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Original Research

Utilizing the Caries Risk Assessment Model (Caries Management by Risk Assessment) in Ecuador

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Abstract

Objective: Although oral health is a preventable disease, it affects a good portion of vulnerable populations, such as the elderly, children, low-income individuals, and certain racial and ethnic groups. Early childhood caries remains the most prevalent chronic childhood condition worldwide with 60%–90% of schoolchildren having dental cavities. We examined contributing and protecting factors that may have an impact on the oral health of the children in three rural communities in Ecuador. **Materials and Methods:** We conducted a minimally invasive clinical dental examination on 131 Ecuadorian children aged 6–12 years and used a modified caries management by risk assessment (CAMBRA) form to assess contributing and protecting factors for oral health. Data were analyzed using SPSS software (version 24). **Results:** Preliminary data show that about 80% of the mothers or primary caregivers had active decay in the past year and did not have a dental home. Almost half of the children had not seen a dentist within the last year, and some of them had never seen a dentist until the encounter with this study. The use of bottles or sippy cups with fluids other than water and frequent snacking was common in the communities. The results of the clinical examination indicated that the majority of the children had obvious dental decay, restorations, and dental plaque and a good proportion had also gingivitis. **Conclusion/Implications:** CAMBRA should become a standard tool of the comprehensive oral examination conducted by any health care professional and should be used as the basis for a preventive and treatment plan.

Keywords: Caries management by risk assessment, caries risk indicators, epidemiological triad, protective factors

Introduction

Dental disease is an often overlooked health issue with systemic implications and global distribution. Despite oral disease being preventable, many factors influence and predispose individuals to be impacted by it. This is evident by the fact that nearly 100% of adults have dental cavities, severe periodontal disease is found in 15–20% of adults between the ages of 33–44 years, and 60–90% of young children worldwide are affected by caries.[1] Dental caries is a multifactorial disease, and as with any infectious disease, it adheres to the epidemiological triad. As such, it requires all three factors: agent, environment, and host to be present for disease to occur. The epidemiological triad refers to the three criteria necessary to determine causality for dental disease. These are a susceptible individual, a number of species of cariogenic bacteria, and protective and/or contributing factors that may either reduce or increase the likelihood of disease occurrence [Figure 1].[2,3] Understanding the interactions between these factors should allow researchers to examine dental disease as a multifactorial disease and to understand the application and use of a caries risk assessment process in identifying the patient's relative risk for dental caries.[4,5]

Host

The host is the person and the biological factors intrinsic to that individual. Host factors affect susceptibility to disease. Examples of host factors are age, race and ethnicity, diet, nutrition, and socioeconomic status. Studies have shown that the prevalence of dental caries increases with age.[6] According to the National Health and Nutrition Examination Survey,

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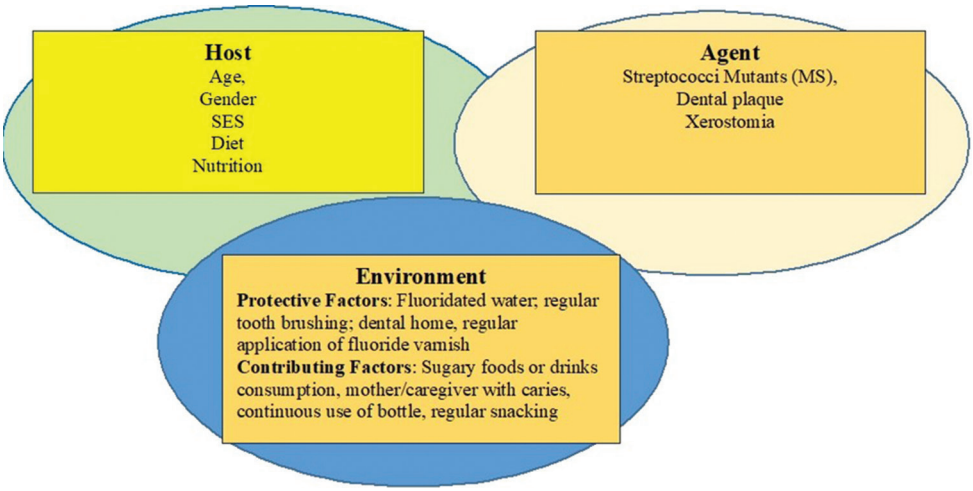

Figure 1: Epidemiological triad for dental disease

there was an increase of 11% in the prevalence of caries when comparing 20–34 years of age group to the 50–64 years of age group. Males, Black, and Hispanic adults and individuals with lower incomes and less education have more untreated decay compared to their counterparts.[6]

Although the prevalence of dental caries among children appears to be decreasing, particularly in high-income countries, a high proportion of children (60%–90%) in low-and-middle-income countries are affected by dental disease which is mostly untreated due to inappropriate, unaffordable, or unavailable oral health care services.[1,7]

The impact of diet and malnutrition on oral disease has been well documented by the literature.[8,9] In a study conducted in the Ecuadorian Amazon region, researchers found that "for each unit increase in frequency of mouth pain interfering with sleeping, children had increased odds for underweight (adjusted odds ratio [AOR] = 1.27; 95% confidence intervals [CI]: 1.02–1.54; $P = 0.004$) and reduced odds for overweight (AOR = 0.76; 95% CI: 0.58–0.97; $P = 0.032$)."[10]

Agent

The agent is a factor that must be present in order for the disease to appear. Mutans streptococci (MS) have been identified as the most common bacteria related to the pathogenesis of dental caries.[11-13] MS adhere to smooth surfaces and initiate the formation of dental plaque, while lactobacilli promote acid production that is capable of destroying the tooth enamel. MS are notable as being highly cariogenic, virulent, and the chief bacterium to initiate decay.[14]

Vertical transmission of MS from the mother to the child, along with the mother's oral hygiene, periodontal disease, and socioeconomic status has been well- documented in the literature as risk factors for dental caries.[5,15,16] Horizontal transmission from a sibling or a caregiver to the child has also been documented.[17,18] The frequent ingestion of fermentable carbohydrates is linked to dental caries because it can be acted upon by MS and lactobacilli to create plaque and acid.

Environment

The environment is composed of all the external factors that cause or allow the transmission of the disease; the environment can also be composed of protective factors that prevent the development of disease. Examples of contributing factors for oral disease include sugary food or drink consumption, a mother/caregiver with caries, continuous use of bottle, and frequent snacking. In a study conducted by Curtis *et al*., it was found that the diet in three rural communities in Ecuador was very high in sugars and fermentable carbohydrates. In fact, almost half of the participants reported consuming some type of sweet and/or bread every day.

Exposure to excess fluoride is another concern in this population. While fluoride is a great way to prevent dental caries, overexposure can lead to dental fluorosis which causes enamel defects and discoloration of the teeth, along with other important healthcare issues.[9,19,20] Examples of protective factors include optimally fluoridated water, regular oral hygiene, establishing a dental home, sealants, and regular application of fluoride varnish.

Understanding the role of the host, the agent, and the environment on health behaviors and oral disease is crucial to develop a comprehensive strategy that promotes good oral and general health.[4]

Caries management by risk assessment

Dental caries is a multifactorial disease, so conducting a caries risk assessment to determine the patient's relative risk for dental caries has been recommended.[2,21] Utilizing the caries management by risk assessment (CAMBRA) tool as a primary prevention strategy can help healthcare providers from different disciplines identify causative factors and predictors of dental caries, as well as protective factors that would allow them to have an overall picture of the oral health status of a community.

This study utilized a slightly modified version of the CAMBRA Spanish tool developed by the American Academy of Pediatrics (https://www.aap.org/en-us/documents/oralhealth_riskassessmenttoolspanish.pdf) to identify contributing and protective factors that may have an impact on the oral health of school-age children (6–12 years) in three rural communities in Ecuador.

Materials and Methods

We invited parents and their school-age children (6–12 years) of three rural communities in Ecuador to participate in the study. Recruitment of the participants was conducted by investigators from the University of San Francisco de Quito who started working with the community leaders in Tingo Pucara, Tumbaco, and Salasaca 15, 10, and 6 years ago, respectively. This had allowed them to develop trust and rapport with the community. The informed consent form in Spanish was read and explained to the adults since most of them are illiterate. Calibrated dental professionals from four dental schools in Quito used a slightly modified CAMBRA tool to interview the parents or caregivers, conduct a visual clinical oral exam of the children, and collect information about caries risk indicators. Questions about qualifications for Medicaid were deleted since this is a US health insurance plan and did not apply to these local settings.

Data for the following areas were collected caries risk indicators (parent interview), protective factors (parent interview), and caries risk indicators/factors (clinical examination of the child). Data were analyzed using IBM SPSS Statistics software (version 24). Means, standard deviations, counts, and percentages were calculated as appropriate. For the bivariate analysis, Chi-square tests were performed to evaluate associations between the variables. Estimates are presented as OR and 95% CI. This study received approval from the Institutional Review Board and Bioethics Committee at one university in Ecuador and another university in the U.S (ethical approval numbers: 2016012IN [Ecuador IRB] and IRB 2016–141 [USA IRB]).

Results

One hundred and thirty-one children and their parents participated in the study. The three communities selected were at high altitude (7000–120,00 feet above sea level) and experienced high levels of poverty (80–90%). They all had poor access roads, and two of them did not have access to public water. The distance to the nearest health center varied between 2 and 10 miles. The sample was composed of school-age children. The age of the participants ranged from 6 to 12 years (mean = 8.5, standard deviation = 1.8). There were slightly more females (58%) than males.

Nearly 25% of the children (n = 31) had not seen a dentist within the last year.

As is shown by Table 1, most of the parents reported having dental caries in the past 12 months and not having a dental home.

Table 1: Results of caries risk assessment in three Ecuadorian rural communities

	Yes (%)
Caries risk indicators - Parent interview	
Mother or primary caregiver has had active dental decay in the past 12 months	104 (81.90)
Mother or primary caregiver with no dental home	79 (62.20)
Continual use of bottle/sippy cup with fluid other than water	53 (42.10)
Child has frequent (>3 times daily) between-meal snacks of sugars/cooked starch/sugared beverages	77 (61.10)
Protective factors (nonbiological) - Parent interview	
Existing health care center with dental providers	68 (51.90)
Child lives in a fluoridated community	43 (32.80)
Child brushes teeth at least twice daily	109 (84.50)
Caries risk indicators/factors - Clinical examination of child	
Obvious white spot lesions, decalcifications, or obvious decay present on the child's teeth	117 (89.30)
Restorations (fillings) present on child's teeth	82 (63.60)
Visible plaque accumulation	91 (70.50)
Gingivitis (swollen/bleeding gums)	51 (38.90)
Obvious fluorosis	38 (29.20)

Table 2: Oral health risk and protective factors among children who had obvious decay upon a clinical examination

Characteristics	Presence of decay in children	
	n (%)	OR (CI)
Gender		
Female	65 (55.6)	1.4 (1.1-1.9)‡
Male	52 (44.4)	
Caregiver with active decay		
Yes	94 (87.3)	0.86 (0.610-1.20)
No	10 (12.7)	
Caregiver with no dental home		
Yes	69 (61.1)	1.1 (0.814-1.68)
No	10 (38.9)	
Use of bottle/sippy cup		
Yes	45 (40.2)	1.4 (0.8572.36)
No	67 (59.8)	
Frequent snacking		
Yes	66 (85.7)	1.3 (0.974-1.82)
No	11 (14.3)	
Existing health care center		
Yes	60 (88.2)	1.1 (.685-1.81)
No	8 (11.8)	
Drinks fluoridated water		
Yes	38 (88.4)	1.1 (0.520-2.32)
No	5 (11.6)	
Brushes teeth twice a day		
Yes	96 (88.1)	1.1 (0.340-1.30)
No	13 (11.9)	

‡$P \leq 0.05$. OR: Odds ratio, CI: Confidence interval

The consumption of frequent snacks between meals was very common in this population along with the use of bottles and

sippy cups when the children were younger. Most of the parents reported their children brush their teeth at least twice a day. The clinical examiantion conducted by the dental researchers indicated that most of the children had obvious white spot lesions, decalcifications, or obvious decay and plaque accumulation.

Table 2 shows cross-tabulations of risk and protective factors by the presence of decay in children. Female participants were 1.4 times more likely to show the presence of decay upon the clinical examination than males. The presence of decay in children was more likely to be found among those children with parents with reported active decay and no dental home, but this association was not statistically significant. The presence of decay was also more likely to be found among children who snacked frequently, but this association was not statistically significant. None of the protective factors seemed to reduce the rate of decay in this population of children.

Discussion

The primary outcome of this study was to show clinical evidence of caries among school-age children (6–12 years) in three rural communities in Ecuador. The prevalence of dental caries among this population was (89%) which was higher than the national prevalence (62.4%). The secondary outcome of this study was to identify contributing and protective factors that may have an impact on the caries risk level of the children. We found that mothers or primary caregiver reported having high rates of decay (81.9%). Mothers and primary caregivers are considered to be important sources of transmission of dental caries to their children through their intimate contact with the children during the 1st 2 years of life. Studies have shown that infants acquire *Mutans streptococci* (MS) from their mothers only after the eruption of primary teeth.[2] Children acquire MS during a discrete period between the age of 19 and 33 months, designated as the first window of infectivity, and the source of initial infection mostly is through the mother.[14,22,23]

This study also showed there were a high percentage of mothers who reported not having a dental home (62%). The American Dental Association and the American Academy of Pediatric Dentistry strongly support the concept of a "dental home" for both the mother and the child. A dental home is the place where the mother and the child have an established and ongoing relationship with their dentist where comprehensive, ongoing and continuous oral health care is provided during pregnancy and continues during the life of the child.[21,24] A dental home is a key protective factor for dental caries in children in that it promotes prevention and early intervention.

The distance between the communities and the closest health care center ranged from 2 to 10 miles. The great distances between the communities being served and the health centers accompanied by the absence of reliable transportation constitute a significant barrier to access to dental care.[9] In addition, most of the health centers are staffed by temporary dentists who are completing their rural year, which is a prerequisite for obtaining a dental degree in Ecuador. The lack of dental continuity can be a hindrance and a barrier for developing a true dental home and, therefore, for delivering optimal dental care with an emphasis on initiating preventive strategies during pregnancy and infancy.[21,24] Having a dental home may also ensure coordination between medical and dental care as dental providers can encourage medical providers to refer pregnant women to the dental staff for anticipatory guidance, oral health education, and treatment.

A high proportion of children with obvious decay reported frequent snacking during the day between meals. It has been well shown that children who report frequent snacking, particularly sweets and fermentable carbohydrates, are more likely to show dental decay than those who do not snack on a regular basis.[25-27]

None of the water systems had been treated with fluoride; however, one of the community's water systems had a fluoride level of 4.86 mg/L (maximum accepted value = 0.7 mg/L). Evidence of fluorosis was found in most of the residents of this community (Curtis *et al*., 2017).

Findings from this study should be considered in light of its strengths and limitations. As far as we know, the CAMBRA tool had never been utilized in Ecuador before this study. CAMBRA has been shown to be a critical tool not only to educate the parents on caries risk factors but also to motivate and encourage them to develop self-management goals that will help them address potential caries risk factors with their children. Another strength of this tool is the ability to incorporate nondentist practitioners in caries prevention strategies. Allowing the medical staff to conduct motivational interviewing sessions with the parents, apply topical fluoride in children, or discuss nutrition issues with the parents and/or caregivers will promote a holistic approach to caries prevention and control.

Using CAMBRA, we were able to reveal the high burden of dental decay in the children of these three rural communities in Ecuador. Our findings bring to light areas for future research. Studies that assess the impact of socioeconomic and cultural factors on dental caries in these rural communities are needed

Figure 2: Visual dental examination using a mirror

Figure 3: Dentist using a headlamp in preparation for the oral examination

to improve the understanding of the root causes for dental caries risk. Since CAMBRA is a fairly new tool used as a protocol for caries management, more systematic reviews are needed to obtain a consensus on the protocol to be used for data collection, analysis, and reports of the findings. Finally, additional research is needed to assess whether utilizing the CAMBRA protocol contributes to long-term caries prevention.

This study was limited by several factors. This study utilized cross-sectional data, and therefore, causality cannot be inferred. Data were self-reported; therefore, they may be subject to recall and information (social desirability) bias. For example, we believe the children do not brush their teeth twice a day as reported based on the results of clinical examination. We were not able to collect saliva from children and their mothers and culture it for MS. Doing this, would have allowed us to show a stronger association between maternal and child salivary MS levels indicating that the mother's MS count could be an important risk indicator for early childhood caries development. A visual dental examination of the participants with the use of an explorer, a dental mirror, and a battery-powered headlamp [Figures 2 and 3] was conducted in community centers or school settings provided by the communities. This allowed us to briefly assess visible cavities and presence of white spot lesions, restorations, visible plaque, and signs of irritation, swelling, or bleeding. Conducting a more thorough dental examination using a dental office, X-rays, and a dental operating light would have allowed us to better visualize decay, especially on the interproximal surfaces.

The sample used in this study was one of convenience and was small; thus, the results of the study cannot be generalized as participation in this study was restricted to those living in these three rural communities in Ecuador.

Conclusion

The aim of this study was to understand the risk and protective factors that may have an impact on the oral health of schoolchildren (6–12 years) in three rural communities in Ecuador. Understanding how dental disease occurs and the role of the host, the agent, and the environment in the development of dental disease will allow Ecuadorian researchers and dental professionals to appreciate the application and use of a caries risk assessment tool in identifying the patient's relative risk for dental caries. This study provides first-hand evidence of the impact of multiple risks and protective factors on the oral health of children in Ecuador. Local providers and national health authorities should be motivated by the results of this study to establish mechanisms for addressing oral behaviors that can affect the health of the populations. Oral health campaigns should provide regular strategies to raise awareness about the most pressing issues in oral health in these communities. Ongoing education for adults and children about oral hygiene practices and application of fluoride varnish and sealants should be considered the pillars of a prevention and control strategy to improve the oral health in the communities. Training of dental and nondental providers on the use of CAMBRA and coordination between dental schools in Ecuador to provide "train-the-trainer" workshops in local communities will allow clinicians to reach successful outcomes in caries management. We hope the results of this study will offer Ecuadorian clinicians, researchers, and policymakers helpful information that will allow them to identify the level of risk of communities in terms of oral disease development so that they can alter their future preventive and treatment strategies with the goal of decreasing the rate of oral disease in Ecuador.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

References

1. What is the Burden of Oral Disease? World Health Organization; 2010. Available from: http://www.who.int/oral_health/disease_burden/global/en/. [Last accessed on 2018 July 5].
2. Anderson M. Risk assessment and epidemiology of dental caries: Review of the literature. Pediatr Dent 2002;24:377-85.
3. Lesson 1: Introduction to Epidemiology. Centers for Disease Control and Prevention. Centers for Disease Control and Prevention; 2012. Available from: https://www.cdc.gov/ophss/csels/dsepd/ss1978/lesson1/section8.html. [Last accessed on 2018 May 21].
4. Bowers T. The Challenge of Oral Disease. FDI World Dental Federation; 2015. Available from: http://www.myriadeditions.com/books/the-oral-health-atlas/. [Last accessed on 2018 May 21].
5. Berkowitz RJ, Jones P. Mouth-to-mouth transmission of the bacterium *Streptococcus mutans* between mother and child. Arch Oral Biol 1985;30:377-9.
6. National Health and Nutrition Examination Survey (NHANES).

United States Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics; 1999-2004. Available from: https://www.cdc.gov/nchs/nhanes/index.htm. [Last accessed on 2018 May 21].
7. Lagerweij MD, van Loveren C. Declining caries trends: Are we satisfied? Curr Oral Health Rep 2015;2:212-7.
8. Ehizele A, Ojehanon P, Akhionbare O. Nutrition and oral health. Benin J Postgrad Med 2009;11:76-81.
9. Curtis D, Ortega F, Monar J, Bay R, Eckhart S, Thompson P. Assessing self-reported oral health status of three Andean indigenous communities in Ecuador. J Int Oral Health 2017;9:207.
10. So M, Ellenikiotis YA, Husby HM, Paz CL, Seymour B, Sokal-Gutierrez K. Early childhood dental caries, mouth pain, and malnutrition in the Ecuadorian Amazon region. Int J Environ Res Public Health 2017;14. pii: E550.
11. Maheswari SU, Raja J, Kumar A, Seelan RG. Caries management by risk assessment: A review on current strategies for caries prevention and management. J Pharm Bioallied Sci 2015;7:S320-4.
12. Yoo SY, Park SJ, Jeong DK, Kim KW, Lim SH, Lee SH, *et al.* Isolation and characterization of the mutans streptococci from the dental plaques in Koreans. J Microbiol 2007;45:246-55.
13. Loesche WJ. Role of *Streptococcus mutans* in human dental decay. Microbiol Rev 1986;50:353-80.
14. Li Y, Caufield PW. The fidelity of initial acquisition of mutans streptococci by infants from their mothers. J Dent Res 1995;74:681-5.
15. Davey AL, Rogers AH. Multiple types of the bacterium *Streptococcus mutans* in the human mouth and their intra-family transmission. Arch Oral Biol 1984;29:453-60.
16. Wan AK, Seow WK, Purdie DM, Bird PS, Walsh LJ, Tudehope DI. Oral colonization of *Streptococcus mutans* in six-month-old predentate infants. J Dent Res 2001;80:2060-5.
17. Mattos-Graner RO, Li Y, Caufield PW, Duncan M, Smith DJ. Genotypic diversity of mutans streptococci in Brazilian nursery children suggests horizontal transmission. J Clin Microbiol 2001;39:2313-6.
18. Mitchell SC, Ruby JD, Moser S, Momeni S, Smith A, Osgood R, *et al.* Maternal transmission of mutans streptococci in severe-early childhood caries. Pediatr Dent 2009;31:193-201.
19. Susheela AK, Kumar A, Bhatnagar M, Bahadur R. Prevalence of endemic fluorosis with gastrointestinal manifestations in people living in some North-Indian villages. Flouride 1993;26:97-104.
20. Petersen PE, Lennon MA. Effective use of fluorides for the prevention of dental caries in the 21st century: The WHO approach. Community Dent Oral Epidemiol 2004;32:319-21.
21. American Academy of Pediatric Dentistry Foundation. The Dental Home: It's Never Too Early to Start. American Academy of Pediatric Foundation, Chicago. Available from: http://www.aapd.org/assets/1/7/DentalHomeNeverTooEarly.pdf. [Last accessed on 2018 May 21].
22. Damle SG, Yadav R, Garg S, Dhindsa A, Beniwal V, Loomba A, *et al.* Transmission of mutans streptococci in mother-child pairs. Indian J Med Res 2016;144:264-70.
23. Kulkarni GV, Chan KH, Sandham HJ. An investigation into the use of restriction endonuclease analysis for the study of transmission of mutans streptococci. J Dent Res 1989;68:1155-61.
24. Shetty K, Acharya B, Higgins M. Anticipatory guidance in pediatric oral health. Internet J Pediatr Neonatol 2006;6:1-11.
25. Ramos-Gomez FJ, Crystal YO, Ng MW, Crall JJ, Featherstone JD. Pediatric dental care: Prevention and management protocols based on caries risk assessment. J Calif Dent Assoc 2010;38:746-61.
26. Johansson I, Holgerson PL, Kressin NR, Nunn ME, Tanner AC. Snacking habits and caries in young children. Caries Res 2010;44:421-30.
27. Loesche WJ. Nutrition and dental decay in infants. Am J Clin Nutr 1985;41:423-35.