children with unknown self-reported awareness of unrestored dental caries and unknown race/ethnicity were excluded from the analysis.

higher-SES groups were more likely to participate in the study than were low-SES groups. While the survey data were weighted to account for some sample design factors, it is possible that the sample weights used in the analysis may not have accounted completely for differences in race/ethnicity and SES status between the sample and target population.<sup>27</sup>

Finally, given the cross-sectional nature of the study, it was difficult to account for natural teeth exfoliation during the study period. For example, a parent might have perceived unrestored dental caries during the 12 months prior to the screening component of the survey, yet the carious tooth might have exfoliated before the examination—causing an overestimation of incorrect awareness of unrestored dental caries. Additionally, a parent might not have perceived unrestored dental caries during the 12 months prior to the screening component when a carious tooth was actually present, thereby resulting in an underestimation of incorrect awareness of unrestored caries. Regardless of the scenario, any exfoliation that occurred during the study period probably did not systematically bias the results.

This investigation also contains a number of strengths that support further use and investigation of these results. First, the findings were representative of kindergarten and third-grade children in Maryland, since only 2 of 24 counties did not participate in the study. Second, there was 100% compliance with those children who received an examination and whose parents returned surveys prior to the examination. Furthermore, the similarity of this investigation's subjective and normative findings upon comparison to other studies lent additional support for the methodology that was incorporated. Finally, the multivariate analysis of predictors for incorrect awareness of unrestored dental caries provided a more understandable portrayal of the influence that the descriptor variables had on the outcomes because it controlled for potential confounding factors.

Future investigations in developing a better measure of self-perceived need may benefit from this study's incorporation of a clinical oral examination in tandem with a self-assessment oral health questionnaire. Additional research will be needed, however, to further explore the answers and questions raised by this study. A better understanding of the variables in this study, and their specific impact on the public's realization of oral health need, and subsequent related behaviors and actions, will be needed if access to oral health care services has

any chance of improving for those most in need.

## Conclusions

1. Incorrect awareness of unrestored dental caries is higher in low-SES populations.
2. Parents' self-awareness of unrestored dental caries in their children is very low when compared to actual clinically determined findings of unrestored dental caries.
3. Studies that incorporate a clinical oral examination in tandem with a perceived awareness questionnaire may provide a better understanding of self-perceived awareness.
4. More attention is needed to address perceived need determinants if access to the oral health care delivery system for populations most in need is to improve.

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## References

1. Andersen R. Revisiting the behavioral model and access to medical care: Does it matter? *J Health Soc Behav.* 1995;36:1-10.
2. Souminen-Taipale AL, Nordblad A, Alanen P, Alha P, Koskinen S. Self-reported dental health, treatment need, and attendance among older adults in two areas of Finland. *Community Dent Health.* 2001;18:20-26.
3. Atchison KA, Mayer-Oakes SA, Schweitzer SO, Lubben JE, DeJong FJ, Matthias RE. The relationship and preventive participation among a well-elderly sample. *J Pub Health Dent.* 1993;53:88-95.
4. Kiyak HA. Explaining patterns of dental service utilization among the elderly. *J Dent Educ.* 1986;50:679-687.

5. Wilson AA, Branch LG. Factors affecting dental utilization of elders aged 75 years or older. *J Dent Educ.* 1986;50:673-677.
6. Vered Y, Sgan-Cohen HD. Self-perceived and clinically diagnosed dental and periodontal health status among young adults and their implications for epidemiological surveys. *BMC Oral Health.* 2003. Available at: <http://www.biomedcentral.com/1472-6831/3/3>. Accessed May 25, 2003.
7. Ostberg AL, Eriksson B, Lindblad U, Halling A. Epidemiological dental indices and self-perceived oral health in adolescents: Ecological aspects. *Acta Odontol Scand.* 2003;61:19-24.
8. Marcus M, Freed JR, Coulter ID, Der-Martirosian C, Cunningham W, Andersen R, Garcia R, Schneider DA, Maas WR, Bozzette SA, Shapiro MF. Perceived unmet need for oral treatment among a national population of HIV-positive medical patients: Social and clinical correlates. *Am J Public Health.* 2000;90:1059-1063.
9. Kuthy RA, Odom JG, Salsberry PJ, Nickel JL, Polivka BJ. Dental utilization by low-income mothers. *J Public Health Dent.* 1998;58:44-50.
10. Vargas CM, Ronzio CR. Relationship between children's dental needs and dental care utilization: United States, 1988-1994. *Am J Public Health.* 2002;92:1816-1821.
11. Friedman LA, Mackler IG, Hoggard GJ, French CI. A comparison of perceived and actual dental needs of a select group of children in Texas. *Community Dent Oral Epidemiol.* 1976;4:89-93.
12. McCunniff MD, Damiano PC, Kanellis MJ, Levy SM. The impact of WIC dental screenings and referrals on utilization of dental services among low-income children. *Pediatr Dent.* 1998;20:181-187.
13. Kallio P, Ainamo J. Self-assessment of gingival bleeding. *Int Dent J.* 1990;40:231-236.
14. Trevonen T, Knuuttila M. Awareness of dental disorders and discrepancy between "objective" and "subjective" dental treatment needs. *Community Dent Oral Epidemiol.* 1988;16:345-348.
15. Helöe LA. Comparison of dental health data obtained from questionnaires, interviews, and clinical examinations. *Scand J Dent Res.* 1972;80:495-499.
16. Robinson PG, Nadanovsky P, Sheiham A. Can questionnaires replace clinical surveys to assess dental treatment needs of adults? *J Public Health Dent.* 1998;58:250-253.
17. Macek MD, Wagner ML, Goodman HS. Survey of the oral health status of Maryland schoolchildren, 2000-2001. A report to the Maryland Department of Health and Mental Hygiene. Baltimore, Md: University of Maryland Dental School; 2002.
18. US Department of Health and Human Services. National Institutes of Health. National Institute of Dental Research. *Oral health surveys of the National Institute of Dental Research. Diagnostic criteria and procedures.* NIH publication 91-2870. Washington, DC: Government Printing Office; 1991.
19. Dean AG, Dean JA, Coulombier D, Burton AH, Brendel KA, Smith DC, Dicker RC, Sullivan KM, Fagan RF. *Epi Info, version 6. A word-processing, database, and statistics program for public health on IBM-compatible microcomputers.* Atlanta, Ga: Centers for Disease Control and Prevention; 1995.
20. SAS Institute, Inc. *The SAS system for Windows. Release 8.0.* Cary, NC: SAS Institute, Inc; 1999.
21. Research Triangle Institute. *SUDAAN. Release 8.0. Software for the statistical analysis of correlated data.* Research Triangle Park, NC: Research Triangle Institute; 1998.
22. Striffler DF. Dental treatment need, demand, and utilization. In: Striffler DF, Young WO, Burt BA, eds. *Dentistry, Dental Practice and the Community.* 3rd ed. Philadelphia, Pa: WB Saunders Company; 1983:293-339.
23. Edelstein BL, Manski RJ, Moeller JF. Pediatric dental visits during 1996 and analysis of the federal Medical Expenditure Panel Survey. *Pediatr Dent.* 2000;22:17-20.
24. Vargas CM, Crall JJ, Schneider DA. Socio-demographic distribution of pediatric dental caries: NHANES III, 1988-1994. *J Am Dent Assoc.* 1998;129:1229-1238,1526.
25. Vargas CM, Monajem N, Khurana P, Tinanoff N. Oral health status of preschool children attending Head Start in Maryland, 2000. *Pediatr Dent.* 2002;24:257-263.
26. Chambers CT, Reid GJ, Craig KD, McGrath PJ, Finley GA. Agreement between child and parent reports of pain. *Clin J Pain.* 1999;14:336-342.
27. Census Bureau. United States Census 2000. Census 2000 data for the state of Maryland. Available at: <http://www.census.gov/census2000/states/md.html>. Accessed June 14, 2003.

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