Caries pattern identification in primary dentition: a comparison of clinician assignment and clinical analysis groupings

David C. Johnsen, DDS, MS David Schubot, PhD Mohandas Bhat, MDS, Dr PH Paul K. Jones, PhD

Abstract

The purpose of this study was to compare the assessment of caries patterns by clinical definition and by cluster analysis. One of five etiology-oriented caries patterns was assigned to Head Start children in primary dentition. Cluster analysis grouped children based on carious tooth surfaces for each child. One hundred twenty-seven of the 155 children with at least one carious lesion fell into clusters of at least four children. At least two-thirds of the subjects in each cluster were assigned to a single caries pattern. The largest cluster of 70 children had 66 of its subjects assigned to the pit and fissure pattern. The second largest cluster of 26 children had 20 of its subjects assigned to the faciolingual pattern (intended to identify bottle caries). This study is interpreted to reinforce the notion that caries in the primary dentition occurs in fairly distinct patterns. (Pediatr Dent 15:113-15)

Introduction

Caries assessment for a population traditionally has been conducted by measuring average severity; some parameters precluded by the approach are localization of caries for individuals and prevalence of specific caries patterns such as bottle caries. Caries severity for a population traditionally has been based on an average number of carious teeth or tooth surfaces for individuals in a sample. Refinements have been made to consider specific carious surfaces, for example, approximal surfaces.[1] However with marked caries decreases in the last three decades, it is evident that caries is not a uniform disease across populations. Many preschool children are caries free, while a few have extensive caries experiences.[2] Distinct caries patterns such as bottle caries further complicate the use of caries measures for a population.[3] Caries measures in the permanent dentition have been used in attempts to quantify descriptive measures.[4, 5]

Descriptions of specific caries patterns in the primary dentition have not yet been incorporated into a caries measure. Thus, the use of a caries measure has been limited when planning interventions or developing patient protocols. A caries measure in the sense of providing numbers of children with specific patterns has been offered in the primary dentition; the measure classifies individuals based on etiology.[6-8] This measure is intuitive with no statistical corroboration. The patterns used so far in depicting caries in a population have been:

- Caries free
- Pit and fissure
- Hypoplasia
- Faciolingual (intended to show bottle caries)
- Molar approximal
- Faciolingual/molar approximal.[2]

The approach has some advantages over measures of average severity:

1) The percentage of children with specific etiologies in a population can be determined in baseline assessment.
2) Needs assessment can be refined in deciding on interventions in a population.
3) Caries etiology can be used to consider future experience on an individual basis.
4) The approach is reproducible as are traditional measures.

The approach now has disadvantages; the main one is that there is no statistical corroboration for such an intuitive approach. No matter the outcome of attempts to quantify caries descriptions, traditional caries measures will not be replaced.

Despite current shortcomings of caries descriptions in populations, it is of potential interest (for example, in planning interventions or in designing office protocols) to seek statistical bases for descriptive caries measures. Cluster analysis has been used in other biomedical areas and has potential use here. While it is descriptive and has limits in interpretation, cluster analysis groups similar individuals based on measurements from those individuals. A limitation of cluster analysis is that a level of significance is not an outcome.

The purpose of this study was to determine the degree of similarity of two different caries assessments in primary dentition: 1) caries patterns of children based on clinical definitions, and 2) groupings resulting from the descriptive statistical tool of cluster analysis. The level of agreement for the two methods may give direction for further attempts to quantify caries descriptions.

Methods and materials

Data were taken from a field study of Head Start children in Cleveland, Ohio.[2] Children were 3–1/2 to 5 years old at the time of the dental examination. Cleveland has been fluoridated since the 1950s. A dental caries examination was performed with mirror, explorer, and portable light at Head Start facilities. The World Health Organization caries diagnostic method was used as a basis for scoring. The two examiners had an overall interexaminer agreement of 99%. No radiographs were used for the study.

Regarding consent, the examinations filled the requirement of dental examinations for entry into the Head Start Program. Parental consent for the examination was included in the child's Head Start record. The examination protocol for the study was the same as that required by Head Start for the screening dental examination. Thus, no separate consent was used for the study. Institutional approval was obtained for the study.

From the referenced field study, 155 consecutive children, each having at least one carious lesion were used. Caries-free children were excluded, assuming that a single cluster would form. Information used in performing the cluster analysis was limited to the specific carious tooth surface. Clustering was based on carious tooth surfaces for each child using the program BMDP2M™.[9] BMDP2M begins by placing each patient into a single cluster. It then joins cases in a stepwise process with highly similar cases linked in the same cluster. To simplify the cluster analysis, respective surfaces of antimeres were combined.

Caries pattern assignment was based on the individual child according to overall caries pattern as described in previous studies.[2,6,7] Each child was assigned to one of five caries patterns according to the following definitions.

Carious lesions associated with developmental defects:

1. Pit and fissure — One or more lesions at sites of pit and fissure enamel defects in primary molars: occlusal surfaces of any molar, as well as lingual surfaces of maxillary second molars and facial surfaces of mandibular second molars.
2. Hypoplasia — Altered enamel contour with a detectably rough surface and darkened enamel or dentin, including caries adjacent to areas of hypoplasia and caries on the medial aspect of the facial surface of the primary canine.[10]

Smooth surface lesions:

1. Faciolingual (only cavitated lesions were included; "white spot" lesions were not) — One or more lesions on a facial or lingual surface of any tooth (except for the facial surface of the mandibular second primary molar and the lingual surface of the maxillary second primary molar where fissures are common) or an approximal surface of an incisor tooth.
2. Molar approximal — One or more lesions on the approximal surfaces of the primary molars or distal surfaces of the primary canines.
3. Faciolingual/molar approximal — One or more of both types of smooth surface lesions.

In the remainder of the paper, the term "cluster" will refer to a statistical grouping. The term "pattern" will refer to the caries pattern assignment. The term "assessment" will refer to the process of attempting to depict caries in a population.

Results

A schematic of the clustering is shown in the figure. Overall, 127 of the 155 children fell into clusters of at least four children; in each cluster at least 75% of the subjects had a single predetermined caries pattern. The largest cluster consisted of 70 children, 66 of whom fit the pit and fissure caries pattern. An additional six children clustered homogeneously for the pit and fissure pattern. The remaining 11 children classified in the pit and fissure pattern did not cluster and appeared individually.

The second largest cluster consisted of 26 children; 20 fit the faciolingual pattern. Immediately adjacent to this second largest cluster were three consecutive children classified in the faciolingual pattern. Seven additional children classified in the faciolingual pattern were in two small clusters, one immediately adjacent to the second largest cluster. The remaining five children classified in the faciolingual pattern did not cluster and appeared individually.

Of the 13 children with the molar approximal pattern, seven appeared in two clusters while five of the remaining six appeared singly. Of the nine children with the faciolingual/molar approximal pattern, two clustered with four children having the faciolingual pattern. The remaining six children with the molar approximal pattern did not cluster.

Fifteen children had the hypoplasia pattern. Eight appeared in two homogeneous clusters of four each and two were in the second largest cluster, having the faciolingual pattern predominantly.

Discussion

While there are many limitations in drawing extensive conclusions from the present study, it does reinforce the

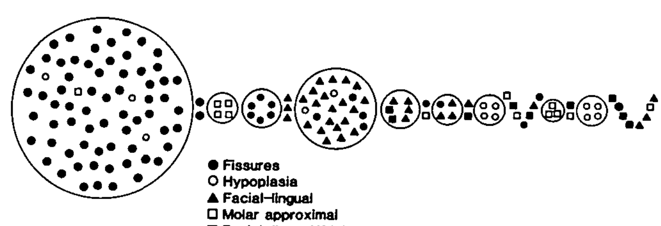

Fig. Schematic representation of cluster analysis by carious surfaces for 155 children with at least one carious lesion. Different symbols indicate caries pattern assignment from clinical definitions. Enclosures represent clusters. Each symbol represents one subject. Spatial relationships approximate statistical distances. Two adjacent points indicate similarity; two distant points indicate disparity. The five caries patterns were assigned previous to the cluster analysis.

notions that caries occurs in distinct patterns, that the number of major patterns is limited, and that caries is not an average disease. The convergence of outcomes from two different assessments of caries based on the individual would seem to warrant continued exploration of this approach; assessments from both clinical-based definitions[2] and from the use of cluster analysis arrive at nearly the same point. It is interesting that a high percentage of children fell into one of the clusters. Also interesting is the fact that the clusters were nearly homogeneous for previously assigned caries patterns. The clustering of children based on statistical proximities for carious tooth surfaces is similar to the patterns assigned by clinical definition. The clusters may thus reflect a natural pathologic basis. One preliminary conclusion is that a more definitive statistical approach can be explored for measuring caries based on the individual. The results also are interpreted to support the notion that the number of major caries patterns may be limited.

The large number of small clusters is perhaps the most difficult to explain. The numerous cases that did not cluster could indicate that some children have a combination of etiologies or that an etiology has been overlooked. The relatively small clusters for some caries experiences is presumed to be an accurate reflection of this population. A logical extension of the present work is to test the reproducibility of results using a different cluster analysis and to test the outcome of cluster analysis for a different population.

A theoretical implication is that the outcome of the cluster analysis, if reproducible in other populations, provides support from a statistical standpoint for the etiology-oriented measure of caries for individuals. A practical implication then can be the reinforcement of specific strategies for prevention or treatment. For example, the present population has two distinct groups that would differ in prevention approaches. The group having predominantly the faciolingual pattern is most likely afflicted with bottle caries. Strategies for prevention could include health education counseling to ensure that the child has discontinued nighttime bottle feeding to control the infection before the age of one year. The strategy for children with the fissure pattern could be sealing of tooth defects. If the molar approximal group was to predominate, a strategy using fluorides could be considered. The use of cluster analysis as a technique does not lead directly to strategies. However, it does provide support for caries measures based on the individual and that may reinforce strategy formulation.

Dr. Johnsen is professor and chairperson, Department of Pediatric Dentistry, School of Dentistry, Case Western Reserve University. Dr. Schubot is assistant professor, Department of Family Medicine, Medical College of Wisconsin. Dr. Bhat is director, Craniofacial Development and Disorders, Extramural Programs, National Institute of Dental Research. Dr. Jones is associate professor, Department of Epidemiology and Biostatistics, School of Medicine, Case Western Reserve University, Cleveland, Ohio.

1. Koch G: Evidence for declining caries prevalence in Sweden. J Dent Res 61:1340–45, 1982.
2. Johnsen DC, Bhat M, Kim MT, Hagman FT, Allee LM, Creedon RL, Easley MW: Caries levels and patterns in head start children in fluoridated and non-fluoridated, urban and nonurban sites in Ohio, USA. Community Dent Oral Epidemiol 14:206–10, 1986.
3. Ripa LW: Nursing caries: a comprehensive review. Pediatr Dent 10:268–82, 1988.
4. Poulsen S, Horowitz HS: An evaluation of a hierarchical method of describing the pattern of dental caries attack. Community Dent Oral Epidemiol 2:7–11, 1974.
5. Katz RV, Meskin LH: Testing the internal and external validity of simplified dental caries index on an adult population. Community Dent Oral Epidemiol 4:227–31, 1976.
6. Johnsen DC, Schechner TG, Gerstenmaier JH: Proportional changes in caries patterns from early to late primary dentition. J Public Health Dent 47:5-9, 1987.
7. Johnsen DC, Schultz DW, Schubot DB, Easley MW: Caries patterns in Head Start children in a fluoridated community. J Public Health Dent 44:61–66, 1984.
8. Johnsen, DC: Dental caries patterns in preschool children. Dent Clin North Am 28:3–20, January 1984.
9. BMDP Statistical Software: 1981. Berkeley, Calif.: University of California Press, 1981.
10. Ainamo J, Cutress TW: An epidemiological index of developmental defects of dental enamel (DDE Index). Commission on Oral Health, Research and Epidemiology, FDI. Int Dent J 32:159–67, 1982.