CRISTIANE MARIA DA COSTA SILVA

"STUDY OF DEMARCATED ENAMEL OPACITIES IN DECIDUOUS AND PERMANENT MOLARS"

"ESTUDO DE OPACIDADES DEMARCADAS DE ESMALTE EM MOLARES DECÍDUOS E PERMANENTES"

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Orientador: Prof. Dr. Fábio Luiz Mialhe

"*ESTUDO DE OPACIDADES DEMARCADAS DE ESMALTE EM MOLARES DECÍDUOS E PERMANENTES*"

Tese de doutorado apresentada ao Programa de Pós-graduação em Odontologia, da Faculdade de Odontologia de Piracicaba, da Universidade Estadual de Campinas, para obtenção do título de Doutora em Odontologia, na área de Saúde Coletiva.

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> O tempo e as jabuticabas. Rubem Alves

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"Já escrevi sobre uma surpresa que tive, faz muitos anos, numa manhã de frio intenso, vento forte e céu enfarruscado, que anunciavam que haveria neve pela tarde. As árvores sabiam disso e já estavam todas sem folha. Foi então que, caminhando pelo jardim que à tarde estaria todo branco, vi uma planta doida. Ela não ligava para a nevasca da tarde: um botão de flor preparava-se para abrir."

Quarto de badulaques. Rubem Alves

RESUMO

Os Defeitos de Desenvolvimento do Esmalte (DDE) são comuns tanto na dentição decídua quanto na permanente. Entre os dentes decíduos, a alta prevalência de opacidades demarcadas de esmalte em segundos molares levou pesquisadores a definir um termo próprio que os caracterizam: Molares Decíduos Hipomineralizados (DMH – sigla em inglês). A DMH é comparada à Hipomineralização Molar Incisivo (MIH – sigla em inglês) em vários aspectos e ambas têm sido citadas em estudos transversais como fatores fortemente associados à maior experiência de cárie entre dentes afetados. No entanto, a relação entre DDE e cárie pode sofrer influência de vários outros fatores, como características socioeconômicas da família, acesso a serviços de saúde e outras variáveis clínicas, ainda não analisadas até então. Assim, os objetivos desse trabalho, composto por 4 estudos, foram realizar uma revisão de literatura de forma a aprofundar o conhecimento sobre o assunto (capítulo 1); verificar de forma transversal a associação da DMH com variáveis socioeconômicas e cárie na dentição decídua (capítulo 2); verificar o impacto da DMH e outros fatores clínicos, socioeconômicos e comportamentais, no desenvolvimento de novas lesões de cárie em segundos molares decíduos (capítulo 3) e por fim, verificar de forma longitudinal, a associação da MIH com a cárie dentária em primeiros molares permanentes recém-irrompidos (capítulo 4). Para alcançar os objetivos 2-4, , crianças de 4 a 6 anos foram examinadas clinicamente em ambiente escolar, a cada seis meses, pelo período de dois anos. Todos os exames seguiram as recomendações da Organização Mundial da Saúde para levantamentos epidemiológicos em saúde bucal. Os pais responderam ao questionário socioeconômico, de hábitos e cuidados com as crianças, os dois últimos especialmente desenvolvidos para esta pesquisa. Os dados foram tabulados e a estatística realizada no programa SAS. Pela revisão de literatura (estudo 1), ficou claro que além do conhecimento técnico, o profissional deve estar preparado para lidar com as necessidades sociais e psicológicas de cada criança, a fim de proporcionar uma qualidade de cuidado mais satisfatória. No estudo 2, foi verificado uma prevalência alta de DMH (22,2% das crianças apresentaram pelo menos um segundo molar decíduo afetado) . Após

aplicar análises bivariadas e de regressão logística observou-se que as crianças com DMH apresentaram maior prevalência de cárie quando comparadas ao grupo sem DMH (p = 0,0061; OR ajustado 2,28; IC[1,04-4,98]). No estudo 3, a relação prospectiva entre DMH e cárie na dentição decídua, foi analisada por meio do modelo hierárquico *stepwise muliple Generalised Estimating Equation* (GEE). Os resultados não demonstraram haver associação entre o defeito de esmalte e o incremento de cárie (ceos) em segundos molares decíduos. No entanto, fatores como escolaridade materna e presença de placa visível, estiveram positivamente associados ao incremento de cárie após dois anos de avaliação. A estatística GEE também foi realizada para verificar os fatores de risco para a cárie em primeiros molares permanentes recém-irrompidos e foi verificado que a MIH e a presença da placa visível em dentes anteriores esteve associada ao incremento de cárie após dois anos de avaliação. Assim, os resultados desta tese demonstraram haver fatores confundidores envolvidos na relação entre DDE e cárie dentária.

Palavras-chaves: epidemiologia, esmalte dentário, cárie dentária, hipomineralização dentária

ABSTRACT

Developmental defects of enamel (DDE) are common in both deciduous and permanent dentition. The high prevalence of DDE among deciduous teeth led researchers to define it with an appropriate term: deciduous molar hypomineralization (DMH). It is compared to Molar Incisor Hypomineralization (MIH) in many aspects and both have been cited in cross-sectional studies as risk factors to the development of caries in affected teeth. However, the relationship between DDEs and dental caries may be under influence of other factors, such as socio-economic status, access to health services and other not yet analyzed. Thus the aims of the present three population-based studies were to review the current literature in order to deeper the knowledge about the theme (chapter 1), to verify the association of DMH with socio-economic variables and deciduous teeth decays by cross-sectional analysis (chapter 2), to address the impact of DMH and other clinical, socio-economic and behavioral factors on the development of new caries lesions on the surface of primary second molar (chapter 3); and to assess from a longitudinally way, the association of MIH with dental caries in permanent first molars (Chapter 4). Children aged from 4 to 6 years old were clinically examined at school, every six months, for two years, after their parents have signed the free informed term of consent, according to our Research Ethics Comittee. This was done to reach chapters 2 to 4. All the exams followed the World Health Organization (WHO) guidelines to epidemiological surveys. Children's parents have answered the socio-economic, children habits and child care questionnaires, both last specially developed to this study. Then the data were tabulated and statistically analyzed by SAS Software. According to the literature review (study 1), it was clear that besides technical knowledge, the professional must be prepared to deal with the social and psychological needs of each child. The second study identified a high prevalence of DMH (22.2% of children presented at least one affected primary second molar). Bivariate and logistic regression tests indicated that children with DMH had a higher prevalence of dental caries when compared to the group without DMH (p = 0.0061; OR adjusted 2.28; IC[1.04-4.98]). The third study showed no association between enamel defects and caries

increment (dmfs) in primary second molar. For this result, prospective relations between DMH and deciduous teeth caries were analyzed based on the hierarchical model stepwise multiple Generalised Estimating Equation (GEE). On the other hand, factors such as maternal level of education and maternal perception, besides the presence of visible dental plaque, have been associated to the caries increment after two years of evaluation. The statistical GEE was also performed to verify the risk factors for caries in permanent first molars. It was found that the presence of MIH and visible plaque on anterior teeth was associated with caries increment after two years of evaluation. So the results of this thesis have demonstrated that there are confounder factors involved in the relationship DDE and dental caries.

Key-words: epidemiology, dental enamel, tooth hypomineralization, dental caries

SUMÁRIO

INTRODUÇÃO

O esmalte dentário é um tecido que, uma vez formado, não sofre remodelação como outros tecidos do corpo humano, pois os ameloblastos, células responsáveis pela sua formação, são incapazes de sofrer regeneração (Glavind & Zander, 1970; Nanci & Smith, 2000). Em função dessa característica, qualquer alteração durante seu processo de formação é permanentemente registrada em sua superfície, caracterizando os defeitos de desenvolvimento do esmalte (DDEs). Os DDEs são divididos em duas principais categorias, hipolasias e hipomineralizações (Suckling, 1989; Suga, 1989; FDI, 1992). As hipoplasias referem-se a defeitos quantitativos resultantes de injúrias que ocorrem na fase secretória da amelogênese, visualizadas clinicamente por meio de diminuição na espessura do esmalte afetado. Já as hipomineralizações, ou defeitos qualitativos, visualizadas clinicamente como opacidades, são decorrentes de injúrias que ocorrem na fase de maturação da matriz orgânica do esmalte (Suckling, 1989; Suga, 1989; FDI, 1992). A figura 1 apresenta exemplos de características clínicas de defeitos hipoplásicos e hipomineralizados.

Figura 1 A. Defeitos de esmalte hipoplásicos em face vestibular dos dentes 32 e 33. Note as bordas arredondadas e a menor espessura no tecido afetado. Criança RBL, 09 anos, gênero masculino. FONTE: Costa-Silva, 2010.

Figura 1B. Opacidade demarcada de esmalte em incisivo permanente (42). Note a demarcação nítida entre tecido hígido e afetado. Criança LRS, 10 anos, gênero masculino. FONTE: Costa Silva, 2012.

DDEs são comuns tanto na dentição decídua quanto na permanente (Staylon *et al.*, 2001; Calderara *et al.*, 2005; Hoffmann *et al.*, 2007; Elfrink *et al.*, 2008; Elfrink *et al.*, 2010; Costa-Silva *et al.*, 2010) e sua prevalência varia consideravelmente no mundo dependendo da população estudada e dos métodos de diagnósticos empregados (Hoffmann *et al.*, 2007; Elfrink et al, 2008; Costa-Silva *et al.*, 2010). Na dentição decídua, por exemplo, Lunardelli & Peres (2005), avaliaram crianças catarinenses com faixa etária entre 3 a 5 anos de idade e observaram que 6,1% destas apresentavam opacidades demarcadas. Estes resultados se aproximam dos encontrados por Elfrink *et al.*(2010) e Ghanim *et al.* (2012) que observaram prevalência de 4,6% de opacidades demarcadas entre crianças holandesas de 5 anos e 6,6% de opacidades demarcadas entre as iraquianas, respectivamente. No entanto, observa-se que prevalência bem superior foi encontrada no Estado de São Paulo (Hoffmann *et al.*, 2007) onde mais de 20% de crianças com 5 anos de idade, apresentaram defeitos de esmalte. Para a dentição permanente esta discrepância parece ser ainda maior, sendo observadas hipomineralizações em primeiros molares e incisivos permanentes em 2,8% de um grupo de crianças chinesas de 11 a 14 anos (Cho *et al.*, 2008), até mais de 40% entre crianças de 7 a 13 anos, no Estado do Rio de Janeiro (Soviero *et al.*, 2009).

Entre os dentes decíduos, os segundos molares são reportados como um dos dentes mais afetados pelos DDEs (Seow, 1997; Staylon *et al.*, 2001;Lunardelli & Peres, 2005) sendo as opacidades demarcadas um achado comum (Staylon *et al.*, 2001; Seow, 1997). Segundos molares decíduos que apresentam opacidades demarcadas de esmalte, foram recentemente denominados como molares decíduos hipomineralizados (DMH – sigla em inglês) (Elfrink *et al.*, 2008). Da mesma forma, opacidades demarcadas em primeiros molares e incisivos permanentes, frequentemente encontradas entre crianças de diversas partes do mundo (Koch *et al.*, 1987; van Amerogen et al, 1995; Alaluusua *et al.*, 1996; Jälevik *et al.*, 2001; Leppäniemi et al, 2001; Preusser *et al.*, 2007; Cho *et al.*, 2008; Soviero *et al.*, 2009; Costa-Silva, 2010) foram denominadas em 2001, por Hipomineralização Molar Incisivo (MIH – sigla em inglês) (Weerheijm *et al.* 2001).

A MIH tem chamado a atenção de clínicos e pesquisadores em todo o mundo, principalmente pelas suas consequências clínicas, como grandes destruições coronárias (Jälevik & Möller, 2007; Weerheijm *et al.* 2001) decorrentes da fragilidade estrutural do tecido hipomineralizado (Jälevik *et al.*, 2001; Mahoney *et al.*, 2004a; Mahoney *et al.*, 2004b; Xie *et al.*, 2007; Xie *et al.*, 2008) além de maior propensão ao desenvolvimento de cárie dentária entre as crianças afetadas (Leppäniemi *et al.*, 2001; Jälevik & klingberg, 2002; Preusser *et al.*, 2007; Costa-Silva *et al.*, 2010). Outras características dos dentes afetados por MIH referem-se a maior sensibilidade dentária (Rood et al, 2007), além de necessidades de tratamentos extensos e recorrentes (Jälevik & klingberg, 2002; Jälevik *et al.*, 2005; Williams *et al.*, 2006).

Nota-se que frequentemente os DDEs estão associados à maior experiência de cárie dentária, em ambas as dentições (Leppäniemi *et al.*, 2001; Ribeiro *et al.*, 2005; Oliveira *et al.*, 2006; Preusser *et al.*, 2007; Hoffmann *et al.*, 2007; Costa-Silva *et al.*, 2010; Elfrink *et al.*, 2010). Para a dentição decídua, existe forte evidencia de que as hipoplasias de esmalte representam maior risco para o desenvolvimento de cárie do que a própria amamentação noturna e hábitos de higiene oral da criança (Oliveira *et al.*, 2006). No entanto, a relação entre defeitos qualitativos de esmalte e cárie dentária ainda apresenta resultados conflituosos na literatura (Costa-Silva *et al.*, 2010; Preusser *et al.*, 2007; Leppaniemi *et al,* 2001; Heitmuller *et al.*, 2012), o que sugere o desenvolvimento de estudos prospectivos que avaliem esta questão.

Supõe-se que a presença de DDEs poderia ser umas das explicações para as desigualdades encontradas na distribuição da cárie dentária (Oliveira *et al.*, 2006), visto que os dois problemas bucais são mais encontrados em populações menos favorecidas socioeconomicamente (Rugg-Gunn *et al.*, 1997; Rugg-Gunn *et al.*, 1998; Massoni *et al.*, 2007) e encontram-se intimamente relacionados (Oliveira *et al.*, 2006).

Observa-se que, além de maior experiência de cárie, as crianças com hipomineralizações de esmalte são frequentemente expostas a tratamentos clínicos repetitivos nos dentes acometidos (Jälevik & Klingberg, 2002; Williams *et al.*, 2006),

decorrentes não só da fragilidade estrutural do tecido afetado (Jälevik *et al.*, 2001; Mahoney *et al.*, 2004a; Mahoney *et al.*, 2004b; Xie *et al.*, 2007; Xie *et al.*, 2008), como também da dificuldade por parte dos profissionais em propiciar terapia restauradora adequada (Jälevik & Klingberg, 2002; Williams *et al.*, 2006). Esta maior necessidade de retratamentos faz com que a criança com dentes hipomineralizados corra maior risco de entrar no ciclo restaurador repetitivo (Elderton, 1997) que além de prejuízos funcionais e psicológicos, como medo e ansiedade (Jälevik & Klingberg, 2002), em um país com marcadas desigualdades na distribuição de doenças e do acesso aos serviços de saúde (Antunes *et al.*, 2004; Antunes *et al.*, 2006), implica em um desafio para o planejamento e organização dos serviços.

Algumas características em comum entre a MIH e DMH podem ser destacadas, como a distribuição assimétrica pela dentição e a presença de perdas estruturais pós-irruptivas (Elfrink *et al.*, 2008; Weerheijm et al, 2001). Além disso, verificou-se em estudos recentes, que crianças com opacidades demarcadas em segundos molares decíduos apresentam maior chance de apresentarem MIH na dentição permanente (Costa-Silva, 2010; Elfrink *et al.*, 2012). Os mesmos fatores etiológicos são relatados para os dois defeitos de esmalte (Li *et al.*, 1995; Aine *et al.*, 2000; Jälevik *et al.*, 2001; Staylon *et al.*, 2001; Lunardelli & Peres, 2005; Kuscu *et al.*, 2008; Whatling & Fearne, 2008; Combrie *et al*., 2009). Injúrias que ocorrem no final da gestação até o segundo ano de vida das crianças, época em que ocorre a mineralização das coroas dentárias dos segundos molares decíduos e a formação das coroas dos primeiros molares permanentes (Moorres *et al.*, 1969), podem afetar ambas as dentições, resultando em defeitos de esmalte similares (Aine *et al.*, 2000; Elfrink *et al.*, 2012).

Alguns estudos transversais verificaram maior prevalência de DDEs e cárie em populações menos favorecidas socioeconomicamente (Oliveira *et al.*, 2006; Rugg-Gunn *et al.*, 1997; Rugg-Gunn *et al.*, 1998; Massoni *et al.*, 2007), não sendo possível descartar a influência de fatores socioeconômicos na incidência dos mesmos. Os fatores socioeconômicos (FSE) não seriam, com certeza, fatores causais diretos dos DDEs e da

cárie dentária. Entretanto, estes apresentam alto poder discriminatório, visto que crianças pertencentes a famílias com diferentes níveis socioeconômicos apresentam diferenças importantes nos indicadores de saúde, inclusive para as doenças bucais. Uma das possíveis explicações para a associação entre fatores socioeconômicos e DDEs seria, por exemplo, decorrente da maior incidência de carências nutricionais e baixo peso ao nascer observada em populações carentes (Spencer *et al.*, 1999; Assis *et al.*, 2007). A desnutrição durante a primeira infância interfere no desenvolvimento de todo o organismo humano, incluindo o esmalte dentário (Agarwal *et al.*, 2003; Massoni *et al.*, 2007). Outra hipótese que permite supor que haja uma associação entre DDEs e FSE seria a maior dificuldade de acesso aos bens e serviços de saúde por parte das pessoas pertencentes a baixos estratos sociais (Gabardo *et al.*, 2008). Por exemplo, o não acesso à água tratada fluorada pode ter como consequência para o esmalte hipomineralizado, a maior propensão a perdas estruturais pós-irruptivas, decorrentes de sua fragilidade mecânica (Mahoney *et al.*, 2004a; Mahoney *et al.*, 2004b; Xie *et al.*, 2007; Xie *et al.*, 2008) o que facilitaria o desenvolvimento da cárie.

Outra variável socioeconômica, destacada em diversos estudos epidemiológicos de saúde bucal, é a escolaridade (Chu *et al.*, 1999; Dini *et al.*, 2000; Gonçalves *et al.*, 2002;Peres *et al.*, 2003; Brandão *et al.*, 2006; Ferreira *et al.*, 2007; Oliveira *et al.*, 2008). A educação escolar dos pais (pai e mãe) tem sido associada à experiência de cárie entre crianças, onde se observa nível mais alto da doença entre aquelas cujos pais apresentam baixa escolaridade (Chu *et al.*, 1999; Dini *et al.*, 2000; Gonçalves *et al.*, 2002; Peres *et al.*, 2003; Brandão *et al.*, 2006; Ferreira *et al.*, 2007; Oliveira *et al.*, 2008). O papel da educação dos pais nos indicadores de saúde ainda não está bem explicado, mas a escolaridade pode dar acesso à determinada ocupação e consequentemente, a um determinado nível de renda e por isso pode influenciar o acesso e o desenvolvimento de diferentes condutas relacionadas à saúde (Gonçalves *et al.*, 2002). Além disso, mães com menos tempo de educação formal tendem a valorizar menos a dentição decídua, onde a

informação e o conhecimento em saúde parecem exercer importante papel (Chu *et al.*, 1999).

Observa-se que o acesso aos serviços de saúde, assim como o maior discernimento quanto a real necessidade de tratamento da criança é proporcional ao nível de escolaridade dos pais (Travassos *et al.*, 2003; Ribeiro *et al.*, 2006; Noro *et al.*, 2008).Tal fato pode explicar a maior incidência de cárie entre as crianças, tanto na dentição decídua quanto na permanente, cujos pais apresentam baixa escolaridade (Leroy *et al.*, 2005a; Leroy *et al.*, 2005b). No caso específico dos DDEs, a escolaridade dos pais pode interferir na busca por tratamento de suas sequelas, como perdas estruturais pós-irruptivas e até mesmo da cárie dentária, que se desenvolve com maior facilidade sobre o esmalte hipomineralizado, que devido a sua maior porosidade e estrutura desorganizada (Jälevik *et al.*, 2005), se torna mais suscetível à desminarelização (Sukling *et al.*, 1987).

Assim, observa-se que vários fatores podem atuar como confundidores na relação entre DDEs e cárie dentária. Entretanto, muitas destas suposições e associações são oriundas de estudos transversais, não existindo, até o momento, estudos prospectivos que as confirmem. Assim o presente estudo teve como objetivos: 1. Realizar uma revisão de literatura sobre o assunto; 2. Verificar de forma transversal a associação da DMH com a cárie dentária na dentição decídua; 3. Verificar de forma longitudinal a associação da DMH com incremento de cárie nos segundos molares decíduos entre crianças com 4 a 6 anos e 4. Verificar de forma longitudinal a relação entre MIH e cárie em primeiros molares permanentes de crianças inicialmente de 5-6 anos do município de Botelhos, Minas Gerais, Brasil.

CAPÍTULO 1[1]

HIPOMINERALIZAÇÃO MOLAR-INCISIVO: CONSIDERAÇÕES PARA O MANEJO CLÍNICO EM ODONTOPEDIATRIA

Molar-incisor hypomineralization: considerations for clinical management in dental care for children

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Resumo

Introdução: Clinicamente visualizada como opacidades demarcadas em primeiros molares e incisivos permanentes, a Hipomineralização Molar-Incisivo (HMI) representa um desafio clínico para profissionais da odontologia. Histologicamente, estas opacidades apresentam-se porosas, tornando o esmalte afetado menos resistente à cárie e às forças mecânicas da mastigação. Consequentemente, crianças com este defeito de esmalte podem apresentar necessidades de tratamentos restauradores recorrentes e em geral, mais complexos, o que aumenta a ansiedade das mesmas perante o atendimento odntológico. Além disso, quando presentes em incisivos, tais defeitos podem causar prejuízos psicológicos e sociais às crianças portadoras. **Objetivo:** A partir de uma revisão da literatura e apresentação de casos clínicos, este artigo discute sobre os defeitos de desenvolvimento do esmalte (DDE), com ênfase na HMI, a fim de proporcionar ao profissional, base teórico-conceitual para que este ofereça um cuidado mais adequado às crianças com esta alteração de esmalte. **Conclusão:** O manejo dos dentes com HMI pode envolver desde o diagnóstico precoce, à extração dentária e acompanhamento ortodôntico nos casos mais severos. As crianças portadoras deste defeito, bem como suas famílias, devem receber atenção especial por parte do profissional e serem orientadas quanto aos necessários cuidados bucais e prognósticos de cada caso. Por isso, é necessário que além do conhecimento técnico, o profissional esteja preparado para lidar com as necessidades sociais e psicológicas de cada criança, a fim de proporcionar uma qualidade de cuidado mais satisfatória.

Descritores: esmalte dentário, hipomineralização molar-incisivo, cuidados bucais para crianças

Abstract

Introduction: Clinically seen as demarcated opacities in permanent first molars and incisors, Molar-Incisor Hypomineralization (MIH) is a clinical challenge to dental professionals. Histologically, these opacities are shown to be porous, making the affected tooth enamel less resistant to the mechanical forces of mastication. Consequently, children with this enamel defect may require more frequent and often more complex restorative treatments, which increases their anxiety before treatment begins. Furthermore, when present in incisors, these defects may damage children's psychological and social development. Based on a literature review, this article discusses the developmental defects of enamel (DDE), with emphasis on MIH. **Aim:** The purpose is to provide professionals with a theoretical and conceptual basis that will enable them to provide more appropriate care that takes into consideration not only the clinical needs of affected children, but their psychological and social needs as well. **Conclusions:** The management of teeth with MIH may involve stages ranging from early diagnosis through to tooth extraction and orthodontic follow-up in more severe cases. Children with this defect, and their families, should receive special care and guidance about the necessary oral care and prognosis of each case. Therefore, in addition to technical knowledge, it is necessary for the professional to be prepared to deal with the psychological and social needs of each child, to provide a more satisfactory quality of dental care.

Key Words: dental enamel, molar-incisor hypomineralization, dental care for children.

Introduction

The clinical management of developmental defects of enamel (DDEs) is a challenge for dental professionals worldwide. For example, enamel hypoplasia may facilitate the caries process, as a result of greater plaque accumulation on their surfaces (1,2). In addition hypomineralization may cause rapid coronal destruction by mechanical forces, due to the structural weakness of the affected enamel (3-6).

Among the DDEs, the scientific literature has pointed out "Molar Incisor Hypomineralization" (MIH) (3), as a result of its high prevalence in the child population, severe clinical consequences for affected children, in addition to the difficulty of professionals find with its treatment (1,3,6-8).

It is a fact that children with MIH present more frequent and more complex dental treatment needs when compared with those who have normal tooth enamel (9-11). As it is more porous and less resistant (4,12), the hypomineralized enamel facilitates the entry of bacteria into the subjacent dentin (13), resulting in a constant state of pulp inflammation (14) which causes discomfort on mechanical manipulation of the affected tooth (3,7). In some more severe cases, this hypersensitivity may also make it difficult to achieve efficient dental anesthesia, contributing to an increase in anxiety in children when they are faced with the prospect of dental treatment (11). Moreover, when present in incisors, these defects may cause the affected children psychological and social harm (16).

Therefore, the aim of this article is, by means of a review of the literature, to discuss DDEs, with emphasis on MIH, in order to provide professionals with theoretical-conceptual bases so that they are able to offer more adequate care, which considers not only the clinical needs of affected children, but their psychological and social characteristics.

Review of the literature and discussion

A brief review about the process of dental enamel formation and the developmental defects of enamel

Tooth enamel is a tissue of epithelial origin, incapable of being regenerated after its formation. As a result of this characteristics, injuries that occur during the period of formation are permanently recorded on its surface (17,18), characterizing the DDE.

Didactically, the process of enamel formation, or amelogenesis, is divided into two main phases. The first phase, denominated the secretion phase, is when the organic matrix deposition of enamel by the ameloblasts occurs, cells responsible for its production. The matrix is deposited in layers throughout the entire thickness of the future enamel, and alterations that occur during this phase result in quantitative defects or hypoplasia (18), clinically visualized by the reduced thickness of the affected enamel.

The second and longer phase of amelogenesis is the maturation of the organic matrix. At this time, the ameloblasts modulate and transport ions necessary for the growing mineralization of the tissue. Alterations that occur during this phase result in a tissue with a large quantity of organic matter and lower mechanical resistance than normal enamel, configuring the qualitative defects or hypomineralization (18). These defects are clinically visualized by means of alterations in translucence of the affected enamel, or opacities, which may be diffused, characteristic of fluorosis, or demarcated (17,18). Figure 1 shows the clinical characteristics of the DDEs presented (Figure 1).

Molar Incisor Hypomineralization

Hypomineralization or demarcated opacities of enamel are common in the permanent teeth of children and adolescents all over the world (19-21). When these are present in permanent first molars, either associated with affected permanent incisors, or not, these defects are denominated Molar Incisor Hypomineralization (MIH) (3).

In 2003, the European Academy of Pediatric Dentistry published the diagnostic criteria of MIH, in which atypical restorations that involved the free surfaces generally not affected by caries, would also be comprised within this classification (22). Moreover, in spite of the low number studies, characteristic enamel defects may also be found in primary second molars (23-25).

It has been recognized that MIH is of systemic origin, resulting from problems such as prematurity, low birth weight and infections during early childhood (3, 26), the cause of the problem remains unknown (27). It is known, however, that injuries to the ameloblasts occur during the maturation phase of enamel (3).

The opacities of MIH range from white to yellow-brown. This variation in color is related to the histological aspect of the lesion, as darker opacities present more intense porosity (12). Furthermore, there is also a correlation between the clinical appearance of the lesion and mineral density, as the darker opacities are less resistance and contain a lower mineral content in comparison with the lighter types (29). Dark demarcated opacities also have less mechanical resistance (29) resulting in more extensive structural losses after eruption of the affected tooth (19). Whereas, the lighter opacities generally have a covering of well mineralized enamel (12), and present a lower incidence of post-eruptive structural loss (29).

Frequently post-eruptive structural losses are progressive, and may result in extensive coronal destruction (29, 30). Hypomineralized enamel presents a reduction in its modulus of elasticity, with regard to its resistance to abrasion (4). These structural losses may occur due to fracture of the hypomineralized enamel, as a result of its structural weakness or wear of the most affected tissue. Studies have demonstrated that hypomineralized enamel undergoes greater dental abrasion as a result of brushing (31) and that structural microlosses may be present, even when they are not clinically visible, leaving the tissue superficially rough (19).

As the MIH lesions are most concentrated on the middle and occlusal thirds of tooth crowns (12), the localization of this lesion may also be a fact that contributes to structural losses of enamel after tooth eruption (29), as the occlusal surface of molars present the highest incidence of masticatory forces when compared with the free surfaces of incisors, for example (7). Figure 2 shows and example of post-eruption structural loss progression in a hypomineralized tooth.

Clinical Management of MIH

As has been affirmed, laboratory studies have demonstrated that in addition to greater porosity, hypomineralized enamel has less mineral density, thinner and more irregular prisms, and lower mechanical resistance (4,12). All these characteristics added to masticatory force contribute to post-eruptive structural losses being common in teeth affected by MIH (19,29,30). This appears to be the main fact responsible for the difficulty in obtaining satisfactory results in the restoration of affected teeth (10,32).

Dealing with the structural losses of MIH is a clinical challenge, as these losses may contribute to plaque accumulation and consequent development of dental caries, a growing cause for concern. Nevertheless, in addition to structural losses that may create niches for bacterial retention, the affected teeth are hypersensitive to mechanical manipulation, probably as a result of the constant state of pulp inflammation found in the teeth (14), which makes it difficult to clean them (3,7,26). Another clinical concern is the esthetic problems generated when the permanent incisors present demarcated opacities, which may harm the self-esteem and social life of children with MIH (16).

All of these characteristics of MIH lesions have led to a great variety of treatments being proposed. Nevertheless, the choice of the best treatment for teeth affected by MIH includes, among other factors, the severity of the lesion. Although no single criterion has yet been arrived at for the classification of severity, some authors have suggested that MIH lesions must be divided into light or severe (6), according to their clinical characteristics such as structural loss, in conjunction with other subjective considerations, such as the patient's sensitivity to management of the affected tooth (33). According to the Guideline for the clinical treatment of MIH of the European Academy of Pediatric Dentistry (6), lesions that present demarcated opacities only, free of sensitivity, must be treated as slight lesions and receive only preventive treatment. Whereas lesions that present structural losses and/or sensitivity, deserve special treatment, which begins with prevention, restorative treatments and in more severe cases, going as far as extraction

and orthodontic follow-up at an opportune time. Examples of mild and severe MIH are shown in Figure 3.

However, in severe cases, the affected teeth must be kept in the oral cavity with the minimum sensitivity and structural compromise possible, until they are definitively restored, or even until they can be extracted (34). But how can these teeth be maintained in the oral cavity in such a way that they do not interfere in the child's quality of life? This question emphasizes the need for a holistic approach to the patient, considering not only his/her clinical needs, but his/her psychological and social characteristics as well, which includes making the family aware of these needs and having their cooperation during treatment.

Early diagnosis of MIH, prevention of caries and post-eruptive structural losses

Early diagnosis is particularly important, because when there is presence of a demarcated opacity in a primary molar that is still erupting, the dentist must be alert to the possibility of the involvement of incisors and other first molars. In the same way, the presence of a demarcated opacity in a permanent incisor may be an indication of MIH and the professional must be alert to these characteristics. Thus, the child must be monitored constantly until the four permanent first molars have completely erupted.

Another important aspect for successful dental treatment is to make the parents aware of the problem. It has been well explained in the literature that children with MIH have a higher incidence of caries, greater and repeated dental treatment needs, hypersensitivity to manipulation, even when the enamel is visually intact (3,9). All these characteristics are important at the time of providing the parents/guardians with guidance. Counseling on diet and some attitudes, such as the parents' help during tooth brushing and the use of fluoridated toothpastes, may also help to prevent caries and reinforce the tooth structure. Simple measures, such as the use of warm water during brushing, are important for the reduction of sensitivity, and also help to promote better control of plaque and consequently, of dental caries(34).

Another intriguing question is related to the use of resin-based fissure sealants, considering that hypomineralized enamel is resistant to acid etching as a result of its high protein content (28,34). However, resin sealants applied after the use of 5th generation adhesives appear to have better retention to hypomineralized enamel (36). There is also the possibility of the use of glass ionomer cement to protect the fissures in affected teeth, thus allowing asymptomatic preservation (34). Small lesions, even with superficial structural losses limited to enamel may also be rehabilitated in this manner.

The use of other sources of fluoride, such as the application of concentrated fluoridated varnishes, may help with the mineralization process and reinforce the tooth structure, particularly in recently-erupted teeth, which are more susceptible to caries and structural losses (3). Another product that has been tested is calcium-phosphate casein, which has been shown to be effective, not only in the remineralization of the deeper layers of white spot caries, but also in increasing the phosphorous and calcium levels in MIH, which contributed to structural reinforcement and reduction in dentinal sensitivity (37). These treatment modalities must be preferred instead of the use of more invasive measures, such as metal crowns or extractions.

Restorative Treatment

Restorative treatment is recommended in the case of more severe structural loss, with dentinal exposure or the development of carious lesion in the affected tissue. Nevertheless, it is necessary to consider two main questions: the patient's sensitivity to manipulation, as well as under the effect of anesthesia, and the feasibility of maintaining the tooth in the oral cavity.

The dentist must be prepared for the difficulties encountered during the manipulation of affected teeth, such as hypersensitivity and the difficulty in providing the correct anesthesia. In addition, it may be necessary to perform extensive restorative interventions, constant re-treatments due to failures in the restorations, or even

endodontic treatment, and placement of prosthetic crowns, overloading the child emotionally and leading to behavioral problems during dental treatment (9).

The interference of the opacities in permanent incisors in the social life of affected children must also be considered, because even if they do not present structural losses or sensitivity, these teeth may harm their quality of life. In these cases, interventions such as microabrasion and/or esthetic restoration with resin composite are recommended.

With regard to the restorative material, the professional should prefer adhesive materials to amalgam, because of its poor performance in the restoration of teeth with MIH (10). The use of glass ionomer cement is recommended, particularly as an intermediate restoration in a tooth still at the stage of eruption, and which may remain as a future base for adhesive restorations.

The performance of adhesive restorations seems to be the best found up to now, compared with other restorative materials (10,38). Nevertheless, one must consider that when the restoration margins are in hypomineralized enamel, there is greater possibility of future structural losses and marginal leakage, due to the low mechanical resistance and the low bond strength to this tissue (35). Therefore, it is still necessary to conduct longitudinal studies with reference to the durability of these restorations with regard to cavity preparation (5,6), in order to opt between whether or not to remove all the hypomineralized enamel.

Whereas, metal crowns must be applied to teeth in which there is not sufficient dental structure to support a conventional restoration (6).

Extraction and orthodontic treatment

The extraction of teeth with MIH and orthodontic follow-up may be a feasible alternative when the tooth is severely affected. Some authors have demonstrated that the extraction of affected molars in the correct period would not cause serious occlusal problems, and in some cases, would be the best alternative (39,40). This period varies according to the formation of the second permanent molars and good results have been

found, also with the spontaneous closure of the space and establishment of acceptable occlusion (39,40).

Final considerations

After considering all the characteristics of MIH presented, the conclusion was reached that the management of teeth with MIH could involve procedures ranging from early diagnosis through to tooth extraction and orthodontic follow-up in more severe cases. Both children and their families must receive special attention and be guided with regard to the oral care required and the prognosis of each case. Therefore, in addition to technical knowledge, it is necessary for the professional to be prepared to deal with the social and psychological needs of each patient, in order to provide a more satisfactory quality of care.

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Figure 1. Examples of developmental defects of enamel. In A. Enamel Hypoplasia in mandibular central incisors (31 and 41) in a 7-year-old child. Note the rounded edges and less thickness of the affected tissue. In B. Tooth enamel fluorosis in a permanent first molar (26) in a 7-year-old child. Note absence of clear limits between healthy and affected tissue, in which it is possible to observe fine spaced lines in the mesial to distal direction, with small groups. In C. Demarcated enamel opacity in a permanent incisor (32) of a 6-year-old child. Note the clear demarcation between healthy and affected tissue. Source: Costa-Silva, 2012.

Figure 2 – In A: MIH defect in a permanent mandibular first molar (36) with the beginning of structural loss of the affected tissue, in a child initially 6 years old. At a smaller size, the permanent incisors of the same child, demonstrating the presence of demarcated opacities in these teeth (11 and 31). In B: the same tooth (36), 18 months after the first exam, presenting more accentuated tissue loss. Source: Costa-Silva, 2012

Figure 3. Examples of MIH severity. In 3A, one notes the opacity demarcated on the vestibular surface of tooth 46 in a 7-year-old child, without pain symptoms. In 3B a severe case of MIH in a 7-year-old child is presented, with structural loss and dental caries, in which there was sensitivity to manipulation. Not the plaque accumulation on the lesion, due to the child's difficulty in performing oral hygiene. Source: Costa-Silva, 2012

Figure 1.

Figure 2.

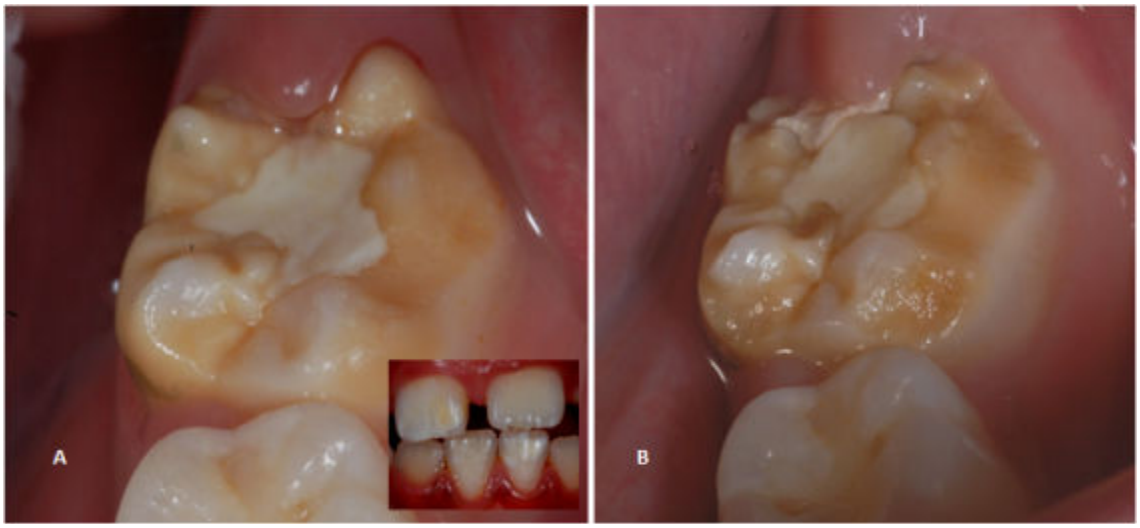
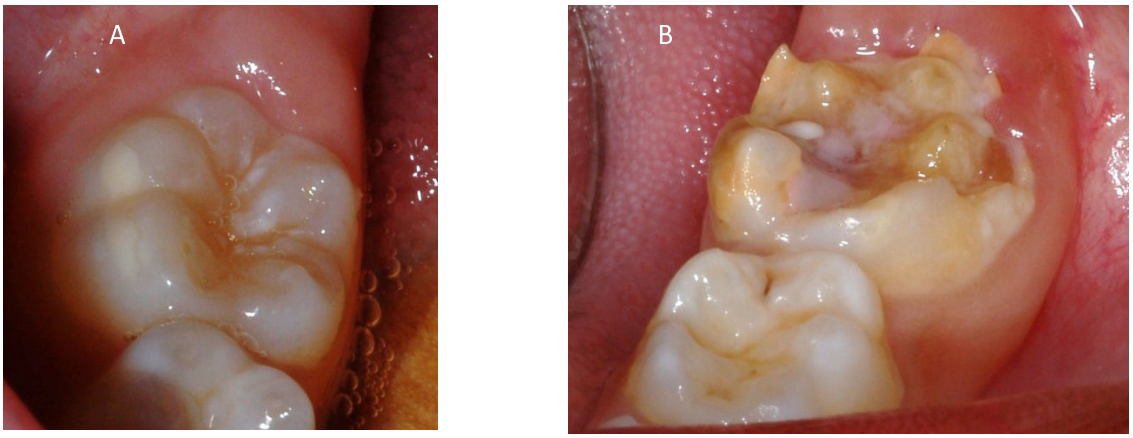


Figure 3.



CAPÍTULO 2[2]

PREVALENCE OF DEMARCATED ENAMEL HYPOMINERALIZATION IN DECIDUOUS TEETH AMONG CHILDREN AGED 4-6 YEARS FROM BOTELHOS, MINAS GERAIS, BRAZIL

Short title: Demarcated hypomineralization in deciduous teeth

Key words: children, epidemiology, dental caries, enamel hypomineralization

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Abstract:

Background: Deciduous Molar Hypomineralisation (DMH) was the denomination suggested to describe the presence of demarcated enamel hypomineralisation in second primary molars. DMH has been compared with Molar Incisor Hypomineralisation (MIH) as regards its clinical appearance and consequences, but there are no reports about the prevalence of DMH among Brazilian children. **Aim:** to determine the prevalence of DMH among Brazilian children and verify the association of these defects with demographic factors and dental caries in deciduous teeth. **Methodology:** This was a cross sectional population based study that comprised 216 children, aged 4-6 years old, from public school in Botelhos, Brazil. Children with all second primary molars erupted were eligible for participation. Clinical examination was performed by one calibrated examiner. DMH was recorded according to modified EAPD criteria for MIH. Chi-square test and Logistic Regression Model were used to adjust the results for effects of covariates **Results:** Among the 216 children examined, 22.2% presented DMH. After adjustment for logistic regression, DMH was positively associated only with the presence of dental caries in deciduous teeth. **Conclusion:** the results of this study reinforce the importance of developmental defects of enamel (DDE) caries development.

Introduction

Without the capacity of remodeling, dental enamel may be considerable a stable structure and injuries during the process of enamel formation can be permanently recorded in these surfaces as developmental defects of enamel (DDE)[1]. DDE are usually classified into hypomineralisation and hypoplasia. Hypoplasia is a quantitative defect with reduced enamel thickness due to injuries during the secretory phase of enamel[1,2]. Enamel hypomineralisation is a qualitative defect of the enamel, with change in translucency or opacity, due a disturbance during the maturation phase of enamel formation [1,2].

DDE are common in both permanent and deciduous dentition[3-7]. Among deciduous teeth, the second primary molar is the tooth most commonly affected by enamel defects[3,8-11]; mainly by demarcated opacity[6,10]. Recently Elfrink *et al.*[6,12] suggested the name Deciduous Molar Hypomineralisation (DMH) to describe the presence of demarcated enamel hypomineralisation in second primary molars.

DMH has been compared with Molar Incisor Hypomineralisation (MIH) as regards its clinical appearance and consequences, and the same diagnostic criteria proposed by the European Academy of Paediatric Dentistry (EAPD) in 2003[13], have been used in clinical studies to describe the prevalence of DMH[5,6,14,15] .

The exact mechanism and etiological factors underlying MIH are not fully understood, however, as the formation of second primary molars coincides with that of permanent first molar formation, a common cause for the both MIH and DMH processes may be considered[15]. Some of the most common etiologies suggested include childhood illness, low birth weight, adverse neonatal and maternal health during pregnancy. Researchers agree that intake of fluoride is not implicated in the aetiology of MIH[16-18]. However, there is no study that has examined the association between fluoride level in drinking water and the prevalence of DMH.

DDE is often associated with higher caries experience among affected children[6,11,20]. In Brazil, for example, a prospective study suggested that the presence of DDE was the main risk factor associated with the development of caries in 36-month-old

children from low socioeconomic status, surpassing other classic risk factors such as night-time breast-feeding and the tooth brushing habits[11]. Considerable observations about the positive relationship of DDE and dental caries have been made as regards children from diverse countries[6,8,20,21]. However, to the authors' knowledge, there is no study about the relationship of DMH and dental caries in Brazilian children. Hence, the aim of this study was to determine the prevalence of DMH among Brazilian children aged 4-6 years old and verify the association of these defects with demographic factors and dental caries in deciduous teeth.

Methodology

Ethical Aspects

Approval for this assessment was obtained from the Ethics Committee of the Piracicaba Dental School, São Paulo, Brazil (Protocol 037/2010). Parents of the participants in the study gave their informed consent before the study began.

Study design and Subjects

This was a cross sectional population based study. Children from all public schools born between January, 2004 and December, 2006, who resided in urban and rural areas of Botelhos, Minas Gerais, Brazil were invited to participate. Children were excluded if they were absent on the day of the examination or if their parents declined to give their consent.

The city has slightly over 15.000 inhabitants and has a Human Development Index of 0.7. The level of fluoride in the community water after fluoridation is 0.7 ppm/F.

Assessment of Socio Demographic Factors

Data were collected by means of a structured questionnaire that was previously verified for clarity of the questions. The questionnaire was used to collect sociodemographic information related to the children, and was completed by the parents.

The sociodemographic factors were: children`s age (dichotomized by median) and gender (male or female), place of residence (rural or urban) and access to fluoridated water (yes/no).

Assessment of DMH, dental caries, treatment needs and visible plaque

The exam was carried out in school environment by the first author (CMCS) in May, 2010, in accordance with the World Health Organisation guidelines for epidemiologic oral health studies[22]. Before the examination, the participating children were given toothbrushes and fluoridated toothpaste for brushing their teeth.

As part of this exam, second primary molars were examined for demarcated enamel opacity, according to modified EAPD criteria for the diagnosis of MIH in permanent dentition[13]. Any participant who presented with demarcated enamel opacity on at least one surface of any of their second primary molars was diagnosed with DMH. Defects of less than 1 mm were not reported in this study[23].

Dental caries was assessed using the decayed, missing and filled tooth index (dmft) in accordance with the recommended criteria of the World Health Organization[22] and the presence of visible plaque on the buccal surface of incisors (yes/no). The presence/absence of visible plaque was recorded before the children participated in brushing sessions activities.

The personal-level of demarcated enamel hypomineralisation was defined as present whenever any of the second primary molars exhibited demarcated enamel opacity according the EAPD criteria[13].

The median dmft was calculated and information was also collected on the number of primary teeth with restorative treatment needs, in accordance with the international methodological criteria defined by the World Health Organization[22] (one or more tooth need fillings, extraction, pulp care, crown), and after this the frequency of children in need of dental treatment was assessed (yes/no).

Calibration and Reproducibility

A calibration exercise was conducted and the methodology used for diagnosis of DMH was confirmed. A calibration exercise was conducted using a series of clinical oral photographs of children (all with enamel defects). Moreover, in order to determine intra-examiner agreement, about 10% of the examined children were randomly selected and re-examined on a separate occasion, after an interval of 24 hours, without access to the previous records. Kappa statistics were used to measure the concordance. The kappa values for intra-examiner reliability with regard to the presence of dental caries, treatment needs and DMH were 0.92, 0.92 and 0.94, respectively.

Statistical analyses

All statistical analyses were performed with software program SAS 9.2 for Windows (SAS Institute Inc. Cary, NC, USA). The presence of DMH defects (yes/no) was analyzed as a dependent variable. The Odds Ratio (OR) and confidence intervals (CI) were calculated and *p-values* were obtained using the Chi-square test. To adjust the OR for the effects of covariates, the Logistic Regression Model was used. Only variables with $p < 0.2$ in the bivariate analyses were selected for the model. The variables that remained in the Logistic Regression Model at $p < 0.05$ were considered statistically significant and the result of logistic regression was accepted only if approved by the Hosmer-Lemeshow goodness-of-fit statistics.

Results

General Characteristics of the Sample

A letter about the investigation was sent to the parents of 231 children aged 4 to 6 years old, asking them to give permission for their child to participate in this study. Overall, 216 children (52.7% girls; median of age = 5) who were present on the day of examination and whose guardians had filled out and signed the term of free and informed consent, were enrolled in this study. A total of 35 (16.3%) children lived in rural area and

did not have access to fluoridated water. No significant difference was found between the sociodemographic characteristics of children and the presence of DMH (Table 1).

Prevalence of DMH, Dental Caries, Treatment Needs and Visible Plaque

Subjects were classified as having DMH if they present one or more second primary molars affected by demarcated enamel opacity, according the EAPD criteria[13]. Among the 216 children examined, 22.2% (n = 48) presented DMH. At tooth level, 64 of the 864 primary second molars scored were diagnosed with DMH (7.4%). No differences were found in the presence of DMH between the mandible and maxilla, or between the left and right sides. Demarcated enamel opacities (89%) were the most frequently scored characteristics, followed by atypical restorations and posteruptive enamel loss.

Caries prevalence was expressed as the percentage of individuals in a given group with caries experience in their primary teeth (dmft>0). Among 216 children, 55.5% (n = 120) presented dmft > 0. The maximum dmft score was 19 and the overall median of caries was 1. Almost 50% of all evaluated children (n = 103) presented caries experience above median (dmft > 1), with two or more teeth presenting caries experience. Furthermore, visible plaque was present in 43.5% of all children. The frequency distribution of DMH, dental caries, treatment needs and visible plaque experience data by age are presented in Table 2.

The bivariate and multiple analyses at child level using the presence of DMH as the exploratory factor are shown in Table 3. Bivariate logistic regression showed that children with DMH presented more treatment need, visible plaque, more experience of dmft than children without DMH. However, after adjust by logistic, the model showed that children with DMH was positively associated only with the presence of dental caries on deciduous teeth.

Discussion

This article is the first to present data on the prevalence of DMH among Brazilian children, and its and relationship with dental caries in deciduous teeth. Reports of clinical

studies on the prevalence of demarcated enamel hypomineralisation in second primary molars are scarce[5,14,15]. Only two study showed the relationship between hypomineralisation in second primary molars and dental caries in primary dentition[6,15], which was confirmed by the findings of this study.

In this population based study, 22.2% of all examined children, aged between 4-6 years old were found to have at least one tooth affected by DMH. The prevalence of DMH found in this group was higher than the prevalence previously reported in literature. Elfrink *et al.*[5] reported a DMH prevalence of 4.9% in primary dentition among 5-year-old Dutch children. Later, Elfrink *et al.*[14] reported a prevalence of 8.7% among children from Netherlands, aged 5-6 years old. Ghanin *et al.* [15] found 6.6% in 7- to 9-year-old Iraqi children. Cross comparison of the results of the various studies were difficult because of examination variability, methods of recording and different age groups. Reports of clinical studies on the prevalence of the demarcated hypomineralisation in deciduous teeth using DDE index[23] showed a wide variation in prevalence rates[4,8,10,11,24]. However, the prevalence of other developmental defects of enamel varies considerably around the world and for permanent teeth, the same variation has been observed. In the case of MIH, which has been compared with DMH from various aspects, there was a prevalence of 2.5% among Chinese children[25] while in Brazil, for this same city as the one mentioned in this study, a prevalence of 19.8% among children aged 6-to-12 years old was reported[7].

DMH has been compared with MIH from several aspects, such as asymmetric distribution in the dentition, and their clinical consequences, such as posteruptive enamel breakdown and the presence of atypical restorations[5]. The same possible causes of MIH are mentioned for DMH[15] and researchers agree that intake of fluoride is not implicated in the aetiology of MIH[16-18]. In this study, there was no difference in prevalence of the enamel defects in children living in fluoridated and non fluoridated areas. Hence, the prevalence of DMH, as in the case of MIH, seems to be unaffected by environmental fluoride levels.

In Brazil, residents in the rural areas are at greater risk for the development and aggravation of dental diseases. This increase in the burden of dental diseases may be due to the greater concentration of public health services in the urban areas or to the more limited access of the rural population to public health interventions, such as community water fluoridation[26]. However, some of these factors are linked to unfavourable socioeconomic contexts such malnutrition and other socially dependent factors that may influence the incidence of enamel defects on a population basis[8,27-29]. It is interesting to note that although previous studies have shown higher prevalence of MIH in rural areas[7,30] this study did not show a higher prevalence of DMH among children from the rural area.

DDE is often associated with higher rates of caries experience among affected children[11,13,20,21]. The correlation between enamel defects and early childhood caries is an important issue for the polarization of caries experience in underprivileged populations[11]. Brazil is a country with significant socioeconomic discrepancies, which result in an uneven distribution of oral diseases in the population[31].

In this study, even after adjustment by logistic regression, the results showed a positive association between DMH and dental caries in deciduous teeth. This fact highlighted the importance of enamel defects in the development of dental caries, even in a population with moderate caries experience. The high prevalence rates of DMH and the potential of this defect to affect the oral health of children suggest the importance of enamel defects being included as an indicator of dental health status in oral epidemiological studies of children[32]. The understanding of the relationship between DMH and dental caries could have implications for the public health planners and the result of this study shows the need for further research about the influence of DMH on the pattern of caries in primary dentition.

Conclusion

A positive association between DMH and caries in primary dentition was found, even after adjustment for other clinical and demographic variables. This fact highlighted

the importance of DDE in the development of dental caries, which should be considered when planning public health actions.

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Table 1. Association between the child's general sociodemographic factors and DMH

Sociodemographic factors	DMH? Yes N (%)	DMH? No N (%)	Total N (%)	p value*	OR	CI 95%
Gender (n = 216)						
Male	23 (22.55)	79 (77.45)	102 (100)	0.9130	1.04	
Female	25 (21.93)	89 (78.07)	114 (100)		Reference	0.54-1.97
Age in years (n = 216)						
> 5 years old	17 (18.89)	73 (81.11)	90 (100)	0.3193	0.71	
≤ 5 years old	31 (24.61)	95 (76.19)	126 (100)		Reference	0.37-1.39
Place of residence (n = 215)						
Rural	6 (17.14)	29 (82.86)	35 (100)	0.4210	0.70	
Urban	42 (23.33)	138 (76.67)	180 (100)		Reference	0.36-1.75
Access to fluoridated water (n = 209)						
Yes	41 (23.42)	134 (76.58)	175 (100)		Reference	
No	5 (14.70)	29 (85.30)	34 (100)	0.2613	0.56	0.20-1.55

* Chi-square test, $\alpha = 5\%$

Table 2. DMH, Dental Caries, Treatment Needs and Visible Plaque Experience Data by Age

Age in years	DMH		Treatment Needs		Visible plaque		DMFT			Total
	Yes N (%)	No N (%)	Yes N (%)	No N (%)	Yes N (%)	No N (%)	dmft = 0 N (%)	dmft > 0 N (%)	Mean (SD)	N (%)
4 years old	15 (28.84)	37 (71.16)	21 (40.38)	31 (59.62)	19 (36.53)	33 (63.47)	29 (55.77)	23 (44.23)	1.77(±2.82)	52 (100)
5 years old	16 (21.62)	58 (78.38)	35 (47.30)	39 (52.70)	26 (35.13)	48 (64.87)	32 (43.25)	42 (56.75)	2.55 (±3.58)	74 (100)
6 years old	17 (18.89)	73 (81.11)	45 (50.00)	45 (50.00)	49 (55.45)	41 (45.55)	35 (38.89)	55 (61.11)	2.77 (±3.29)	90 (100)
Total	48 (22.22)	168 (77.78)	101 (46.75)	115 (53.25	94 (43.52)	122 (56.48)	96 (44.45)	120 (55.56)	2.45 (±3.30)	216 (100)

Table 3. Association between the Child's Clinical Factors and DMH

Clinical variables	DMH? Yes N (%)	DMH? No N (%)	Total N (%)	P value*	OR	IC 95%	OR Adjusted	IC 95%
Presence of dental caries in deciduous teeth								
dmft = 0	13 (13.54)	83 (86.46)	96 (100)		Reference			
dmft > 0	35 (29.17)	85 (70.83)	120 (100)	0.0061	2.63	1.30-5.32	2.28	1.04-4.98
Dental caries experience (median = 1)								
Children with dmft ≤ 1	17 (15.04)	96 (84.96)	113 (100)		Reference			
Children with dmft > 1	31 (30.09)	72(69.91)	103(100)	0.0079	2.43	1.25-4.73		
Treatment needs								
Yes	30 (29.70)	71 (70.30)	101 (100)	0.0132	2.28	1.18-4.40		
No	18 (15.65)	97 (84.35)	115 (100)		Reference			
Visible Plaque								
Yes	27 (28.72)	67 (71.28)	94 (100)	0.0437	1.94	1.01-3.71		
No	21 (17.21)	101 (82.79)	122 (100)		Reference			

CAPÍTULO 3[3]

DECIDUOS MOLAR HYPOMINERALIZATION AND DENTAL CARIES IN SECOND PRIMARY MOLARS : A PROSPECTIVE COHORT STUDY

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Abstract

Cross sectional studies have shown that children with Deciduous Molar Hypomineralization (DMH) have higher levels of caries experience in primary second molars (PSM) than children without DMH. Nevertheless, in the literature, there are no prospective studies that confirm this cause-effect relationship. The aim of this study was to evaluate the independent and mutual effects of socioeconomic, oral health behaviors and individual clinical factors, including DMH, on the development of new caries lesions in PSM over a period of 2-years. The study population consisted of 216 children, initially aged from 4-6 years old. Children were examined for DMH and dental caries in a school setting and were recalled every 6 months from 2010 to 2012. The caregivers filled out a semi-structured questionnaire about their socio-demographic and oral health-related behaviors. Data analysis was performed by the hierarchical model which comprised three levels (socioeconomic and demographic variables; children and their caregivers´s oral health-related behaviors; children´s oral health). Multiple analyses were performed at each level and the results were tested for stepwise multiple Generalized Estimating Equation. There was a prevalence of 22.2% children with DMH. At final examination, 33.3% of children developmented new caries lesions in PSM. The model showed that the number of years of mother's schooling and the caregiver´s perception about their children's caries experience played a protective role in the incidence of dental caries. Children who had white spot lesions were more likely to develop new caries lesions in PSM. Children with DMH showed no higher incidence of caries in their PSM than those without DMH. However, further studies are needed to better understand the role of DMH in dental caries development.

Introduction

Despite the reduction in the incidence of dental caries in permanent dentition, it continues to be the most prevalent disease in childhood, especially in younger populations [Casamassino et al., 2009; Li et al., 2011; Brazil, 2011]. In this context, the primary second molars have attracted the attention of researchers, not only because of their high risk for caries development [Elfrink et al., 2006; Elfrink et al., 2010] but also because of the prevalence of idiopathic enamel hypomineralization - called Deciduous Molar Hypomineralization (DMH) - in these teeth [Elfrink et al., 2008; 2010; 2012].

Cross sectional studies have shown a higher association of dental caries with the primary second molars (PSM) in children with DMH, than in those without DMH [Elfrink et al, 2010; Ghanin et al., 2012]. However, up until now, there has been no prospective study that has evaluated the the potential risk of dental caries development in primary second molars with DMH. Furthermore, it is unknown whether the impact of DMH on dental caries could be mediated by other factors such as clinical and socioeconomic variables.

It is known that children from areas of social deprivation have higher prevalence and severity of dental caries [Adair et al., 2004; Antunes et al., 2004; Finlayson et al., 2007; Oliveira et al., 2008; Celeste et al., 2009; Ismail et al., 2009; Arora et al., 2011]. Moreover, social status may have an indirect influence on the risk of caries due its association with certain behaviors, such as eating and preventive habits [Watt & Sheiham, 1999; Sohn et al., 2007; Pieper et al., 2012].

The role of caregivers in the prevention of dental caries in childhood has also been reported in the literature [Szatko et al, 2004]. Many studies have shown a positive association between caregivers' characteristics and their children's risk of dental caries, including caregivers' perceptions about their oral health behaviours and those of their children. [Smith et al., 2002; Finlayson et al., 2007; Sohn et al., 2007; 2008]. For example, Finlayson et al. [2007] found that maternal knowledge of children's oral health and maternal education was inversely associated with early childhood caries among low income children. Because young children are dependent on their caregiver for oral health

preventive practices and perception of oral health [Sohn et al.2007], it is important to examine the caries process in this broader context.

Hence, the aim of this study was to evaluate the impact of socioeconomic status, the oral health behaviors of schoolchildren and their caregivers, and children clinical factors, including DMH, on the development of new caries lesions in PSM tooth surfaces over a period of 2-years.

Materials and methods

Ethical Aspects

Approval for this assessment was obtained from the Ethics Committee of the Piracicaba Dental School, São Paulo, Brazil (Protocol 037/2010). Parents of the participants in the study gave their informed consent before the study began.

Study design and subjects

There are no studies about the prevalence of DMH in Brazilian children. Therefore, as this is an unprecedented study, the option taken was to conduct a population-based study, in which all children from 4 - 6 years of age (n=231), resident in the rural and urban zone of Botelhos Minas Gerais, were invited to participate. The study was conducted from the year 2010 to 2012. The city has slightly over 15.000 inhabitants and has a Human Development Index of 0.7. According to the last epidemiologic survey, the municipality presents a dmft index of 4.2 at the age of 5 years, a value well above the national mean of 2.43 [Brazil, 2011].

At baseline (2010), all 216 children aged 4-to-6-years-old were examined (93.9% of all eligible children). The exam was carried out in the school environment by the first author. The training and calibration process included theoretical information, preliminary diagnostic training with photographs. To determine intra-examiner agreement, about 10% of the examined children were randomly selected and re-examined during the field work, on a separate occasion, after a 24h interval and with no access to the previous records.

The kappa values for intra-examiner reliability with regard to the presence of dental caries, visible plaque and DMH were 0.92, 0.91 and 0.94, respectively.

Before the examination, the participating children received a toothbrush and fluoridated toothpaste to brush their teeth. Only children whose parents had filled out the questionnaire and had given written informed consent were included in this study. Mentally or physically disabled children were not included in the study. Children were recalled and examined every 6 months from 2010 to 2012. The follow-up exams were carried out under the same conditions as those at baseline.

The caregivers filled out a semi-structured questionnaire about their socio-demographic and oral health-related behaviors, which were considered independent variables that could be related to their children's oral health. The theoretical model for this study comprised three levels, based on a hierarchical approach [Victoria et al., 1997].

The first level comprised socioeconomic and demographic variables concerning the child's environment at baseline. The socioeconomic factors involved the family background characteristics, such as family monthly income, parents' educational level and occupations. Family income was calculated by adding up the monthly minimum wages of active members of the family, dichotomized as: up to one monthly wage/ more than one monthly wage. Parents' educational level was measured in numbers of years spent at school: up to 4 years (parents who did not complete the first half of fundamental schooling); over 4 years of schooling. The lowest level of parent's education represents functional illiteracy in Brazil [Ferreira et al., 2007]. The head of the household's occupation was established by the question: what is the head of the household's occupation? Occupation was classified in accordance with the Brazilian Occupation Classification (BCO), regrouped into 2 categories: unskilled labor (for example: sales persons in stores and markets; maintenance workers, persons working in agricultural, forestry, hunting and fishing activities) and workers at technical or higher levels (science and art professionals, medium level technicians, workers at administrative level). The

children's demographic factors involved age, gender, access to fluoridated water (yes/no) and residential area (rural or urban) [Brasil, 2002].

Level 2 of the model included factors involved in children's oral health-related behaviors: frequency of tooth brushing (once or more than once/day); frequency of consuming sweets (once or more than once/day); use of bottle feeding (never, until four years, over four years); dental care visits (yes/no) and their caregiver's behavior (helping the child with tooth brushing? yes/no) and caregiver´s perception of child' oral health (does your child have cavities? yes/no, do not know).

The third level involved the children's clinical variables at baseline: presence of visible plaque on buccal surface of the maxillary incisors (yes/no); presence of dental caries in PSM (yes/no); presence of white spot lesions in PSM (yes/no); presence of DMH in PSM (yes/no).

The dependent variable was the caries increment in PSM after two years (yes/no). Figure 1 summarizes the theoretical model adopted in this study.

Assessment of clinical factors

Data were collected by means of clinical oral examinations. The presence of dental caries on PSM was assessed by using the same criteria as dmfs index for primary dentition, in accordance with the World Health Organisation guidelines for epidemiologic oral health studies [WHO, 1997], with the use of a mirror. A carious lesion was recorded in a PSM when the surface had an unmistakable cavity, undermined enamel, or a detectably softened floor or wall [WHO, 1997]. No radiographs were taken.

DMH was diagnosed when the child had one or more PSM with demarcated opacities, post-eruptive breakdown of the hypomineralized enamel, and atypical restorations according to the EAPD criteria [Weerhjeim et al., 2003]. Demarcated enamel opacities were differentiated from initial caries lesions (white spot), according to their locations in the teeth. Noncavitated carious lesions were often associated with plaque retention, and these were usually located adjacent to the gingival margin and extending

along the buccal or lingual surfaces. In contrast, demarcated enamel opacities have no preferential location on the tooth [Seow, 1997]. Clinically detectable dental plaque was recorded on the buccal surfaces of the maxillary incisors teeth.

At follow-ups, a calibrated dentist (CMCS) evaluated the children for increment of dental caries in PSM. The follow-up was performed under the same conditions as the initial examination allowing direct comparisons to be made after a period of two years. The numbers of new cavitated surfaces (d), filled (f), and missing (m) surfaces due to dental caries were calculated for the sample.

Statistical analyses

Analysis was performed according to Zhou et al [2012], using the Generalized Estimating Equation (GEE) to evaluate the possible risk factors for increase in caries experience. The hierarchical model was used, with the demographic and socioeconomic variables being considered the first level, behavioral variables the second level and clinical variables the third level. Multiple analyses were performed at each level and the variables that presented values of $p<0.25$ were tested in the hierarchical model for stepwise multiple GEE, with values of $p\leq0.05$ being selected. All analyses were performed with the statistical software program SAS 9.2 for windows (SAS Institue In. Cary.NC, USA). Explanatory variables were selected for the final models only if they had a p-value of < 0.05 after adjustment for variables from the same or previous levels of determinants.

Results

General Characteristics of the Sample

In this study the data from 216 children were initially used (47.22% boys; mean age 5.22, SD $\pm$ 0.86). The response rates at each of the 6-monthly follow-ups were 204 (94.44%), 196 (70.74%), 186 (86.1%), and 174 (80.55%), respectively. The dropout rate was mainly due to participants who had moved away from the city. A flowchart of the participants is shown in Figure 2.

At baseline, of the 216 children examined 37.5%(81/216) presented dental caries in one of their PSM according WHO criteria. Thus, 62.5% (135/216) of the children examined were classified as caries free in their PSM. At tooth level, among all 864 PSM included in the analyses, 22.15% had caries at age 4 (median DFS = 0.20 per tooth), 26.36% at age 5 (median dfs = 0.26 per tooth), 24.0% at age 6 (median dfs = 0.24 per tooth).

At baseline, the prevalence of DMH in children was 22.2% (48/216). It was observed that children with DMH had more dental caries lesions in their PSM than those without DMH (χ^2 test, $p<0.0001$; OR = 2.57, IC[1.20-5.53]). At tooth level, the prevalence of DMH was 7.4% (64/864), with a total of 76 surfaces with this enamel defect. No statistical differences were found in the presence of DMH between the mandible and maxilla, or between the left and right sides. Demarcated enamel opacities (89%) were the most frequently scored characteristics of DMH, followed by atypical restorations and posteruptive enamel loss.

At the final examination, after 2 years, 31.8% (14/44) of children initially aged 4 years; 36.3% (20/55) at 5 years and 32.0% (24/75) at 6 years respectively, developed news caries lesions in the surfaces of their PSM. The caries increment was verified mainly due to the incidence of decayed surfaces (92%), followed by fillings (7%) and extracted teeth (1%). Among the 48 children presenting DMH at baseline, only 2 presented dental caries incidence after 2 years.

Multiple Analyses at Each Level

The analyses were performed at subject-level. Income levels were low for the majority of the children's families, with 36% (89/174) of them living on an income of up to 1 minimum wage. The majority of parents also had low educational levels, with only 22.1% (38/172) of the fathers and 28.1% (52/185) of mothers having completed more than 8 years of formal education. For level 1 (socio-demographic factors), the mother's higher educational level was a protective factor for caries incidence in PSM (Table 1).

For level 2, the mothers' perception of the presence or absence of dental caries in their children was a protective factor for incidence of new caries lesions in PSM (Table 2). As regards the variables at level 3, only the variable presence of white spot lesions at baseline was associated with increased risk of caries lesions in PSM after two years (Table 3).

Stepwise Multiple Analysis

The multivariable stepwise GEE analysis generated models 1 through 3. The models (model 1–3) are shown in Table 4. Model 1 showed that the mother's lower schooling at level 1 was associated with higher increment of dental caries on PSM after two years of evaluation. Model 2 showed that the mothers' high level of schooling at level 1 and the mothers' perception of the presence of dental caries in their children were inversely associated with the increment of dental caries in PSM. The final model (Model 3) showed that high level of schooling, and caregiver´s positive perception of child dental caries, played a protective role in the incidence of dental caries. Moreover, children with white spot lesions were more likely to develop new dental caries lesions in their PSM.

Discussion

This is the first prospective study to evaluate the relationship between DMH and caries increment in primary second molars, using the diagnostic criteria proposed by the EAPD [Weerheijm et al., 2003]. Hong et al. [2009] analyzed the influence of hypoplasia present in primary second molars on their caries incidence. However, the author used different diagnostic criteria (DDE index).

The results of the present study, the first on the prevalence of DMH among Brazilian children, demonstrated that the prevalence of DHM was 22.2% in this population, higher than values found by other authors. Elfrink et al. [2008] reported on the prevalence of hypomineralization in PSM in 5-year-old Dutch children and found a prevalence rate of 4.9% at child level. Among Iraqi children, a prevalence of 6.6% was determined [Ghanin et al. 2012].

Studies on the prevalence of DMH are rare, and comparisons of the results of this study with others available in the literature should be made with caution, due to methodological and environmental differences. For example, Ghanin et al. [2012] recruited older children than those analyzed in this study, which may lead to under-recording of DMH prevalence, and masking by other pathologies such as dental caries. Whereas, Elfrink, et al. [2008], performed the children's clinical exams in a dental van, without previous tooth brushing. The type of sample may also have interfered in the results, as in the present study, a sample was used from a sampling cell defined by Census Region, with children of low socioeconomic status, belonging to an urban and rural area.

Another important result that deserves further discussion is the association between DMH and tooth decay. Cross-sectional studies on caries experience in preschool children have shown that children with DMH have a higher degree of caries experience in their PSM. Ghanim et al. [2012] in a study with Iraqi children from 7-9 years of age, observed that the PSM affected by DMH showed a 3 times greater chance of developing caries lesions than those without DMH. A similar result was found by Elfrink et al. [2010] among 5 years Dutch children, and they observed a 3.2 times greater chance of occurrence of caries in primary second molars with DMH when compared with teeth without the defect. Information from the baseline of the present study shows the same tendency, i.e. children with DMH had 2.57 times greater chance of having caries lesions in their PSM. However, in this prospective study, DMH does not seem to have influenced the incidence of new carious lesions in PSM, although their prevalence was higher among children with DMH.

In spite of other studies also having found no association between DDE and caries at child level [Hong et al., 2009; Carvalho et al., 2011], several factors may have contributed to these results.

From a biochemical point of view, teeth with enamel hypomineralization have a higher risk of dental caries due their higher porosity and lower mechanical resistance [Mahoney et al., 2004], factors that predispose the enamel to post-eruptive enamel

breakdown and create a suitable local environment for adhesion and colonization of cariogenic bacteria [Li et al., 1996]. However, the weaker impact of DMH on caries increments in PSM may indicate that as regards enamel hypoplasia, other intra oral variables, such as caries activity (for example, white spot lesions) represent a greater risk for future caries development than the only presence of DHM. Therefore, DMH has an early influence on dental caries, but the risk effect may not continue to put subjects at an increased risk for caries many years after eruption [Hong et al., 2009].

As regards the type of sample used in this study, it was found that caries prevalence at baseline was high, and it is possible that the more severe DMH lesions already had caries cavities, or may even have been restored, which made it impossible to diagnose them correctly. This observation leads one to suggest that further studies should be conducted in populations of a lower age than the studied sample, preferably in whom the PSM have recently erupted, thereby avoiding this possible bias.

Another aspect to be discussed is the unit of analysis utilized in studies evaluating the impact of defects of enamel on caries. In the present study, as in the study of Hong et al. [2009], the information collected evaluated the relationship between caries and enamel defects using only the primary second molars as units of analyses. Prospective studies that evaluated the relationship between risk of enamel defects and dental caries in the primary dentition usually take several groups of teeth as the unit of analysis, or even all deciduous teeth present in the children's oral cavity at the time of examination [Oliveira et al., 2006, Zhou et al., 2012], which does not allow direct assessment of the relationship between studies, making it difficult to analyze and compare the results.

There are several interactions among confounders and traditional risk factors, which can contribute to the causation of dental caries. Instead of using socioeconomic status as a single index for evaluating the impact of social determinants on caries incidence, as many other studies have done, in the analysis of the present study, a set of socioenvironmental variables was included, comprising family environment, such as parents' education and family income, number of children, access to fluoridated

community water and rural or urban residence, which could have an influence on caries development, according to Li et al. [2011]. In the present study, it was found that children whose mothers had a higher level of schooling and had the perception of the presence of dental caries in their children were less likely to develop new caries lesions in their PSM.

In this study, it was verified that a higher maternal educational level was inversely related to the increase in caries increment in PSM after two years. Mothers are usually more directly involved in child feeding than fathers, in the first five years of life [Reisine and Douglass, 1998] and the maternal educational level has been identified as a factor associated with cariogenic feeding practices [Feldens et al., 2012]. In the present study, the fact that children whose mothers had a lower level of schooling had a greater dental caries increment is in agreement with others studies. Studies have indicated that the children whose mothers with a higher socioeconomic level brushed their teeth more frequently, consumed fewer cariogenic foods, visited the dentist more frequently, and showed lower prevalence of caries in comparison with children whose mothers had a lower educational level [Verrips et al., 1993; Szatko et al., 2004; Camargo et al., 2012; Feldens et al., 2012; Tagliaferro et al., 2006]. These behaviors are related to caries experience: the more frequently they are performed, the lower is the children's dmfs index [Feldens et al., 2012].

Likewise, the mothers' perception of the presence of caries in their children was inversely associated with dental caries increment in PSM over two years. Studies have shown that the parents' perception of their children's oral health is closely related to the children's oral health status. The fact that they participated in this study and were asked about the oral health status of their children may have influenced the attitudes of parents as regards the presence of caries in their children. Moreover, perceived oral health needs is an important predictor of the use of dental health services in young children [Medina-Solís et al., 2006; Sohn et al., 2007; Goettems et al., 2012].

At the children's oral level, incipient caries lesions (white spot) was an important risk indicator for caries incidence, which is in agreement with other prospective studies on

the association of this factor with the development of early childhood caries [Pienihäkkinen et al., 2004; Ferreira-Zandoná et al. 2012]. However, the progression of caries lesions to cavitation may vary according to the type of surface at baseline and disease activity. In this study, white spot lesions in occlusal surfaces of PSM were more likely to cavitate over two years than those in the buccal and lingual surfaces, as was observed in the study of Ferreira-Zandoná et al. [2012].

Based on the results of the present study, it was concluded that for this population, children with DMH showed no higher incidence of caries in their PSM in comparison with the group without DMH over 2 years. However the limitations of the study must be recognized because important intraoral factors related to dental caries, such as oral bacteria and plaque levels, were not included in the analysis. Moreover, further studies are needed to better understand the role of DMH in caries development, including studies of longer duration, with larger and diverse samples, in populations with a low level of caries experience. We believe that there may possibly be a bias related to the sample size, however, there are no published data in the literature that could serve as a parameter for calculating the sample size. In spite of this, the present article may be unprecedented from the aspect that it may provide statistical data that will facilitate the development of further studies.

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Legends

Table 1. Association between socioeconomic and demographic factors and incidence of dental caries

Table 2. Association between children's and parent's oral health-related behaviors and incidence of dental caries

Table 3. Association between the children's clinical variables and incidence of dental caries

Table 4. Risk factors associated with incidence dental caries analyzed by "Generalized Estimating Equation"

Figure 1: Theorical model adopted in the study.

Figure 2. Flowchart of the participants

Table 1.

Socioeconomic Factors	Increment in caries experience				Total		Estimate	Standard error	RR(95%IC)	p-value
	Yes		No							
	n	%	n	%	n	%				
Monthly Income										
Up to 2 minimum wages	40	27.77	104	72.23	144	100	Reference			
Over 2 minimum wages	7	17.5	33	82.5	40	100	-0.2700	0.2798	0.76(0.44-1.32)	0.3346
Persons in the home										
Up to 4	36	32.14	76	67.86	112	100	Reference			
More than 4	19	33.33	38	66.67	57	100	-0.1367	0.2580	0.87(0.53-1.45)	0.5963
Father's Educational Level										
Fundamental	19	30.16	44	69.84	63	100	Reference			
Over 4 years of schooling	29	32.22	61	67.78	90	100	0.4976	0.2698	1.64(0.97-2.79)	0.0651
Mother's Educational Level										
Fundamental	26	46.43	30	53.57	56	100	Reference			
Over 4 years of schooling	29	26.60	80	73.39.	109	100	-1.0328	0.2775	0.36(0.21-0.61)	0.0002
Profession										
Unskilled labor	12	33.33	24	66.67	36	100	Reference			
Technical or high level	41	32.29	86	67.71	127	100	-0.0630	0.3370	0.94(0.48-1.82)	0.8517
Age in 2010										
Higher median	24	32.43	50	67.57	74	100	Reference			
Lower median	34	34.00	66	66.00	100	100	0.1072	0.1313	1.11(0.86-1.44)	0.4141
Gender										
Male	30	35.29	55	64.71	85	100	Reference			
Female	28	31.46	61	68.54	89	100	-0.4444	0.2472	1.56(0.96-2.53)	0.0722
Place of residence										
Urban	46	31.94	98	68.06	144	100	Reference			
Rural	12	40.00	18	60.00	30	100	0.3764	0.4538	1.46(0.60-3.55)	0.4069
Access to fluoridated water										
Yes	45	31.91	96	68.09	141	100	Reference			
No	10	35.71	18	64.29	28	100	0.1910	0.4288	0.83(0.36-1.91)	0.6560

Table 2.

Behavioral factors	Increment in caries experience				Total		Estimate	Standard error	RR(95%IC)	p-value
	Yes		No							
	n	%	n	%	n	%				
Frequency of tooth brushing										
Once	9	32.14	19	67.86	28	100	Reference			
More than once	47	33.81	92	66.19	139	100	0.1144	0.2861	1.12(0.64-1.96)	0.6892
Helping the child with tooth brushing										
Yes	41	32.54	85	67.46	126	100	-0.2005	0.2481	0.81(0.50-1.33)	0.4190
No	15	36.59	26	63.41	41	100	Reference			
Use of bottle feeding										
Never	4	23.53	13	76.47	17	100	Reference			
Until 4 years	26	34.67	49	65.33	75	100	0.3978	0.5448	1.49(0.51-4.33)	0.4653
More than 4 years	26	35.13	48	64.87	74	100	0.4964	0.5507	1.64(0.56-4.83)	0.3674
Frequency of consuming sweets										
Once a day	17	31.48	37	68.52	54	100	Reference			
More than once a day	39	34.82	73	65.18	112	100	0.1209	0.2435	1.13(0.70-1.83)	0.6196
Dental care visits										
Yes	39	31.71	84	68.29	123	100	-0.3117	0.2681	0.73(0,43-1,24)	0.2450
No	16	37.21	27	62.79	43	100	Reference			
Mothers' perception of dental caries in their children										
Yes	15	20.00	60	80.00	75	100	-0.9687	0.2690	0.38(0.22-0.64)	0.0003
No	34	48.57	36	51.43	70	100	Reference			
Don’t know	5	25.00	15	75.00	20	100				

Table 3.

Clinical Factors	Increment in caries experience				Total		Estimate	Standard error	RR(95%IC)	P value
	Yes		No							
	n	%	n	%	n	%				
Caries in 2010 (n = 174)										
Yes	33	47.14	37	54.86	70	100	0.3459	0.2976	1.41(0.79-2.53)	0.2451
No	21	20.19	83	78.81	104	100	Reference			
Presence visible plaque (n=174)										
Yes	36	47.37	40	52.63	76	100	0.2637	0.2395	1.30(0.81-2.08)	0.2708
No	22	22.45	76	77.55	98	100	Reference			
Presence of DMH (n=174)										
Yes	16	47.06	18	52.94	34	100	0.1906	0.2203	1.21(0.78-1.86)	0.3868
No	42	30.00	98	70.00	140	100	Reference			
Presence of MB (n=174)										
Yes	44	50.57	43	49.43	87	100	0.7427	0.3716	2.10(1.01-4.35)	0.0456
No	14	16.09	73	83.91	87	100	Reference			

Table 4.

Variables	Model 1		Model 2		Model 3	
	RR (IC95%)	p-valor	RR (IC95%)	p-valor	RR (IC95%)	p-valor
Level 1						
Escolaridade Mãe						
Fundamental	Reference		Reference		Reference	
Over 4 years	0.41 (0.26-0.65)	0.0002	0.37 (0.22-0.62)	0.0001	0.39 (0.24-0.64)	*0.0003*
Level 2						
Does your child have caries?						
yes			0.47(0.29-0.78)	0.0030	0.59 (0.35-0.99)	0.0490
no			Reference		Reference	
Don't know						
Level 3						
Presence of white spot						
Yes					1.84 (1.06-3.17)	0.0292
No					Reference	

Figure1.

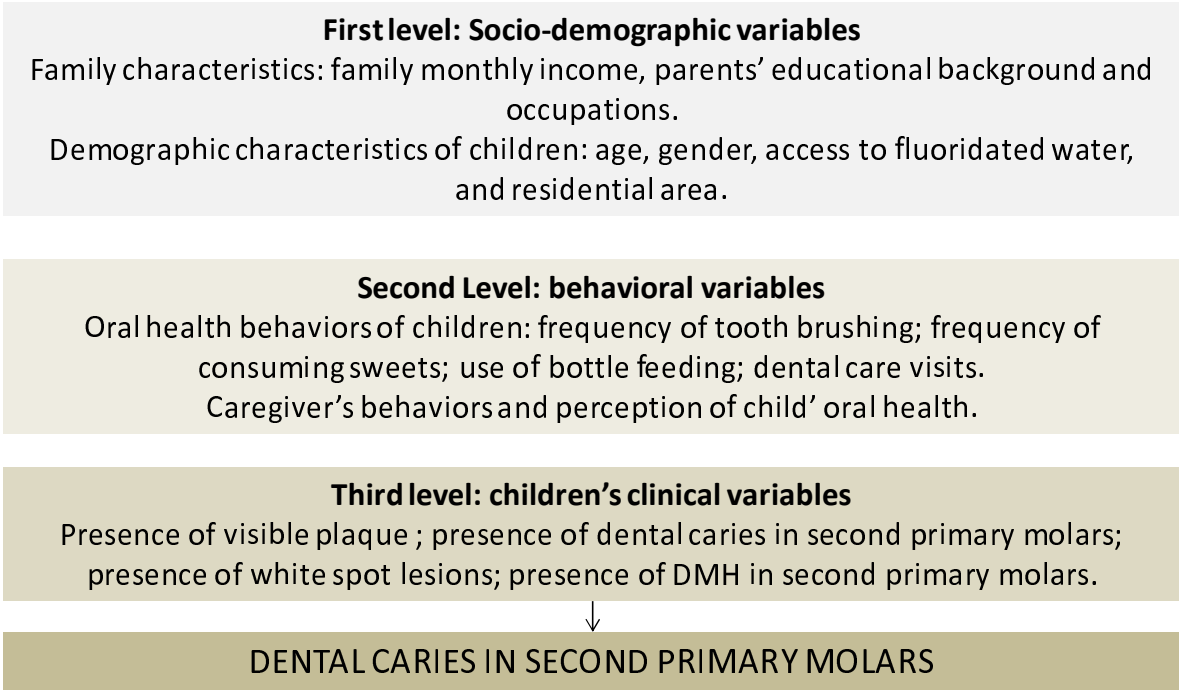
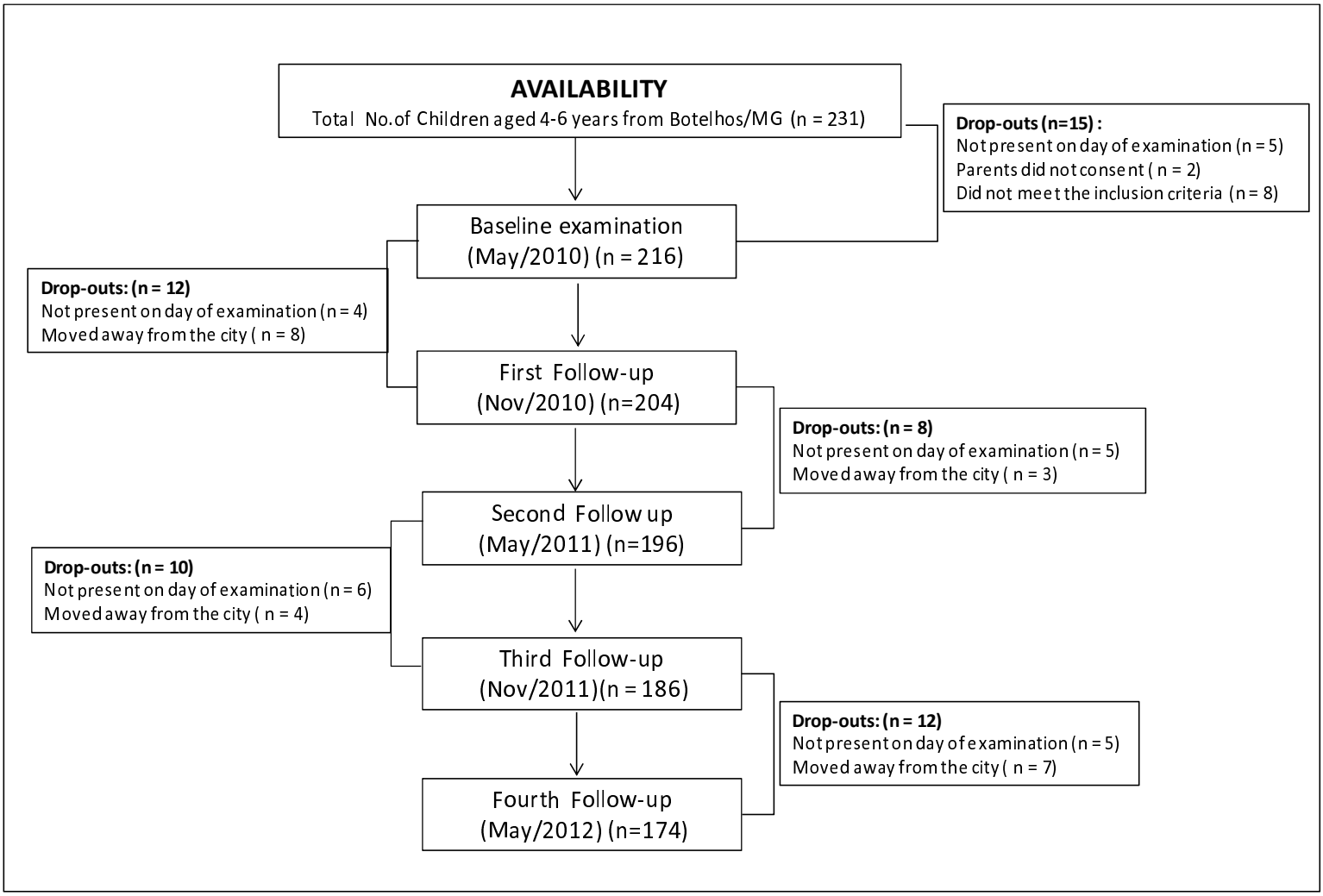

First level: Socio-demographic variables
Family characteristics: family monthly income, parents' educational background and occupations.
Demographic characteristics of children: age, gender, access to fluoridated water, and residential area.
Second Level: behavioral variables
Oral health behaviors of children: frequency of tooth brushing; frequency of consuming sweets; use of bottle feeding; dental care visits.
Caregiver's behaviors and perception of child' oral health.
Third level: children's clinical variables
Presence of visible plaque ; presence of dental caries in second primary molars; presence of white spot lesions; presence of DMH in second primary molars.
DENTAL CARIES IN SECOND PRIMARY MOLARS

Figure 2.


AVAILABILITY
Total No.of Children aged 4-6 years from Botelhos/MG (n = 231)
Drop-outs (n=15) :
Not present on day of examination (n = 5)
Parents did not consent (n = 2)
Did not meet the inclusion criteria (n = 8)
Baseline examination
(May/2010) (n = 216)
Drop-outs: (n = 12)
Not present on day of examination (n = 4)
Moved away from the city (n = 8)
First Follow-up
(Nov/2010) (n=204)
Drop-outs: (n = 8)
Not present on day of examination (n = 5)
Moved away from the city (n = 3)
Second Follow up
(May/2011) (n=196)
Drop-outs: (n = 10)
Not present on day of examination (n = 6)
Moved away from the city (n = 4)
Third Follow-up
(Nov/2011)(n = 186)
Drop-outs: (n = 12)
Not present on day of examination (n = 5)
Moved away from the city (n = 7)
Fourth Follow-up
(May/2012) (n=174)

CAPÍTULO 4[4]

THE IMPACT OF MOLAR-INCISOR HYPOMINERALIZATION ON DENTAL CARIES IN FIRST PERMANENT MOLAR: A PROSPECTIVE COHORT STUDY

Running heading: MIH and dental caries – a longitudinal study

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Abstract

Cross sectional studies conducted worldwide have indicated that Molar-Incisor Hypomineralization (MIH) is strongly associated with dental caries in permanent dentition. However, dental caries is a multifactorial disease and defects of enamel represent only one of causes involved in risk factor models. **Objective:** The purpose of this population based longitudinal study was to assess the relationships between MIH and caries experience in First Permanent Molars (PFM) using a multifactorial theoretical model. **Methods:** A total of 142 children aged 5-6 years were recruited from public schools in Botelhos, Minas Gerais, Brazil. A questionnaire was designed to collect socioeconomic background and behavioral information about children and their parents. Dental caries in PFM was recorded per surface in accordance with WHO methodology at baseline and once every 6 months over a period of two years. The Generalized Estimating Equation (GEE) analysis was performed to identify the risk factors associated with dental caries. **Results:** It was verified that MIH was present in 16.19% of children. Multiple analysis showed that children with MIH and visible plaque on anterior teeth at baseline had a high risk for developing new caries lesions in their PFM over the course of two years. None of variables at community and family levels of influence presented association with dental caries increment in PFM in the period of study. **Conclusion:** It was concluded that MIH appears to be a significant risk factor for caries in PFM and should be considered in caries risk assessment.

Introduction

Cross sectional studies conducted worldwide have indicated that Molar-Incisor Hypomineralization (MIH) is strongly associated with dental caries and restorative needs in permanent dentition (1-3). In a Swedish study, Jälevik and Klingberg (2002) showed that children with MIH underwent dental treatment of their first molars nearly 10 times as often as children without this condition. In Germany, children with MIH showed a higher DMFT value (mean DMFT 0.79) than the controls (mean DMFT 0.51) (3). In Brazil, even in surveys in which the majority of the children presented with carious lesions in their permanent teeth, children with MIH were shown to have twice the chance of having high DMFT than those without MIH (1). However the associations found between dental caries and MIH have been derived from cross sectional studies and it has not been possible to determine causal pathways.

The scientific literature suggests that the relationship between MIH and dental caries is mainly based on the characteristics of hypomineralized enamel, such as the lower mechanical resistance of porous enamel (4-8), which contributes to post- eruptive enamel breakdown, and leads to the creation of suitable niches for plaque accumulation. Other factors such as the fact that MIH-children tend to avoid brushing these sensitive teeth (9,10) and their repeated needs for restorative treatment at brief intervals (4) are involved in the high DMFT value among MIH-children. The onset of dental caries in the affected teeth may occur very soon after the emergence of the teeth in oral cavity (10). Changes in appearance resulting from caries destruction may make preexistent enamel defects difficult to diagnose, which justifies the need for prospective studies to be conducted with young children whose PFM have just erupted.

However, dental caries is a multifactorial disease and defects of enamel represent only one of the causes involved in risk factor models that operate via complex interactions among social, physical environmental and health behaviors, which can be expressed at the individual, family, and community level (11,12). With respect to individual level, it has been well established that oral health behaviors such sugar consumption and oral hygiene

practices contribute to caries development (13-16) Likewise, it is known that distal factors such as environmental and sociocultural risk factors have important indirect effects on oral health status, and a substantial burden of dental caries is found among minority and lower socioeconomic groups (13,17,18).

Since all these factors are involved in dental caries and may represent the underlying reasons for the positive association observed between MIH and dental caries, it seemed interesting to investigate the relationship between MIH and caries development using a multifactorial theoretical model**.** Hence, guided by the Fisher-Owens et al. (11) model, the purpose of this study was to evaluate the influence of MIH and other proximal and distal factors on the development of dental caries in permanent first molar (PFM) in a cohort of Brazilian schoolchildren over a period of two years.

Methodology

Ethical Aspects

Approval for this assessment was obtained from the Ethics Committee of the Piracicaba Dental School, São Paulo, Brazil (Protocol 037/2010). Parents of the participants gave their informed consent before the study began.

Study design and subjects

In this prospective population based study, all children initially 5 to 6 years old, from all public schools in Botelhos, Minas Gerais, Brazil, were invited to participate. The study was conducted from the year of 2010 to 2012, initially involving a total of 142 children aged from 5 to 6 years old (94.03% of all eligible children) who resided in urban and rural areas. The city has slightly over 15.000 inhabitants and has a Human Development Index of 0.7.

At baseline (2010), 142 children aged 5 to 6 years old were examined. They were followed-up until they reached 7 to 8 years of age in 2012. The exams were performed in

the school environment by the first author. The training and calibration process included theoretical information and preliminary diagnostic training with photographs. To determine intra-examiner agreement, about 10% of the examined children were randomly selected and re-examined during the field work, on a separate occasion, 24h apart and with no access to the previous records. The kappa values for intra-examiner reliability with respect to the presence of dental caries, visible plaque and MIH were 0.92, 0.91 and 0.93, respectively.

Only those children whose parents had given written informed consent were included in this study. In addition, children were included only if they had two or more erupted permanent first molars, or when there was an enamel defect present on the erupted portion of the crown (20), in accordance with the WHO methodology (19). Mentally or physically disabled children were not included in the study. Children were recalled every 6 months from 2010 to 2012. Before the caries examination, the participating children received a toothbrush and fluoridated toothpaste to brush their teeth. The follow-up exams were performed under the same conditions.

The caregivers filled out a semi-structured questionnaire about their socio-demographic characteristics and oral health-related behaviors, which were considered independent variables that could be related to dental health of their children. The theoretical model for this study comprised four levels, based in a hierarchical approach (11).

The first level comprised community influences on children's oral health, involving physical environmental characteristics that may also explain social variations in oral health, such as residential area (urban or rural) and access to fluoridated water (yes/no). The second level involved family-influence factors, such as family monthly income, parents' educational level and household crowding. Family income was calculated by adding up the monthly minimum wages of active members of the family, dichotomized as: up to one monthly wage/ more than one monthly wage. Parents' educational level was measured as numbers of years spent at school: up to 8 years; and more than 8 years of

schooling (parents who had completed or who were attending classes in the intermediate level of schooling). Household crowding was dichotomized as more than 3 people living with children and fewer than 3 people living with children. This level also comprised the caregiver´s behavior and perception factors: assistance during child´s tooth brushing (yes or no); reason for the dental caries visits (prevention or other); when did the child begin to brush its teeth (up to 12 months old/more than 12 months old of child's age); and caregiver´s perception of child's oral health (positive or negative).

Level 3 comprised the child's influences and included factors related to oral health behaviors and child's characteristics. Oral health behavior included frequency of tooth brushing (one or more than one times/day); frequency of consuming sweets intake (one or more than one times/day); tooth brushing frequency (once or less/twice or more times/day). Child's characteristics involved birth weight, age and gender. The fourth level involved clinical variables of children at baseline: presence of dental caries on deciduous teeth (dmfs); presence of MIH on PFM (yes/no); presence of visible plaque on buccal surface of the primary maxillary incisors (yes/no). When dental plaque was detected on the buccal surface of two or more incisors, the child was classified as positive for this factor. If the tooth was absent, the tooth next to it was used to assess the dental plaque level (23). The dependent variable was the caries increment in PFM after two years (yes/no). Figure 1 summarizes the theoretical model adopted in this study and lists the factors chosen to represent each domain.

Assessment of clinical factors

Data were collected by means of clinical oral examinations. Caries experience was recorded with the tooth surface as the unit of measurement in accordance with the World Health Organisation Guidelines for Epidemiologic Oral Health studies (19). A carious lesion was recorded when the surface had an unmistakable cavity, undermined enamel, or a detectably softened floor or wall (19). No radiographs were taken.

For this study, caries experience in PFM was considered in two ways: first, caries prevalence was defined as having any decayed lesion and/or filled surfaces on PFM (yes/no). Second, the caries increment was calculated by the number of new decayed and/or filled and missing surfaces in the PFM (DMFS). Moreover, all deciduous teeth were examined for dental caries. Personal level of dental caries on deciduous teeth was defined as present whenever any of the deciduous teeth exhibited decayed and/or filled or missing surfaces due dental caries (dmfs) (19).

The criteria for MIH diagnoses was the when child had one or more PFM with demarcated opacities, post-eruptive breakdown of the hypomineralized enamel and atypical restorations, according to the EAPD criteria (21). Demarcated enamel opacities were differentiated from initial caries lesions (white spot), according to their locations in the teeth. Noncavitated carious lesions were often associated with plaque retention, and these were usually located adjacent to the gingival margin and extended along the buccal or lingual surfaces. In contrast, demarcated enamel opacities have no preferential localization in the tooth (22).

At follow-ups, the calibrated dentist (CMCS) evaluated the children for increment of dental caries in PFM. The follow-ups were performed under the same conditions as the initial examination allowing direct comparisons of dental caries on PFM to be made after a period of two years. The numbers of new cavitated surfaces/dentinal lesions (D), filled lesions (F), and surfaces missing due to caries (M) were calculated for all exams and incidence was computed as the percentage of subjects with new caries lesions in their PFM (yes/no).

Statistical analyses

The generalized estimating equation (GEE) was used to assess the relationship between potential risk factors and dental caries in PFM over a period of 2 years. This statistical method was chosen to analyze the prospective and correlated data, which cannot be done with the use of traditional regression models. The hierarchical model was

used, and the demographic variables were considered the first level, the socioeconomic and behavioral variables in the second and third levels and clinical factors in the fourth level. Analyses were performed at each level and the variables with p-values <0.25 were tested in a stepwise hierarchical multiple GEE model, and those with $p \leq 0.05$ were selected. All analyses were performed with SAS 9.2 statistical software (SAS Institute, Cary, NC, USA).

Results

General Characteristics of the Sample

In this study, the data from 142 children were initially used (49.29% male; mean age 5.96, SD $\pm$ 0.82). The response rates at each of the 6-monthly follow-ups were 141 (99.29%), 138 (97.18%), 136 (95.77%), and 134 (94.37%), respectively. The drop-outs mainly consisted of participants who had moved away from the city. A flowchart of the participants is shown in Figure 2.

Molar-Incisor Hypomineralization in PFM

Among the 142 children evaluated in 2010, 16.19% (23/142) presented MIH in their FPM (n = 39 teeth). The percentage of children affected by MIH remained constant, however the number of teeth with MIH increased to from 39 to 42 until the final exam. Almost all the defects were classified as mild, although they varied in color from white to yellow brown opacities. The only exception was one permanent first molar (36) which was associated with dental caries at baseline and was classified as a severe defect MIH (24).

Caries experience in PFM

At baseline 142 children were examined, presenting a total of 398 PFM. Only two children (one with MIH) presented dental caries in their PFM (occlusal surfaces), with a prevalence rate of 1.41% (02/142). The prevalence rates of dental caries in PFM at the age 5 and 6 were 0% and 1.41% respectively (mean DMFS = 0.015 $\pm$ 0.12). Moreover, of the

142 examined children, 84 children had dental caries in their deciduous teeth (DMFS>0) and the mean dmfs was 4.81(±8.59).

After the first year of assessment (2011), 16 children developed new caries lesions in their PFM, and a mean of 20 carious surfaces (± 0.70). In 2012, another seven children developed caries in their PFM, totaling 25 children with cavitated carious lesions in these teeth at final examination. Of them, 14 children had MIH in their PFM. Overall, the median of DMFS in PFM in 2012 was 0.42 (±1.19). This increase in DMFS index in PFM mainly at the expense of cavities (D) being restored (F) and accounted for only 8.5%. No tooth was extracted. When children with and without MIH were compared, and it was observed that the group of children affected by MIH showed higher caries in PFM in all exams (Figure 3).

Multiple Analyses at Each Level

For Level 1 (community level influences) and 2 (family level influences) no variable was associated with caries increment in PFM during the study period (Table 1). With respect to the variables in Levels 3 (child level) and 4 (oral health level) only the presence of visible plaque on anterior teeth and MIH were associated with caries increment in PFM (Table2).

Stepwise Multiple Analysis

The multivariate stepwise GEE analyses are shown in Table 3. The results showed that children with MIH and visible plaque on anterior teeth at baseline had a high risk for developing new dental caries lesions in their PFM than those without these two factors.

Discussion

To the authors' knowledge, this is the first longitudinal study to evaluate the relationship between MIH and dental caries in PFM. The fact that the evaluated teeth were followed-up from the early stage of their eruption in the oral cavity allowed a more reliable evaluation of the relationship between MIH and dental caries, and prevented

dental caries or restorations from masking pre-existent enamel defects. Moreover, because this was a prospective study, it allowed the cause-effect relationship between the two pathologies to be observed.

With regard to cross-sectional studies, although Heitmuller et al. (25) found no association between MIH and caries in PFM in a population with low caries experience, other studies have shown that MIH was associated with caries experience in children with the defect (1-3). For example, in a study conducted in Finland, Lappäniemi et al. (2) showed that children with MIH had a significantly increased mean DMFT value in comparison with those without MIH (mean DMFT 2.1 and 1.0, respectively).

The unit of analysis used in this study was the PFM, allowing a more accurate assessment of the risk of caries and MIH present in these teeth. As the incisors may or not be affected by demarcated enamel opacities, and usually present milder MIH lesions than PFM, without structural losses, or dental caries (1,10), the authors chose not to put them in the analysis. Moreover, studies of prevalence generally assess the relationship between MIH and dental caries using all the permanent teeth in the children's mouths, which does not allow one to assert that the positive relationship found between these variables was due to the presence of defective enamel in PFM and / or incisors.

The positive relationship found between MIH and dental caries can be explained by the hypomineralized tissue characteristics, such as its structural weakness (5-8). Due to this weakness, teeth with MIH may present enamel loss only when they come into occlusion, leaving exposed dentin, which facilitates the development and progression of caries lesions (9, 10, 21). Moreover, the affected enamel has a rougher surface that favors dental plaque accumulation (10, 26). However, to the authors' knowledge, no longitudinal studies have been conducted to test this hypothesis (27), and many of the studies were cross-sectional or conducted in a laboratory. In this sense, the present study has revealed additional evidence of the relationship of risk between the presence of MIH and caries in PFM.

Behavioral factors, such as oral hygiene, may also contribute to the positive relationship between MIH and dental caries. Although the frequency of fluoride toothpaste use showed no association with caries increment in the PFM in the present study, the presence of visible dental plaque on primary anterior teeth at baseline was shown to be a risk factor for the development of disease in these teeth. The presence of plaque on anterior teeth is a good indicator of overall oral hygiene (28). Several studies have found association between biofilm on primary anterior teeth and dental caries in primary posterior teeth (28,29). Other studies have verified the association between the presence of dental plaque on the occlusal surface of PFM and the development of caries in these teeth (30-32). However, this study demonstrated that the biofilm present in the anterior teeth should be also considered a risk factor for dental caries in PFM. This finding is important because this variable is not widely used and evaluated in caries risk studies in mixed dentition. Knowing that the PFM is one of the teeth most affected by caries in the permanent dentition (33,34), this association found in the present study could be an important indicator for the planning and selection of strategies based on scientific evidence for the control and prevention of caries in the mixed dentition. Furthermore, it underscores the importance of preventive programs directed toward schoolchildren, because it supports the hypothesis that oral hygiene is a risk factor for the development of caries in PFM and highlights the importance of plaque control in young children to prevent future caries development (35).

Factors influencing oral health operate at individual, family, and community levels. Individual children live in families that are embedded in communities. Therefore, a child's dental caries risk cannot be isolated from family and community disease risk (11,36). Hence, in this study, a comprehensive children's oral health model was incorporated by using a multilevel perspective, guided by Fischer-Owens et al. (11). Thus, use of a hierarchical model for the data analysis allowed the complex relationship between the different strata to be observed.

It was noted that the factors from the community, family and the child levels had no influence on caries increment in PFM, however, only the intraoral variables of the children (fourth level of analysis) did have an influence. In other studies of caries risk in children the mother´s education and the past history of dental caries in deciduous teeth was generally associated with dental caries in both permanent and deciduous dentition (18, 36, 37). However, these associations could not be confirmed, perhaps because of the statistical analysis used in the present study (GEE), which is innovative for this type of study. Moreover, it must be considered that even as a population-based study, the sample consisted of a limited number of children examined, which may have affected the power of the associations found. Therefore, it is hoped that the analyses presented here will provide a basis for the future design of studies that evaluate the relationship between MIH and dental caries.

Conclusion

Within the limitations of this cohort longitudinal study, evidence was provided that MIH could be a clinically meaningful predictor for dental caries in PFM and should be considered in caries risk assessment. However, further studies are needed to elucidate whether the same pattern occurs in other populations.

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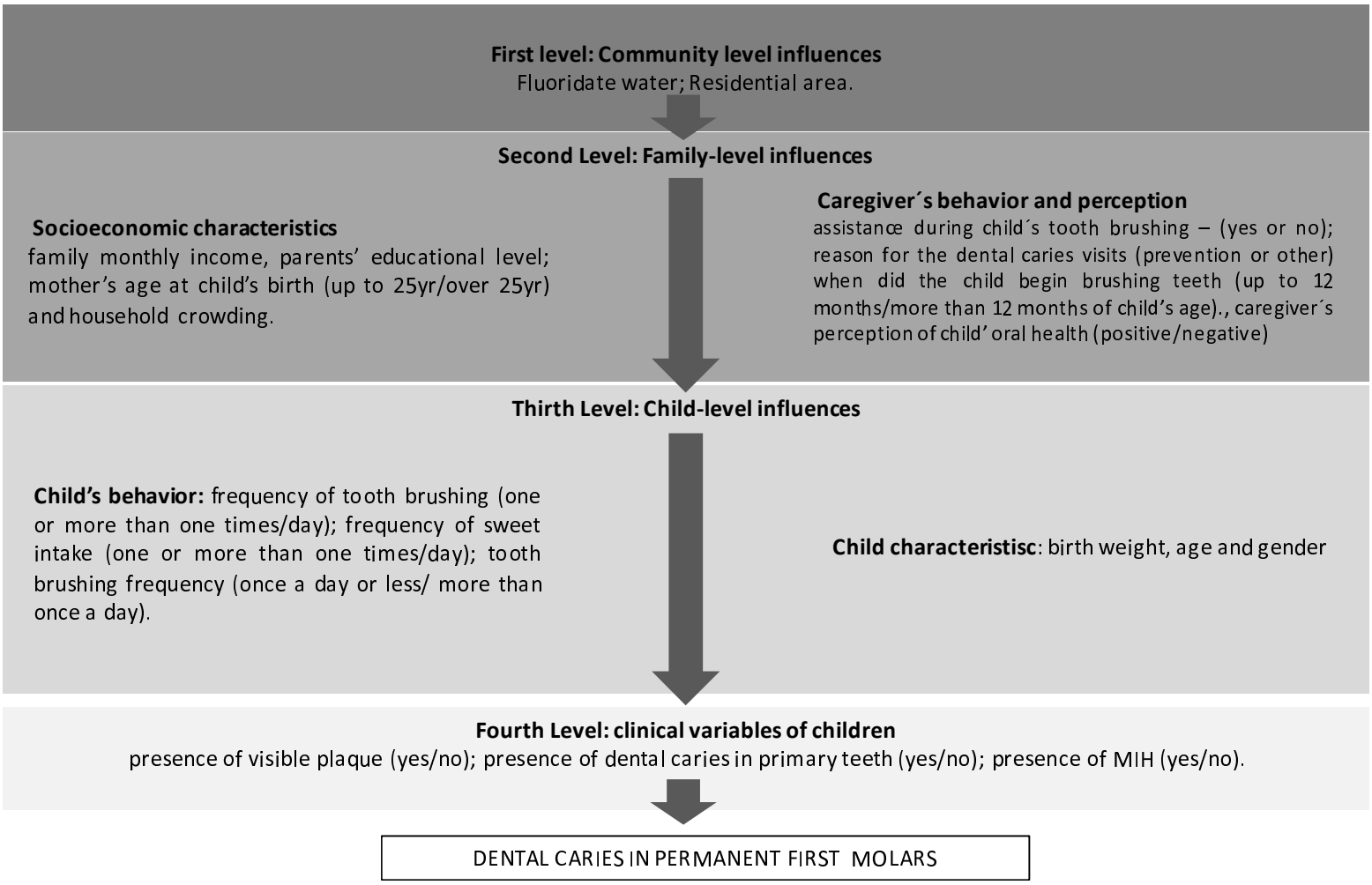

Fig. 1 Theoretical marker for investigating risk factors for dental caries in permanent first molars, structured in hierarchical blocks.

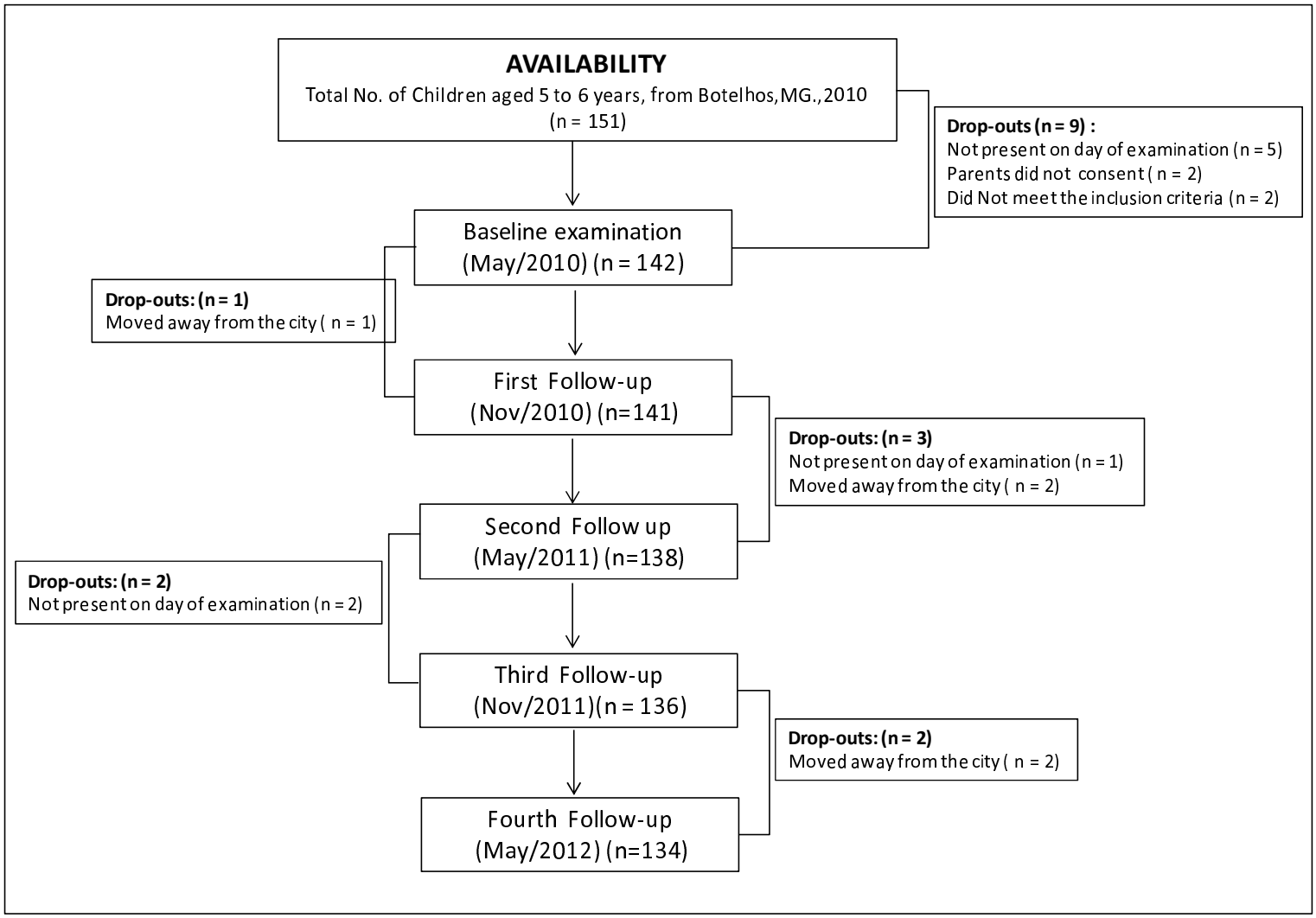

Figure 2. A flowchart of participants.

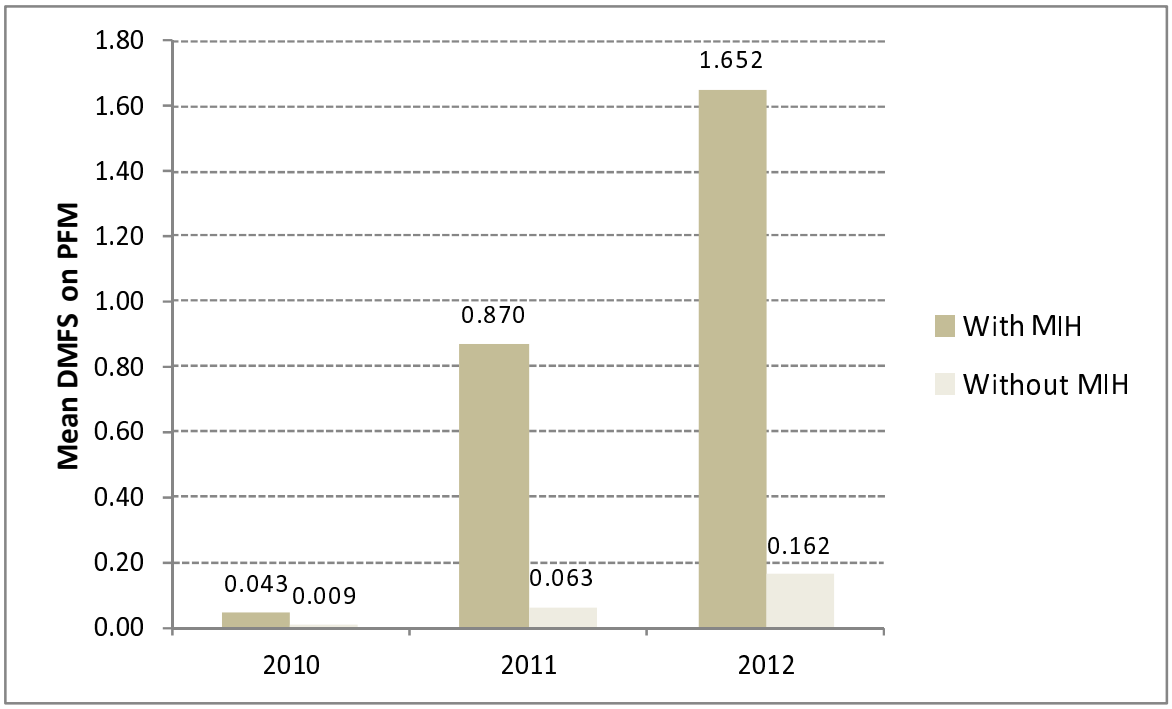

Figure 3. Mean DMFS in PFM according to the presence or absence of MIH.

Table 1. Association between variables, at the community and family level, with the incidence of caries in PFM

Variables	Estimate	Standard error	RR(95%IC)	p-value
Level 1				
Access to fluoridated community water				
yes	Reference			
no	-0,3387	0,6909	0,71(0,18-2,76)	0,6240
Residence				
Rural	Reference			
Urban	0,1156	0,6933	1,12(0,29-4,37)	0,8676
Level 2				
Monthly income				
Up to one minimal wage	Reference			
More than one minimal wage	-0.6519	0.8375	0.52(0.14-1.94)	0.3317
Educational level of father				
Up to 8 years of schooling	Reference			
More than 8 years	0.0078	0.7322	1.00(0.24-4.23)	0.9916
Educational level of mother				
Up to 8 years of schooling	Reference			
More than 8 years	-0.4553	0.6706	0.63(0.17-2.36)	0.4972
Household crowding				
Up to four	Reference			
More than four	0.2314	0.4560	1.26(0.52-3.08)	0.6118
Maternal age at birth				
Up to 25 years old	Reference			
Over 25 years old	0.6139	0.4678	1.85(0.74-4.62)	0.1894
Reason for dental care visit				
Prevention	Reference			
Others	0.8269	0.5202	2.29(0.82-6.34)	0.1119
When did the child begin brushing its teeth				
up to 12 months	Reference			
more than 12 months	0.4021	0.5157	1.49(0.54-4.11)	0.4355
Caregiver´s perception of child's oral health				
Positive	Reference			
Negative	0.3326	0.6251	1.39 (0.41-4.75)	0.5946

Table 2. Association between individual clinical variables and the incidence of dental caries in PFM

Variables	Estimate	Standard error	RR(95%IC)	p-value
Level 3				
Age in years				
Five years old	Reference			
Six years old	0.0866	0.3882	1.09(0.51-2.33)	0.8234
Gender				
Male	Reference			
Female	-0.0443	0.3829	0.96(0.45-2.03)	0.9079
Frequency of tooth brushing				
Once a day	Reference			
Two or more times/day	-0.1991	0.5125	0.82(0.30-2.24)	0.6976
Low birth weight				
Yes	Reference			
No	-0.2297	0.5858	0.79(0.25-2.58)	0.6950
Frequency of consuming sweets				
Once a day	Reference			
Two or more times/day	0.5306	0.5083	1.70(0.63-4.60)	0.2965
Level 4				
Presence of MIH				
Yes	Reference			
No	-1.7286	0.3308	0.18(0.09-0.34)	<0.0001
Dental caries in deciduous teeth				
Yes	Reference			
No	-0.6146	0.3359	0.54(0.28-1.04)	0.0673
Visible plaque				
Yes	Reference			
No	-0.9085	0.3953	0.40(0.18-0.87)	0.0216

Table 3. Risk factors associated with increase in incidence of caries analyzed by "Generalized Estimating Equation" (final model).

Variables	*RR (IC95%)	p-valor
Presence of MIH		
Yes	Reference	
No	0.17 (0.09-0.31)	*<0.0001*
Presence of visible plaque		
Yes	Reference	
No	0.33 (0.15-0.71)	0.0045

*Relative Risk

CONSIDERAÇÕES GERAIS

Apesar de existirem desde a antiguidade (Goodman, 1989), só no final do século passado o mundo científico despertou sua atenção para a relevância clínica dos defeitos não fluoróticos de esmalte (Koch *et al.*, 1987). Dentre os defeitos de desenvolvimento do esmalte, recentemente, o termo Hipomineralização Molar Incisivo (MIH – sigla em inglês) foi sugerido de forma a descrever opacidades demarcadas de esmalte, presentes em 1 a 4 primeiros molares permanentes, associadas ou não a incisivos permanentes afetados. De maneira semelhante, opacidades demarcadas em 1 a 4 segundos molares decíduos, receberam o termo Molar Decíduo Hipomineralizado (DMH – sigla em inglês). Embora a etiologia destes defeitos seja desconhecida, admite-se que ambos tenham origem sistêmica. Em decorrência da coincidência da época de formação do primeiro molar permanente e o segundo molar decíduo, sugere-se que um mesmo fator etiológico possa afetar a ambos, sendo a presença de DMH um alerta aos profissionais sobre o maior risco para a ocorrência da MIH na dentição permanente (Elfrink *et al.*, 2012).

A MIH representa um desafio para profissionais de todo o mundo, em decorrência de suas consequências clínicas como grandes destruições coronárias, hipersensibilidade e necessidades de tratamentos recorrentes. Além disso, crianças afetadas apresentam geralmente dificuldade de manejo durante o atendimento odontológico em decorrência da hipersensibilidade a estímulos térmicos e mecânicos (Weerheijm *et al.*, 2001; Jälevik & Klingberg, 2002). O tratamento das crianças com MIH é bem mais complexo do que se imagina, envolve aspectos clínicos, como reabilitações extensas e extrações, nos casos mais graves, até questões sociais e psicológicas. Por isto, este deve englobar não só a criança, mas também toda a sua família. Estas e outras informações, contidas no artigo 1, são de importantes fontes para que o cirurgião dentista possa basear sua prática clínica.

A partir do exame dos resultados do estudo 2, de corte transversal, foi possível observar que tanto a cárie quanto as opacidades demarcadas de esmalte em segundos molares decíduos, foram prevalentes na população estudada. De um total de 216 crianças

avaliadas no baseline, 22,2% apresentaram pelo menos um segundo molar decíduo com DMH, resultado bem acima dos valores encontrados pelos dois únicos estudos de prevalência de DMH (Elfrink *et al.*, 2008; Ghanin *et al.*, 2012). No entanto deve-se considerar as variações socioambientais e metodológicas entre os estudos. Por exemplo, no estudo de Ghanin *et al.* (2012) os autores avaliaram crianças com faixa etária mais alta do que neste estudo (7-9 anos) e é possível que lesões de DMH tenham sido mascaradas por lesões de cárie ou mesmo restaurações atípicas.

Já em relação à cárie na dentição decídua, este estudo mostrou que esta esteve presente em 55,5% da amostra (n = 120), ou seja, 45,5% das crianças avaliadas apresentaram-se livres de cárie na dentição decídua, valor próximo ao último levantamento do Ministério da Saúde, onde 46,6% das crianças de 5 anos apresentaram-se livres de cárie (Brasil, 2011).

Observou-se também no estudo 2, que as lesões de DMH estiveram associadas à maior experiência de cárie na dentição decídua. Entretanto, para o estabelecimento de uma relação causa-efeito, e o cálculo da relação de risco destas lesões para o desenvolvimento da cárie ao longo do tempo, fez-se necessário o desenvolvimento de um estudo prospectivo. Assim, no estudo 3 foi avaliado o risco de cárie em segundos molares decíduos afetados pelo DHM, e observou-se que a DMH não esteve estatisticamente associada à incidência de novas lesões de cárie. Tal fato desperta a atenção para uma provável relação tempo-dependente entre DMH e cárie.

No entanto, deve-e considerar as limitações deste estudo. Apesar de se tratar de uma amostra de base populacional, o número de indivíduos avaliados foi pequeno, o que não nos leva a descartar a possibilidade de associação entre DMH e incremento de cárie em outras populações. Além disso, mais de 55% das crianças apresentaram ceod > 0 no exame inicial, tratando-se, portanto, de uma população com alta experiência da doença. É possível que lesões de DMH tenham sido mascaradas por tratamentos restauradores ou mesmo pela própria cavidade de cárie, já que o esmalte do dente recém-irrompido apresenta-se mais imaturo, o que nos leva a uma provável subestimação dos resultados.

Consequentemente, recomenda-se que a análise entre defeitos de esmalte e cárie sejam realizadas o mais cedo possível, de preferência assim que os dentes irromperem, de forma a evitar possíveis vieses de diagnóstico. Assim, esta questão nos motivou a desenvolver o estudo 4, acompanhando crianças de 5-6 anos, com primeiros molares permanentes recém-irrompidos, pelo período de 2 anos. Verificamos que a MIH e a presença de placa visível estão envolvidos com a experiência de cárie nestes dentes durante o período de avaliação, o que nos leva a supor que resultado semelhante teria sido obtido no estudo 3 se tivéssemos acompanhado as crianças desde a época de irrupção dos segundos molares decíduos.

Como observado, mesmo na amostra estudada onde mais da metade das crianças apresentaram pelo menos um dente decíduo cariado, a DMH revelou associação positiva com a prevalência de cárie. Assim foi observada também para a dentição permanente, em que a MIH esteve envolvida com o incremento de cárie nos primeiros molares. Visto que a população infantil continua a sofrer com uma doença passível de prevenção, que é a cárie dentária, este fato desperta a atenção para a necessidade do conhecimento epidemiológico dos defeitos de esmalte na população infantil nas diversas regiões do País, principalmente considerando a necessidade de planejamentos contextualizados para ações de promoção e prevenção em saúde bucal.

CONCLUSÃO

Com os resultados desta tese, pode-se observar que as crianças afetadas pela DMH não apresentaram maior risco de desenvolvimento de lesões cariosas nos segundos molares decíduos pelo período de 24 meses de acompanhamento. Este fato não nos leva a descartar que resultados opostos não possam ser encontrados em estudos que avaliem prospectivamente a relação entre DMH e cárie em dentição decídua, com amostras de crianças mais novas. Por outro lado, as crianças que apresentavam MIH em seus primeiros molares permanentes recém-irrompidos e biofilme nos dentes decíduos anteriores tiveram maior risco de desenvolverem lesões cariosas em seus primeiros molares permanentes do que aquelas sem o defeito no mesmo período. Diante do exposto, concluímos que a presença de defeitos de esmalte nos molares permanentes e biofilme nos dentes anteriores deveriam ser variáveis consideradas em avaliações de risco a cárie para a dentição permanente.

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[5] De acordo com a norma da UNICAMP/FOP, baseadas na norma do International Committee of Medical Journal Editors – Grupo de Vancouver. Abreviatura dos periódicos em conformidade com o Medline.

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ANEXO 1

Revista Odonto Ciência (Journal of Dental Science) – Editorial decision

Dear Dr. Cristiane Maria da Costa-Silva,

We are pleased to inform you that your revised manuscript entitled 'MOLAR-INCISOR HYPOMINERALIZATION: considerations for clinical management in dental care for children' was accepted for publication in the Revista Odonto Ciência (Journal of Dental Science).

After editing the page proofs will be sent to your e-mail address for final approval before printing. The online issue will allow the download of full-text articles in pdf file, and a complimentary printed journal will be mailed to you.

We thank you again for considering our journal to publish your work.

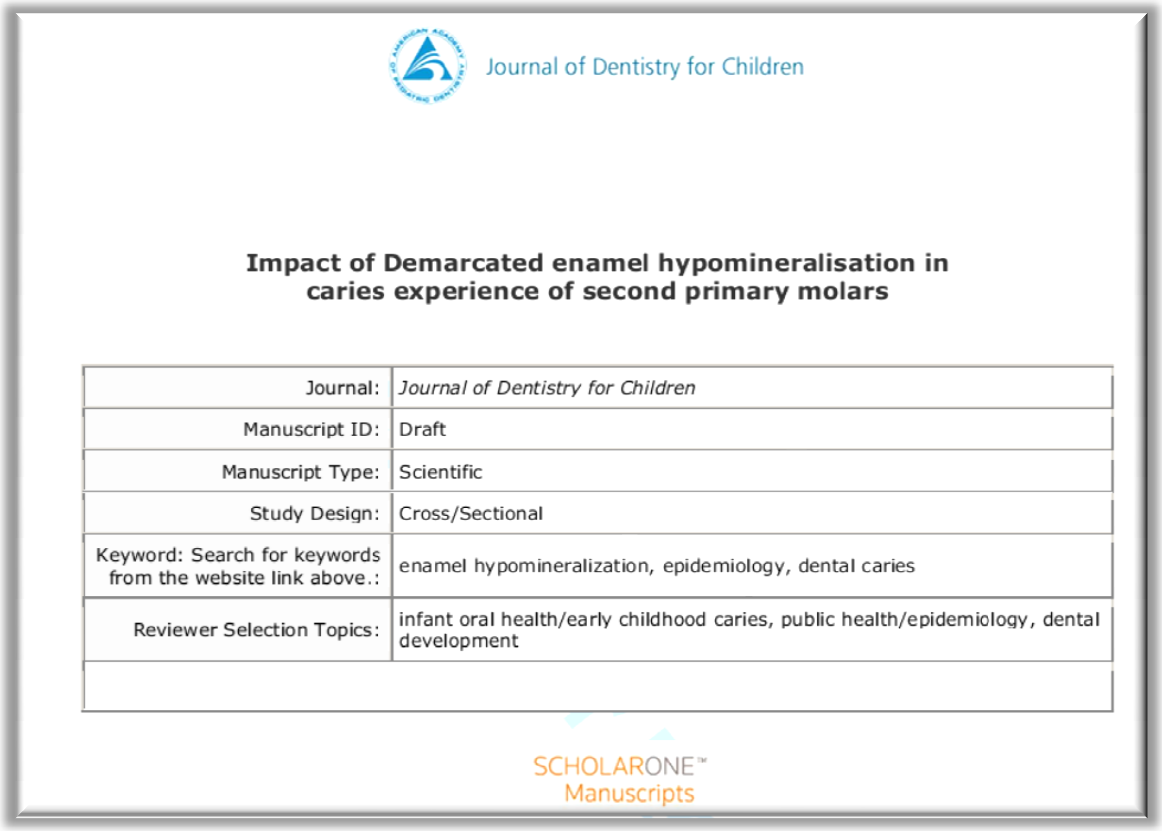
Sincerely,

Rosemary Shinkai, DDS, PhD
Editor-in-Chief
Revista Odonto Ciência (Journal of Dental Science)

http://revistaseletronicas.pucrs.br/ojs/index.php/fo/index

ISSN 0102-9460 (print)
ISSN 1980-6523 (online)

ANEXO 2



Journal of Dentistry for Children

Impact of Demarcated enamel hypomineralisation in caries experience of second primary molars

Journal:	*Journal of Dentistry for Children*
Manuscript ID:	Draft
Manuscript Type:	Scientific
Study Design:	Cross/Sectional
Keyword: Search for keywords from the website link above.:	enamel hypomineralization, epidemiology, dental caries
Reviewer Selection Topics:	infant oral health/early childhood caries, public health/epidemiology, dental development

SCHOLARONE™
Manuscripts

ANEXO 3

09-Nov-2012

Dear Mrs. costa silva:

Your manuscript entitled "DECIDUOS MOLAR HYPOMINERALIZATION AND DENTAL CARIES IN SECOND PRIMARY MOLARS : A PROSPECTIVE COHORT STUDY" has been successfully submitted online and is presently being given full consideration for publication in Caries Research.

Your manuscript ID is CRE-2012-Nov-00266.

Please mention the above manuscript ID in all future correspondence or when calling the office for questions. If there are any changes in your street address or e-mail address, please log in to Manuscript Central at http://mc.manuscriptcentral.com/cre and edit your user information as appropriate.

You can also view the status of your manuscript at any time by checking your Author Center after logging in to http://mc.manuscriptcentral.com/cre .

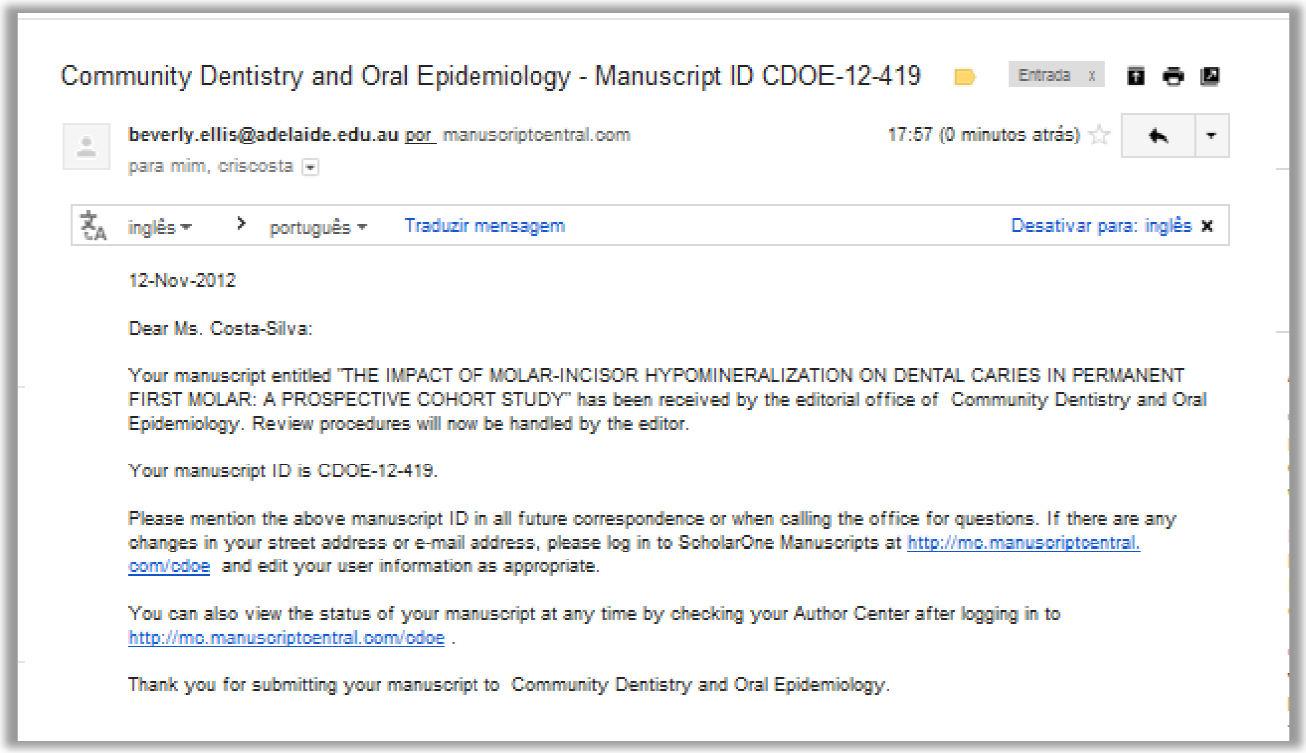
Thank you for submitting your manuscript to Caries Research.

Yours sincerely,

Prof. David Beighton
Caries Research

david.beighton@kcl.ac.uk

ANEXO 4



Community Dentistry and Oral Epidemiology - Manuscript ID CDOE-12-419

Entrada x

beverly.ellis@adelaide.edu.au por manuscriptoentral.com 17:57 (0 minutos atrás)

para mim, criscosta

inglês › português Traduzir mensagem Desativar para: inglês

12-Nov-2012

Dear Ms. Costa-Silva:

Your manuscript entitled "THE IMPACT OF MOLAR-INCISOR HYPOMINERALIZATION ON DENTAL CARIES IN PERMANENT FIRST MOLAR: A PROSPECTIVE COHORT STUDY" has been received by the editorial office of Community Dentistry and Oral Epidemiology. Review procedures will now be handled by the editor.

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ANEXO 5

Critérios utilizados para diagnóstico de MIH

Condição Observada	Descrição
1. Opacidade demarcada	Defeito demarcado envolvendo alteração na translucidez do esmalte, de graus variados. O esmalte defeituoso tem espessura normal, com superfície lisa, podendo ser branco, amarelo ou marrom.
2. Fratura pós-irruptiva	Defeito que indica perda do esmalte formado após a irrupção dentária. A perda possui bordas irregulares e cortantes, sempre associada a uma opacidade demarcada prévia.
3. Restauração atípica	O tamanho e a forma da restauração não são correspondentes a um preparo para remoção da cárie. Em muitos casos, molares têm suas restaurações estendidas para a face vestibular ou palatina/lingual. Frequentemente, as bordas das restaurações apresentam opacidade. Nos incisivos, uma restauração na face palatina pode estar presente, não sendo associada à cárie.
4. Exodontia por HMI	Suspeita-se de exodontia por HMI quando: opacidades ou restaurações atípicas em outros primeiros molares permanentes, combinado com a ausência de um primeiro molar. Ausência dos primeiros molares em uma dentição saudável em combinação com opacidades demarcadas em incisivos. Não é comum encontrar incisivos extraídos pela HMI.
5. Não irrompido	Primeiro molar permanente ou o incisivo a ser examinado não irrompido.

ANEXO 6

QUESTIONÁRIO SOBRE A SAÚDE DA MÃE E DA CRIANÇA

Saúde da mãe durante a gestação da criança:

Final da gestação/gravidez (relativo aos últimos 3 meses de gravidez)

1. Sua gravidez foi de risco: ( ) não ( ) sim porque_____
2. Quantos anos você tinha quando teve seu (a) filho (a)? _____
3. Você apresentou algum problema de saúde na gravidez: ( ) não ( ) sim
   Se sim, qual (is)? _____

   Quais os remédios que você usou durante a gravidez (informe também as vitaminas)?_____

Parto:

1. Tipo de parto: ( ) normal ( ) cesárea
2. Uso de fórceps: ( ) sim ( ) não

Saúde da criança ao nascimento:

1. Seu filho nasceu com que peso? _____
2. Seu filho nasceu com quantas semanas de gestação?_____
3. A criança foi prematura? ( ) não ( ) sim quantas semanas _____
4. A criança ficou na incubadora?: ( ) não ( ) sim
   Se sim, por quanto tempo? _____
   Se sim, qual o motivo?_____
5. A criança precisou tomar algum remédio ao nascer? ( ) não ( ) sim
   Se tomou, qual (is) o (s) nome (s) do (s) remédio(s)? _____
6. A criança teve alguma infecção ao nascimento: ( ) não ( ) sim
   Se sim, qual (s)? _____
7. A criança teve icterícia após o nascimento (ficou amarelinha e precisou de banho se sol ou de luz)?
   ( ) não ( ) sim
8. Existe algum outro problema que a criança apresentou quando nasceu? ( )não ( ) sim
   Se sim, qual problema? _____

Saúde da criança até os primeiros dois anos de vida:

1. A criança teve alergia a alguma coisa? ( ) não ( ) sim
   Se sim, a que? _____
2. A criança fez uso contínuo (crônico) de algum remédio ou vitamina até os dois anos de idade?

   ( ) não ( ) sim Se sim, qual (is): _____

A criança ficava doente com freqüência até os dois anos de vida (ex: dor de ouvido, de garganta, resfriados constantes, infecção de urina etc.)? ( ) não ( ) sim
Se sim, qual (is):_____

3. A criança ficou internada em hospital até os dois anos de vida?: ( ) não ( ) sim
   Se sim, por quantas vezes? _____
   Se sim, qual (is) o (s) motivos (s)? _____ _____

4. A criança apresentou algum problema respiratório (bronquite, asma, pneumonia) até os dois anos de vida? ( ) não ( ) sim
   Se sim, qual (is)? _____
   Se sim, tomou algum remédio para tratamento? Qual (is)?_____

5. **Existe alguma outra informação importante sobre a saúde da criança até os primeiros dois anos de vida, que eu não perguntei e que você acha importante relatar? Por favor, me informe:**_____

ANEXO 7

QUESTIONÁRIO SOBRE HÁBITOS E ACESSO A SERVIÇOS DE SAÚDE DA CRIANÇA

1. Com que idade seu (a) filho (a) começou a escovar os dentes de leite? _____
2. Ele escovava os dentes com pasta de dentes? ( ) não ( ) sim _____

   Se sim, você saberia dizer qual (is) a (s) pasta (s) de dentes ele usava na época em que começou a escovar os dentes? (ex: Tandy, colgate, sorriso, close-up etc)_____
3. A pasta de dentes que seu (a) filho (a) usa hoje em dia tem flúor? ( ) não ( ) sim ( ) não sei
4. Hoje em dia, quantas vezes seu (a) filho (a) escova os dentes por dia?

   ( ) nenhuma ( ) uma ( ) mais de uma
5. Você ou outro adulto ajuda seu (a) filho (a) a escovar os dentes? ( ) não ( ) sim
6. Com quantos anos seu (a) filho (a) começou a usar o fio dental? _____
7. Hoje em dia, seu (a) filho (a) usa o fio dental? ( ) não ( ) sim

   Quantas vezes por dia, seu (a) filho (a) usa o fio dental? ( ) não usa ( ) uma vez ( ) mais de uma vez
8. Seu filho foi amamentado no peito?( ) não ( ) sim Até que idade? _____
9. Seu (a) filho (a) usa ou usou mamadeira? ( ) nunca usou ( ) usou mas não usa mais ( ) ainda usa

   Se sim, até que idade ele (a) usou mamadeira?_____

   Se sim, quantas mamadeiras ele (a) mama (ou mamou) por dia? _____

   Se sim, ele (a) mama (mamou) para dormir? ( ) sim ( ) não
10. O que você coloca (ou colocava) no leite da mamadeira? _____
11. Em média, hoje em dia, quantas vezes por dia seu filho ingere alimentos que contém açúcar (como bala, bolos, refrigerantes, sucos adoçados com açúcar etc)? ( ) nenhuma

    ( ) uma vez ( ) mais de uma vez
12. Seu (a) filho (a) já foi ao dentista? ( ) não ( ) sim

    Se sim, com quantos anos seu (a) filho (a) foi ao dentista pela primeira vez? _____

    Se sim, qual o motivo da consulta do seu (a) filho (a) ao dentista?_____
13. Você acha que seu (a) filho (a) já teve cáries? ( ) não ( ) sim ( ) não sei
14. Você acha que seu (a) filho (a) já teve ou tem algum problema nos dentes? ( ) não ( ) sim ( ) não sei

    Se sim, qual (is)? _____

ANEXO 8

QUESTIONÁRIO DE FATORES SOCIOECONÔMICOS

1. Renda Familiar Mensal (soma de todos os rendimentos/salários das pessoas que trabalham na casa)

( ) Sem renda

( ) Até 1 salário mínimo

( ) Mais de 1 a 2 salários mínimos

( ) Mais de 2 a 3 salários mínimos

( ) Mais de 3 a 5 salários mínimos

( ) Mais de 5 a 10 salários mínimos

( ) Mais de 10 a 20 salários mínimos

( ) Mais de 20 salários mínimos

2. Número de Pessoas que moram na sua casa:_____

3. Profissão do chefe da família (informar mesmo que desempregado no momento):_____

4. Grau de Instrução dos Pais ou Responsáveis (assinalar a alternativa que corresponde ao ultimo ano de estudo cursado pelo pai e pela mãe)

	Pai	**Mãe**	
A.	( )	( )	Não alfabetizado
B.	( )	( )	Alfabetizado
C.	( )	( )	1ª a 4ª Série incompleta (ensino fundamental)
D.	( )	( )	1ª a 4ª Série completa (ensino fundamental – concluiu a quarta série)
E.	( )	( )	5ª a 8ª Série incompleta (ensino fundamental)
F.	( )	( )	5ª a 8ª Série completa (ensino fundamental – concluiu a 8ª série)
G.	( )	( )	2º Grau incompleto (ensino médio)
H.	( )	( )	2º Grau completo (ensino médio - concluiu o terceiro ano do segundo grau)
I.	( )	( )	Superior incompleto
J.	( )	( )	Superior completo

5. A água utilizada na sua casa, para beber e fazer comida, é proveniente de:

( ) rede geral de distribuição (água tratada pela COPASA)
( ) poço ou nascente (mina de água)
( ) outros _____

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Departamento de Odontologia Social

Nº

Cidade:

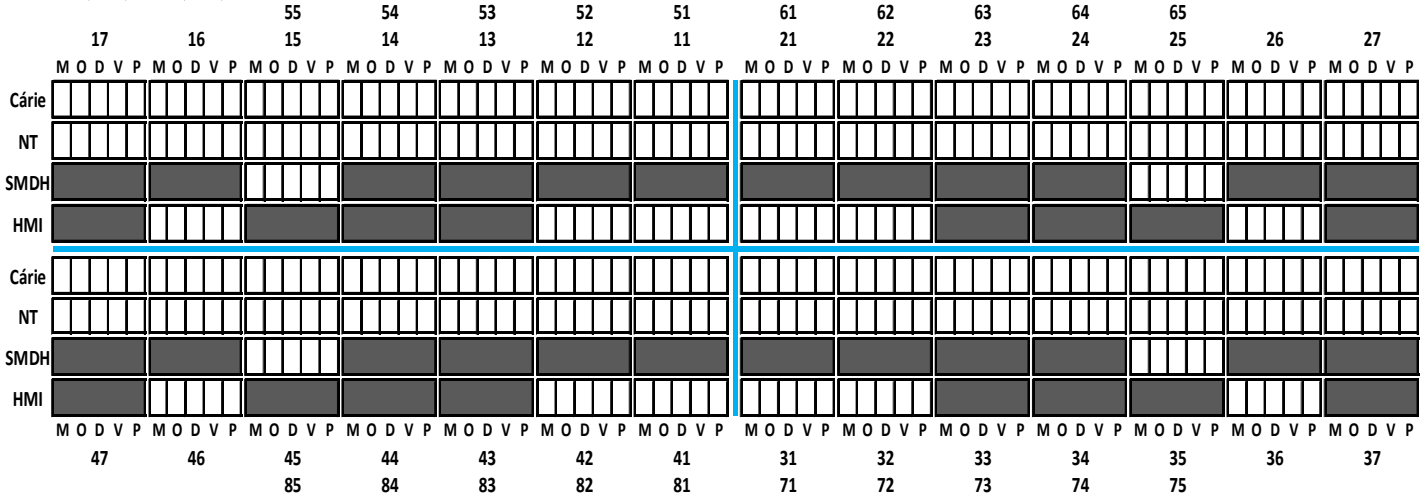
Escola: **Série:** **Data:**

Nome: **Idade:** **Gênero:**

Examinador:

Anotador:

ZR ☐ **ZU** ☐



SUMÁRIO:

c	e	o	ceod	tp	hig	C	P	O	CPOD	TP	HIG

c	e	o	CEOS	tp	hig	C	P	O	CPOD	TP	HIG

SMDH

1	2	3	Sev.

HMI

1	2	3	Sev.

NT

0	1	2	3	4	5	6	7	8	9

CPO	ceo	
0	A	hígido
1	B	cariado
2	C	rest. + cárie
3	D	rest. sem cárie
4	E	perdido p/ cárie
5	F	perd. p/ outras razões
6	G	selante
7	H	apoio de ponte/coroa
8	I	não erupcionado
9	J	excluído
T	T	trauma

SMDH/HMI	
1	manchas
2	Perda est.
3	Rest. Atíp.

Severidade	
1	leve
2	moderada
3	severa

NT	
0	nenhum tratamento
1	rest.1 superf.
2	rest.1 ou + superf.
3	coroa por qq razão
4	faceta estética
5	endo + rest
6	extração
7	rem. MB
8	selante
9	sem informação

ANEXO 10

COMITÊ DE ÉTICA EM PESQUISA
FACULDADE DE ODONTOLOGIA DE PIRACICABA
UNIVERSIDADE ESTADUAL DE CAMPINAS

CERTIFICADO

O Comitê de Ética em Pesquisa da FOP-UNICAMP certifica que o projeto de pesquisa **"Estudos dos defeitos de esmalte na dentição decídua"**, protocolo nº 037/2010, dos pesquisadores Cristiane Maria da Costa Silva e Fábio Luiz Mialhe, satisfaz as exigências do Conselho Nacional de Saúde - Ministério da Saúde para as pesquisas em seres humanos e foi aprovado por este comitê em 26/05/2010.

The Ethics Committee in Research of the School of Dentistry of Piracicaba - State University of Campinas, certify that the project **"Study of enamel defects in deciduous teeth"**, register number 037/2010, of Cristiane Maria da Costa Silva and Fábio Luiz Mialhe, comply with the recommendations of the National Health Council - Ministry of Health of Brazil for research in human subjects and therefore was approved by this committee at 05/26/2010.

Prof. Dr. Pablo Agustin Vargas
Secretário
CEP/FOP/UNICAMP

Prof. Dr. Jacks Jorge Junior
Coordenador
CEP/FOP/UNICAMP

Nota: O título do protocolo aparece como fornecido pelos pesquisadores, sem qualquer edição.
Notice: The title of the project appears as provided by the authors, without editing.

ANEXO 11

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

I. Título

Estudos dos defeitos de esmalte na dentição decídua

II. Introdução

Seu filho (a) foi convidado (a) a participar da pesquisa intitulada "Estudos dos defeitos de esmalte na dentição decídua", sob responsabilidade da pesquisadora Cristiane Maria da Costa Silva e orientação do Prof. Dr. Fábio Luiz Mialhe. Caso você decida pela participação de seu filho (a) nesta pesquisa, é necessário que leia as informações sobre o estudo contidas no texto abaixo e assine, com total liberdade, o termo de consentimento no final deste documento.

III. Justificativa para a realização da pesquisa

Crianças com do defeito de esmalte, apresentam mais experiência de cárie e necessidades de tratamento do que as que não os possuem. No entanto, ainda é necessário o desenvolvimento de estudo que busquem avaliar os fatores etiológicos destes defeitos, assim como confirmar a relação entre defeitos de esmalte nos dentes decíduos e risco de acometimento dos dentes permanentes.

IV. Objetivos

Este trabalho tem como objetivo estudar prospectivamente, a associação de defeitos de esmalte na dentição decídua com a cárie e necessidades de tratamento dentário e defeitos de esmalte na dentição permanente em crianças de 4 a 6 anos , residentes nas áreas rural e urbana do Município de Botelhos, Minas Gerais, Brasil. Além disso, busca-se avaliar possíveis fatores etiológicos para os defeitos de esmalte, tanto na dentição decídua quanto na permanente.

V. Metodologia

As cavidades bucais das crianças serão examinadas pela pesquisadora em ambiente escolar, durante o período de aula, uma vez a cada seis meses. Para este exame, será utilizado espátula de madeira descartável, espelho bucal e sonda, para remoção de possíveis restos alimentares presentes sobre os dentes que possam prejudicar a visualização dos mesmos. O exame é rápido e todas as normas de biossegurança serão respeitadas. As crianças serão avaliadas quanto à presença de defeitos de esmalte, cárie dentária e necessidades de tratamento dentário de acordo com as normas da Organização Mundial de Saúde (OMS). Os dados dos exames serão anotados em fichas individuais, que também fornecerão dados referentes ao gênero da criança (masculino e feminino), idade e local de moradia (zona rural ou urbana). Os pais responderão a um questionário sobre condições socioeconômicas da família, hábitos alimentares e de higiene da criança e acesso aos serviços de saúde. Os pais também responderão a um questionário sobre a saúde da mãe (durante a gestação) e da criança do nascimento até os primeiros 24 meses de vida.

VI. Possibilidade de inclusão em grupo controle ou placebo

Neste estudo não haverá grupo placebo ou controle.

VII. Métodos alternativos para obtenção da informação ou tratamento da condição

Não há quaisquer outros métodos alternativos para obtenção das informações da pesquisa.

VIII. Descrição crítica dos desconfortos e riscos previsíveis

Não há riscos previsíveis aos participantes. Pode ser gerado algum desconforto durante o exame das bocas das crianças, pois algumas crianças pode se sentir incomodadas por medo do procedimento. Entretanto, como o exame bucal é rápido e realizado por um examinador treinado, e com prática no atendimento de crianças, estes desconfortos tendem a ser minimizados. Caso alguma criança se recuse ao exame bucal, esta será liberada do procedimento, sem qualquer prejuízo de tratamento ou repreensão. Os questionários serão respondidos pelos pais, com inteira liberdade de resposta.

IX. Descrição dos benefícios e vantagens diretas ao voluntário

As crianças diagnosticadas com algum problema bucal, como cárie ou mesmo outra necessidade de tratamento, receberão encaminhamento escrito da pesquisadora (CD - Cristiane M Costa Silva), o que possibilita o manejo precoce destes problemas e a diminuição de episódios de dores, infecções ou mesmo perdas dentárias pelas crianças. A pesquisadora também se coloca a disposição para responder quaisquer dúvidas dos pais em relação às condições bucais de seus filhos.

X. Forma de acompanhamento e assistência ao sujeito

As crianças diagnosticadas com cárie e/ou necessidades de tratamento serão encaminhadas a Unidades Básicas de Saúde do Município e seus pais serão informados por escrito sobre as condições bucais de seu filho (a). Há garantia de respostas a quaisquer perguntas e/ou esclarecimentos a respeito de procedimentos, risco, benefícios e de outras dúvidas relacionadas à pesquisa.

XI. Forma de contato com os pesquisadores e com o CEP

Para contato com a pesquisadora, escreva para: Cristiane Maria da Costa Silva. Endereço: Rua Rio Grande do Norte, 350, Centro, Poços de Caldas, MG/ CEP: 37701-040 ou entre em contato pelo e-mail: cristiane@agenciacervantes.com ou telefone: (35) 8831 9446.

XII. Garantia de esclarecimentos

Há garantia de respostas a quaisquer perguntas e/ou esclarecimentos a respeito de procedimentos, risco, benefícios e de outras dúvidas relacionadas à pesquisa. A pesquisadora assume o compromisso de fornecer informações atualizadas obtidas durante o tempo de permanência da criança na pesquisa e garantirá o sigilo do nome e dados pessoais dos participantes. Em caso de quaisquer dúvidas, entre em contato com a pesquisadora ou o Comitê de Ética em Pesquisa.

XIII. Garantia de recusa à participação ou de saída do estudo

A sua participação nesta pesquisa é voluntária. Existe a liberdade de desistência da pesquisa a qualquer momento e de retirada de seu consentimento quanto à utilização dos materiais de pesquisa, sem qualquer punição ou prejuízo aos não participantes, inclusive do ponto do de vista de assistência social ou educacional.

XIV. Garantia de sigilo

A pesquisadora assume o compromisso de sigilo do nome e dados pessoais dos participantes.

XV. Garantia de ressarcimento

Não há previsão de ressarcimento de despesas, uma vez que este estudo não envolve gastos por parte dos participantes.

XVI. Garantia de indenização e/ou reparação de danos

Como a pesquisa não envolve risco aos participantes, não existem formas de indenização previstas.

XVII. Garantia de entrega de copia

Este Termo de Compromisso possui duas cópias, na qual uma ficará com você e a outra com a pesquisadora.

XVIII. Declaração de consentimento

Li as informações contidas neste documento antes de assinar este termo de consentimento. Declaro que fui informado(a) sobre os métodos, as inconveniências, riscos, benefícios e eventos adversos que podem vir a ocorrer em conseqüência dos procedimentos. Declaro que tive tempo suficiente para ler e entender as informações acima. Declaro também que toda a linguagem técnica utilizada na descrição deste estudo de pesquisa foi satisfatoriamente explicada e que recebi respostas para todas as minhas dúvidas. Confirmo também que recebi uma cópia deste formulário de consentimento. Compreendo que sou livre para retirar meu filho (a) do estudo em qualquer momento, por minha vontade ou pela própria vontade do meu filho (a), sem perda de benefícios ou qualquer outra penalidade. Dou meu consentimento de livre e espontânea vontade para o menor sob minha responsabilidade participar como voluntário deste estudo.

_____ _____

Assinatura do responsável Nome da criança

_____ _____

Assinatura da pesquisadora Local e data

_____

Assinatura do orientador

ATENÇÃO: A sua participação em qualquer outra pesquisa é voluntária. Em caso de dúvida quanto aos seus direitos, escreva para o Comitê de Ética em Pesquisa da FOP-UNICAMP. Endereço: Av. Limeira, 901-CEP: 16414-903/ Piracicaba/SP. Tel/Fax: (0xx19) 2106-5349 / E-mail: cep@fop.unicamp.br – website: www.fop.unicamp.br/cep.