Dental Health of Children: Where We Are Today and Remaining Challenges

Michael W. Roberts*

Dental caries remains the most common disease in man and presents a tremendous health-affecting challenge and fiscal burden to both developed and underdeveloped countries. Changing demographics including increased number of ethnic minorities, cultural practices and diet, the number of children living in poverty or near poverty, and the special needs of medically compromised children have made solutions more complex and evasive. Systemic and topical fluoride contacts remain the most cost-effective public health response to preventing caries among children. The time-honored impact of reducing sugars and carbohydrates in the diet and improving oral hygiene practices also remain essential. New technology has the potential of offering remineralization strategies. The dental profession is challenged to be proactive in identifying alternatives and implementing new and creative ways to embrace underserved children and improve their access to care including trauma prevention. The impact on families and society, including financial and general well-being, due to poor oral health is significant. Lower income families absorb disproportionately the effect of dental diseases due to lack of education, food availability and selection, and access to early preventive care.

Keywords: *Children, dental health, caries, trauma, access to care, dental health disparities*
J Clin Pediatr Dent 32(3): 231–234, 2008

INTRODUCTION

Dental caries is the most common chronic disease of childhood in the United States (U.S.) with a prevalence of 41% among children 2-11 years of age which is significantly greater than asthma.[1-3] It is well established that caries is an infectious and transmissible disease caused by bacteria that are commonly transferred from caregiver to child upon the eruption of the primary teeth, often referred to as the "window of infectivity."[4-5]

The U.S. Surgeon General's Conference highlighted the access to dental care problem for children. Minority children, children from low-income families and children with special health care needs were noted to be particularly at risk. An estimated 52 million school-hours a year are lost by children due to dental concerns.[6] This paper will review the current composite dental profile of children, illuminate social issues that contribute to a lack of balance in access to care and identify challenges to the dental profession.

Background: *Streptococcus mutans (SM)* and *Streptococcus sobrinus (S. sobrinus)* have been associated with dental caries. These organisms produce glucans from sucrose that contribute to plaque formation and demineralizing acid production.[7,8] It has been shown that *S. mutans* has the ability to adapt to low pH survival within 20 minutes by altering its proportions of long-chain monounsaturated membrane fatty acids.[9] The oral cavity is at greatest risk of becoming colonized with *SM* when the child is approximately 6-30 months of age.[10] The child's mother or primary care provider is the most common source of infecting bacteria.[11,12,13]

Children's are dependent upon parents/caregivers to make health choices for them including diet, oral hygiene practices, and seeking timely professional preventive care. These choices often include inadequate access to topical and systemic fluoride and inappropriate infant feeding practices.[14] Culturally driven choices or preferences for convenience foods high in sugars or fermentable carbohydrates contribute to the quandary. The relationship between malnutrition and early childhood caries has been well established.[15] Children living in industrialized Western countries ingest larger amounts of sugar which places them a greater risk for dental caries. A failure to introduce good health practices places the child at greater risk for early childhood caries and can interfere with their physical and emotional development.[1,16-24]

In establishing the model for good oral health for children

* Michael W. Roberts, DDS, MScD Henson Distinguished Professor, Department of Pediatric Dentistry School of Dentistry, University of North Carolina at Chapel Hill

Send all correspondence to: Michael W. Roberts, University of North Carolina, School of Dentistry, 228 Brauer Hall, Chapel Hill, NC 27599-7450

Phone: (919)966-2739
FAX: (919)966-7992

Email: mike_roberts@dentistry.unc.edu

it is important to be aware that parental behaviors are affected by their own personal dental history, their diet preferences and their understanding and appreciation for the importance of dental health to general health.[25-26] Community and personal standards can also impact child care practices that affect oral health. Special needs children with significant health issues present an additional challenge to parents, society and dental providers.

The percentage of racial and ethnic minority children is increasing and they often have less educated parents/caregivers who live in poverty or near poverty.[27-28] Children often experience caries at a very early age. Caries has been reported in 6.4% of children by the age of 1 and increases to 35% by age 3.[29] Evidence suggests that Hispanic, African American and American Indian children have a higher incidence of dental disease than non-minority children and compounds the issues of access to care.[30-32] No doubt this is the result of numerous issues but food selection, nursing practices, eating patterns and oral hygiene habits are primary. The negative impact of some of these factors can be modulated by appropriate exposure to fluorides.[4,33]

In addition, new technologies to reverse or prevent dental caries continue to be explored. Casein phosphopeptides (CAP) derived from milk have shown promise. These peptides stabilize aqueous calcium and phosphorous ions (ACP) in dental plaque creating a supersaturation state which reduces demineralization and encourages remineralization when adjacent to enamel.[34-36] Animal and clinical studies have demonstrated caries preventive effects of CPP-ACP.[37-39] The remineralization effects of CPP-ACP can be enhanced with the addition of fluoride to produce an amorphous calcium fluoride phosphate (CPP-ACFP) phase which slowly releases calcium, phosphate and fluoride ions when in contact with demineralized tooth surfaces. CPP-ACP is available as a paste for clinical use as an adjunct remineralization and caries preventing agent (MI Paste™, CG America, Alsip, IL 60803).

Complex but Integrated: The mouth is a complex biological structure and the oral hard and soft tissues are affected by numerous internal and external factors. The presence and number of intra-oral virulent organisms, malocclusions, quantity and quality of saliva, genetics, diet, oral hygiene and family practices all have an impact.

Marginal gingivitis usually the result of inadequate oral hygiene is common in children. An association has been reported in adults between periodontal disease and cardiovascular and pulmonary disease, diabetes, stroke and pregnancy.[40-43] However, overt periodontal disease in children is not common.[44] When present, periodontal disease in children is often associated with debilitating or medical conditions that have compromised the bodies immunological response capacity or is the side effect of medications, such as phenytoin or cyclosporine, that stimulate gingival overgrowth.[45] In addition, inadequate arch length and irregularities of the teeth, craniofacial anomalies and other factors often produce malocclusions that put the child patient at greater risk for periodontal disease.[46-47] Minority children often experience a greater incidence of these complicating factors and are more vulnerable to the consequences due to the lack of early professional intervention.[48-49]

Dental injuries are common among children with males more affected than females. Traumatic injuries, including dental concussion, crown and root fracture, impaction, luxation and avulsion are often associated with falls, play, contact sports and motor vehicle accidents.[50-51] These injuries can have a devastating impact on the developing dentition. Often prompt initial professional response and protracted multidiscipline care are required to manage the trauma. The incidence of oral trauma can be reduced with education to parent/care-givers on how to "child proof" homes, encourage the use of restraints in automobiles and wearing mouth guards during contact sports.

Access to Dental Care: Unfortunately, access to dental care is not universally available to all children. Disparities in access to oral health related to family income have been well-established. Children who do not have dental insurance are at 300% higher risk for dental disease and 250% less likely to receive dental treatment than insured children.[6] It has been estimated that 45 million Americans do not have medical insurance. Even more perplexing is the fact that there are 2.6 times more children without dental insurance than without medical insurance.[6,52] Private and public sectors in the United States invest annually $111 billion in health related research.[53] Medicaid and SCHIP programs have extended dental insurance to millions of children who would otherwise be uncovered. However, reimbursement rates for dental services vary significantly from state to state and often discourage dentist participation. Parental work demands and transportation factors also can have a negative influence on obtaining dental care for children.[1,6,54]

Dentistry's Challenge: The challenge to the dental profession to provide oral health care access for all children needing and seeking it is daunting. There are only about 5000 practicing pediatric dentists in the U.S. Many general dentists do not feel adequately trained to treat very young children.[55] In addition, many families living in isolated or rural areas do not have easy access to dental care either by private practicing dentists or public health clinics.[56-58] An increased number of minority children as the result of a recent large Hispanic influx (both documented and un-documented) has further complicated the issue of understanding, trust and response to health information including oral health practices.[59] To be most effective, the oral health delivery system must appreciate these issues and integrate them into planning for improved access to dental care for all children.

In industrialized countries, including the U.S., the prevalence of dental caries is decreasing but is rapidly increasing in developing nations.[60] Alternative, non-traditional, partnerships offer opportunities to extend the dental professional arm to reach children who could otherwise be missed. These can include school programs, public health clinics for expectant women and new mothers, health fairs and pediatricians/family physicians.[61-62]

Prevention of dental caries continues to be an enigma that has evaded a universal solution to date. A vaccine against caries showed early promise in animal models but no longer seems as viable for humans due to many factors including multiple organisms that can cause dental decay and their ability to rapidly adapt to changing environments.[9,63] Appropriate systemic and topically applied fluorides remain the primary means of preventing caries. Modifications in diets to minimize sugars and carbohydrates coupled with good oral hygiene practices are also pivotal in supporting good dental health for children.

Issues have been identified that need research to address oral health, poverty and the impact of changing society demographics.[64] These include examination of more effective dental health interventions, alternative and more cost effective restorative interventions, establishing the most cost-effective and sustainable preventive interventions, identifying the cultural, social, behavioral and family economic issues that impact oral health. The full impact of the lack of oral health care to children, especially children who do not have adequate access to it, needs to be explored in addition to community, state and federal legislative options.[65] Organized dentistry must continue to promote oral trauma prevention through the support of requiring children to wear protective restraining devices when riding in an automobile or other moving vehicle. Coaches and athletic programs should be encouraged to have their student athletes wear mouth guards to protect the teeth.

SUMMARY

Dental disease has plagued mankind for thousands of years and still does so today. Although there appears to be no magic solution on the horizon, there are time tested means to minimize caries, periodontal disease and reduce the frequency of traumatic injury to the teeth. In addition to continuing to stress the importance of established prevention regimens (personal oral hygiene, diet and fluorides), we must look outside of the traditional dental setting and embrace other health providers, sites and developing technology which can offer an opportunity to improve dental health and access to care.[66] There is also a critical need for focused research to address the multiple issues of dental disease prevention, impacts on society, cultural influences and innovative government intervention strategies.

REFERENCES

1. Edelstein BL. Disparities in oral health and access to care: Findings of national surveys. Ambul Pediatr, 2(2 Suppl): 141–7, 2002.
2. Edelstein BL, Douglass. Dispelling the myth that 50 percent of U.S. children have never had a cavity. Public Health Rep, 110: 522–30, 1995.
3. Vargas CM, Crall JJ, Schneider DA. Sociodemographic distribution of pediatric dental caries: NHANES III, 1988-1994. JADA, 129: 1229–38, 1998.
4. Caufield PW, Griffin AL. Dental caries. An infectious and transmissible disease. Pediatr Clin North Am, 47: 1001–19, 2000.
5. Berkowitz RH, Jones P. Mouth-to-mouth transmission of the bacterium Streptococcus mutans between mother and child. Arch Oral Biol, 30: 377–9 1985.
6. Oral Health in America: A Report of the Surgeon General. Rockville, MD.: U.S. Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health; 2000. NIH publication 00–4713. Also available at: http:www.surgeongeneral.gov/library/oralhealth/. Accessed October, 2007.
7. Waterhouse JC, Russell RRB. Dispensable genes and foreign DNA in *Streptococcus mutans.* Microbiology, 152: 1777–88, 2006.
8. Mattos-Graner RO, Jin S, King WF, Chen T, Smith DJ, Duncan MJ. Cloning of the *Streptococcus mutans* gene encoding glucan binding protein B and analysis of genetic diversity and protein production in clinical isolates. Infect Immun, 69: 6931–41, 2001.
9. Fozo EM, Quivey RG. Shifts in the membrane fatty acid profile of *Streptococcus mutans* enhance survival in acidic environments. Appl Environ Microbiol, 70: 929–36, 2004.
10. Caufield PW, Cutter GR, Dasanayake AP. Initial acquisition of mutans streptococci by infant: evidence for a discrete window of infectivity. J Dent Res, 72: 37–45, 1993.
11. Berkowitz RJ, Jones P. Mouth-to-mouth transmission of the bacterium *S. mutans* between mother and child. Arch Oral Biol, 30: 377–9. 1985.
12. Li Y, Caufield PW. Initial acquisition of mutans streptococci in an infant population. J Dent Res, 72: 402, 1992.
13. Spolidorio DMP, Höfling JF, Pizzolitto AC, Rosa EA, Negrini TC, Spolidorio LC. Genetic polymorphism of *Streptococcus mutans* in Brazilian family members. Brazilian J Microbiol, 34: 213–7, 2003.
14. Selwitz RH, Ismail AL, Pitts NB. Dental caries. Lancet, 369 (9555): 51–9, 2007.
15. Clarke M, Locker D, Berall G, Pencharz P, Kenny DJ, Judd P. Malnutrition in a population of young children with severe early childhood caries. Pediatr Dent, 28: 254–59, 2006.
16. Hobdell MH. Poverty, oral health and human development. JADA, 138: 1433–1436, 2007.
17. Acs G, Shulman R, Ng MW, Chussid S. The effect of dental rehabilitation on the body weight of children with early childhood caries. Pediatr Dent, 21: 109–13, 1999.
18. Slade G. Epidemiology of dental pain and dental caries among children and adolescents. Community Dent Health; 18: 219–27, 2001.
19. Acs G, Lodolini G, Kaminsky S, Cisneros GJ. Effect of nursing caries on body weight in a pediatric population. Pediatr Dent, 14: 302–5, 1992.
20. Filstrup SL, Briskie D, da Fornseca M, Lawrence L, Wandera A, Inglehart MR. Early childhood caries and quality of life: child and parent perspectives. Pediatr Dent, 25: 431–40, 2003.
21. Gift HC, Reisine ST, Larach DC. The social impact of dental problems and visits. Am J Public Health; 82: 1663–68, 1993.
22. Lee JY, Vann WF, Roberts MW. A cost analysis of treating pediatric dental patients using general anesthesia versus conscious sedation. Pediatr Dent, 22: 27–32, 2000.
23. Locker D. Deprivation and oral health: a review. Community Dent Oral Epidemiol, 28: 161–9, 2000.
24. Kanellis MJ, Damiano PC, Momany ET. Medicaid costs associated with the hospitalization of young children for restorative dental treatment under general anesthesia. J Public Health Dent, 60: 28–32, 2000.
25. Woo D, Sheller B, Williams B, Mancl L, Grembowski D. Dentists' and parents' perceptions of health, esthetics, and treatment of maxillary primary incisors. Pediatr Dent, 27: 19–23, 2005.
26. Adair PM, Pine CM, Burnside G, Nicoll AD, Gillett A, Anwar S, Broukal Z, Chestnutt IG, Declerck D, Ping FX, Ferro R, Freeman R, Grant-Mills D, Gugushe T, Hunsrisakhun J, Irigoyen-Camacho M, Lo EC, Moola MH, Naidoo S, Nyandindi U, Poulsen VJ, Ramos-Gomez F, Razanamihaja N, Shahid S, Skeie MS, Skur OP, Splieth C, Soo TC, Whelton H, Young DW. Familial and cultural perceptions and beliefs of oral hygiene and dietary practices among ethnically and socio-economically diverse groups. Community Dent Health, 21(1 Suppl): 102–11, 2004.
27. National Center for Children in Poverty. Basic facts about low-income children: birth to age 18. Available at: http//www.nccp.org/publications/pub_762.html. Accessed October 2007.

28. Mouradian WE, Huebner C, DePaola D. Addressing health disparities through dental-medical collaboration, Part III: Leadership for the public good. J Dent Educ, 68: 505–12, 2004.
29. Trends in oral health status: United States, 1988–1994 and 1999–2004. Vital and Health Statistics, DHHS, Centers for Disease Control, Series 11 (248), 21, 2007.
30. Oral Health in America: A report of the surgeon general. Rockville, Md.: National Institute of Dental and Craniofacial Research; NIH publication 00-4713, 2000.
31. Healthy People 2010: Understanding and Improving Health. 2nd ed., Chapter 21. U.S. Department of Health and Human Services; Washington, D.C: U.S. Government Printing Office; November 2000. Available at:http://www.health.gov/healthypeople/document/pdf/Volume2/21Oral.pdf. Accessed October 2007.
32. Iada H, Auinger P, Billings RJ, Weitzman M. Association between infant breastfeeding and early childhood caries in the United States. Pediatrics, 120: 944–52, 2007.
33. Berkowitz RJ. Acquisition and transmission of mutans streptococci. J Calif Dent Assoc, 31: 135–7, 2003.
34. Rose RK. Effects of an anticariogenic casein phosphopeptide on calcium diffusion in streptococcal model dental plaques. Arch Oral Biol, 45: 569–75, 2000.
35. Cross KJ, Huq NL, Reynolds EC. Casein phosphopeptides in oral health-chemistry and clinical applications. Curr Pharm Des, 13: 793–800, 2007.
36. Reynolds EC. Remineralization of enamel subsurface lesions by casein phosphopeptide-stabilized calcium phosphate solutions. J Dent Res, 76: 1587–95, 1997.
37. Shen P, Cai F, Nowicki A, Vincent J, Reynolds EC. Remineralization of enamel subsurface lesions by sugar-free chewing gum containing casein phosphopeptide-amorphous calcium phosphate. J Dent Res, 80: 2066–70, 2001.
38. Reynolds EC, Cai F, Shen P, Walker GD. Retention in plaque and remineralization of enamel lesions by various forms of calcium in a mouthrinse or sugar-free chewing gum. J Dent Res, 82: 206–11, 2003.
39. Iijima Y, Cai F, Shen P, Walker G, Reynolds C, Reynolds EC. Acid resistance of enamel subsurface lesions remineralized by a sugar-free chewing gum containing casein phosphopeptide amorphous calcium phosphate. Caries Res, 38: 551–6, 2004.
40. Barak S, Oettinger-Barak O, Machtei EE, Sprecher H, Ohel G. Evidence of periopathogenic microorganisms in placentas of women with preeclampsia. J Periodontal, 78: 670–6, 2007.
41. Xiong X, Buekens P, Fraser WD, Beck J, Offenbacher S. Periodontal disease and adverse pregnancy outcomes: a systemic review. BJOG,113: 135–43, 2006.
42. Philstrom BL, Michalowicz BS, Johnson NW. Periodontal diseases. Lancet, 366 (9499): 1809–20, 2005.
43. Loesche WJ. Association of the oral flora with important medical diseases. Curr Opin Periodontal, 4: 21–9, 1997.
44. Dougherty MA, Slots J. Periodontal diseases in young individuals. J Calif Dent Assoc, 21: 55–69, 1993.
45. Delaney JE. Dental care for the preschool child: Periodontal and soft-tissue abnormalities. Dent Clin North Am, 39: 837–50, 1995.
46. Proffit WR, Fields HW. Contemporary orthodontics 3rd ed. St. Louis: 2000: Mosby; 2–22.
47. Proffit WR, Fields HW, Moray LJ. Prevalence of malocclusion and orthodontic treatment need in the United States: Estimates from the NHANES III survey. Int J Adult Orthodont Orthognath Surg, 13: 97–106, 1998.
48. Nelson S, Armogan V, Abei Y, Broadbent H, Hans M. Disparity in orthodontic utilization and treatment need among high school students. J Public Health Dent, 64: 26–30, 2004.
49. Brunelle JA, Bhat M, Lipton JA. Prevalence and distribution of selected occlusal characteristics in the US population, 1988–1991. J Dent Res, 75(Spec Iss): 706–13, 1996.
50. Fried I, Erickson P. Anterior tooth trauma in the primary dentition: Incidence, classification, treatment method, and sequelae: A review of the literature. J Dent Child, 62: 256–61, 1995.
51. Zerman N, Cavalleri G. Traumatic injuries to permanent incisors. Endod Dent Traumatol, 9: 61–4, 1993.
52. Vargas CM, Isman RE, Crall JJ. Comparison of children's medical and dental insurance coverage by sociodemographic characteristics, United States, 1995. J Public Health Dent, 62: 38–44, 2002.
53. Hampton T. Health research funding losing ground. JAMA, 296: 1219–20, 2006.
54. Wall TP, Brown LJ, Manski RJ. The funding of dental services among US children 2 to 17 years old: Recent trends in expenditures and sources of funding. JADA, 133: 474–82, 2002.
55. Seale NS, Casamassimo PS. Access to dental care for children in the United States: A survey of general practitioners. JADA, 134: 1630–40, 2003.
56. Roberts MW, Vann WF Jr. Access to dental care for young children in North Carolina: history and current status of workforce issues. NC Med J, 66: 452 –56, 2005.
57. Goodman HS, Manski MC, Williams JN, Manski RJ. An analysis of preventive dental visits by provider type, 1996. JADA, 136: 221–8, 2005.
58. Mofidi M, Rozier RG, King RS. Problems with access to dental care for Medicaid-insured children: What caregivers think. Am J Public Health, 92: 53–8, 2002.
59. Pachter LM, Dworkin PH. Maternal expectations about normal child development in 4 cultural groups. Arch Pediatr Adolesc Med, 51: 1144–50, 1997.
60. Bratthall D, Hansel-Petersson G, Sundberg H. Reasons for the caries decline: what do the experts believe? Eur J Oral Sci, 104: 416–425, 430–32, 1995.
61. Grant JS, Roberts MW, Brown WD, Quinoñez RB. Integrating dental screening and fluoride varnish application into a pediatric residency outpatient program: clinical and financial implications. J Clin Pediatr Dent, 31: 175–78, 2007.
62. American Dental Association (ADA). Access to care is the umbrella for the major issues facing dentistry. ADA News, 36(16): 1, 10–11, 2005.
63. Smith DJ, Taubman MA. Experimental immunization of rats with a *Streptococcus mutans* 59-kilodalton glucan-binding protein protects against dental caries. Infect Immun, 64: 3069–73, 1996.
64. de la Fuente-Hernández J, Acosta-Gio AE. The effect of poverty on access to oral health care. JADA, 138: 1443–5, 2007.
65. Sgan-Cohen HD, Mann J. Health, oral health and poverty. JADA, 138: 1437–42, 2007.
66. Griffin SO, Jones K, Tomar SL. An economic evaluation of community water fluoridation. J Public Health Dent, 61: 78–86, 2001.