ELAINE PEREIRA DA SILVA TAGLIAFERRO

AVALIAÇÃO DE RISCO DE CÁRIE DENTÁRIA: ESTADO DA ARTE E ESTUDO LONGITUDINAL SOBRE PREDITORES DE RISCO EM ESCOLARES

Tese apresentada à Faculdade de Odontologia de Piracicaba, da Universidade Estadual de Campinas, para obtenção do título de Doutora em Odontologia, Área de Concentração em Saúde Coletiva.

Orientador: Prof. Dr. Antonio Carlos Pereira

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PROF. DR. SILVIO ROCHA CORREA DA SILVA

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"Mudar o rumo da jornada nem sempre é fácil mas, muitas vezes, necessário. Quando se acerta na escolha, tudo se torna gratificante e recompensador"

RESUMO

A avaliação de risco de cárie é uma ferramenta importante na odontologia, uma vez que favorece o planejamento das ações em saúde com base em evidência científica. Esta tese, composta por dois estudos, teve como objetivos: a) apresentar uma visão geral e atual da avaliação de risco de cárie dentária (Capítulo 1); e b) determinar quais variáveis clínicas, comportamentais, socioeconômicas e demográficas identificaram indivíduos com maior probabilidade de desenvolver incremento de cárie, em estudo longitudinal realizado em um período de sete anos (Capítulo 2). No primeiro estudo, uma revisão da literatura odontológica sobre avaliação de risco de cárie nos últimos 10 anos foi realizada, a fim de identificar os fatores/preditores de risco da doença em crianças e adolescentes. Para isso, uma busca de artigos científicos publicados entre 1997 e 2007 foi conduzida na base de dados MEDLINE. Os estudos foram conduzidos principalmente com escolares (n=19), seguidos pelas pesquisas realizadas em crianças em idade pré-escolar (n=11), adolescentes (n=8) e crianças de até dois anos (n=5). A experiência de cárie, condição gengival, contagem microbiológica, hábitos de higiene oral, concentração de minerais no biofilme dental, exposição ao fluoreto, nível socioeconômico e educacional, características demográficas, antropométricas, bem como hábitos bucais, dietéticos e de escovação foram as variáveis estudadas. A experiência passada de cárie foi o preditor de risco predominante em todas as faixas etárias pesquisadas. Outras variáveis como os hábitos dietéticos, incluindo o consumo de açúcar, e os de escovação também podem ajudar a identificar indivíduos de alto risco de cárie. No segundo estudo, 206 escolares de três escolas de Piracicaba, estado de São Paulo, foram examinados no *baseline* e após sete anos pelos mesmos cirurgiões-dentistas, previamente calibrados, sob luz natural, usando espelho e sonda e seguindo as recomendações da Organização Mundial da Saúde para levantamentos epidemiológicos em saúde bucal. Os examinadores coletaram dados sobre as seguintes variáveis clínicas: cárie dentária, fluorose, higiene oral e presença de selante. Adicionalmente, informações sobre nível socioeconômico, uso de fluoreto, acesso a serviços odontológicos, hábitos dietéticos e de higiene oral foram obtidas no *baseline* por meio de questionário semi-estruturado enviado aos pais. Para testar a associação entre o incremento de superfícies cariadas, perdidas e obturadas (CPOS) e as variáveis

independentes, uma análise univariada foi conduzida utilizando-se o teste de Qui-quadrado ou o Exato de Fisher. A regressão logística múltipla foi usada para obter estimativas de *Odds Ratios* (OR), seus intervalos de confiança (IC) ao nível de 95% e níveis de significância. O modelo de predição demonstrou que os escolares com experiência de cárie em dentes permanentes (OR=2,49; IC=1,02-6,04; p=0,04) ou em dentes decíduos (OR=2,29; IC=1,24-4,23; p=0,001), bem como aqueles cuja escolaridade máxima da mãe era de oito anos de estudo (OR=1,88; IC=1,03-3,45; p=0,03) apresentaram probabilidades significativamente superiores de apresentar incremento de CPOS. Os resultados desta tese demonstraram que o nível educacional materno pode identificar os escolares com risco de desenvolver a doença e que as variáveis relacionadas à experiência passada de cárie continuam sendo o principal preditor de risco.

Palavras-chave: Cárie dentária, Avaliação de risco, Fatores de risco, Preditores de risco

ABSTRACT

Caries risk assessment is an important tool for dentistry, because it may help planning health actions based on scientific evidences. This thesis, composed of two studies, aimed to a) present an overview of caries risk assessment (Chapter 1); and b) determine which clinical, behavioral, socioeconomic and demographic variables could identify children with higher probability of developing caries increment in a seven-year longitudinal study (Chapter 2). In the first study, a search of the published English language literature from 1997 to 2007 was made for articles that reported on caries risk assessment in the MEDLINE database. The studies were conducted mainly in schoolchildren (n=19), followed by preschool children (n=11), adolescents (n=8), and infants (n=5). Variables such as caries experience, gingival status, microbiological counts, oral hygiene, plaque mineral concentration, fluoride history, socioeconomic and educational level, demographic, anthropometrical, oral, dietary and toothbrushing habits were studied. Past caries experience has been the predominant predictor of caries risk in 0-18-years old subjects. Other predictors such as dietary habits, including sugar intake, and toothbrushing habits may also help to identify high-risk individuals. Variables related to caries experience continue to be the main predictor of caries increment. In the second study, two hundred and six children from three schools in Piracicaba, Brazil, were examined at baseline and after 7 years by the same calibrated dentists in an outdoor setting, under natural light, using a dental mirror and probe following the World Health Organization recommendations for oral health surveys. The examiners collected data on the following clinical variables: dental caries, fluorosis, oral hygiene and presence of sealant. Moreover, information on socioeconomic level, fluoride usage, dental service utilization, dietary and oral hygiene habits was also obtained at baseline by means of a semi-structured questionnaire sent to the parents. In order to evaluate the association between the decayed, filling and missed surfaces (DMFS) increment and independent variables, a univariate analysis was performed using the Chi-square or Fisher exact tests. The multivariate logistic regression was used to estimate the adjusted Odds Ratio (OR), their 95% confidence intervals (CI) and significance levels. The prediction model demonstrated that the schoolchildren with caries experience in permanent (OR=2.49; CI=1.02-6.04; p=0.04) or primary teeth (OR=2.29;

CI=1.24-4.23; p=0.001), as well as those whose mothers´ educational level was up to eight years of schooling (OR=1.88; CI=1.03-3.45; p=0.03) were more prone to have DMFS increment. The results of this thesis demonstrated that the educational level of mothers could identify the schoolchildren at risk of developing the disease and that variables related to past caries experience continue to be the main risk predictor.

Key Words: Dental caries, Risk assessment, Risk factors, Risk predictors

SUMÁRIO

INTRODUÇÃO

A cárie dentária é uma doença multifatorial, resultante de um distúrbio no equilíbrio entre o dente e a microbiota presente no biofilme dental (Fejerskov, 2004). Atualmente, sua severidade e prevalência estão em declínio em várias áreas do mundo, incluindo o Brasil. Os resultados dos últimos levantamentos epidemiológicos de saúde bucal conduzidos no país demonstraram uma importante redução nos níveis de cárie da população de 12 anos (Brasil, 1988, 2004). Outros estudos nacionais e internacionais também vêm demonstrando um declínio da doença em escolares (Chawla *et al*., 2000; Irigoyen & Sánchez-Hinojosa, 2000; Pereira *et al*., 2000; Sales-Peres & Bastos, 2002; Bonecker & Cleaton-Jones, 2003; Bastos *et al*., 2004; Marthaler, 2004; Pakshir, 2004; Pieper & Schulte, 2004; van Wyk & van Wyk, 2004; Meneghim *et al*., 2006; Campus *et al*., 2007).

Os principais fatores que têm contribuído para a redução da doença cárie no Brasil, principalmente em crianças, são a fluoretação da água de abastecimento público, a utilização de dentifrícios fluoretados e a expansão dos programas preventivos realizados em escolas, creches, etc. (Pereira *et al*., 2000; Cury *et al*., 2004; Narvai *et al*., 2006).

Juntamente com o declínio da severidade e prevalência da doença, outros eventos também têm sido observados como a progressão mais lenta das lesões de cárie (Hintze, 2001; Rugarabamu *et al*., 2002; Moberg Skold *et al*., 2005), a concentração de novas lesões em superfícies oclusais (Splieth & Bernhardt, 1999; Campain *et al*., 2003; Batchelor & Sheiham, 2004; David *et al*., 2006) e a polarização da doença em grupos de risco (Burt, 1998; Seppä, 2001; Tickle, 2002). De fato, cerca de 80% das superfícies dentais cariadas estão concentradas em aproximadamente 25% a 30% das crianças e adolescentes (Poulsen & Scheutz, 1999; Pereira *et al*., 2007).

Dessa forma, a avaliação de risco de cárie é uma ferramenta importante na odontologia, favorecendo o planejamento das ações em saúde baseado em evidência científica. Segundo Douglass (1998), ela permite identificar os pacientes e grupos populacionais que irão beneficiar-se da prevenção, possibilita o uso mais apropriado de certos tipos de serviços preventivos para certas populações alvo e serve como alerta para a realização de um exame mais minucioso, fornecendo, assim, dicas importantes para o

diagnóstico oral final. Conhecer os fatores de risco é crucial na identificação daqueles indivíduos que apresentam os estágios iniciais da doença e são candidatos às novas e emergentes tecnologias preventivas.

A avaliação de risco de cárie consiste em determinar quais indivíduos são mais ou menos prováveis de prevenir ou controlar a doença cárie no futuro (Douglass, 1998), conhecendo quais variáveis clínicas, socioeconômicas, demográficas, ambientais, comportamentais, dentre outras, estão associadas com a doença.

Quando uma variável apresenta associação/relação estatisticamente significativa com a experiência de cárie em um dado momento (estudos transversais), é reconhecida como indicador de risco. Entretanto, um estudo transversal não apresenta o delineamento mais indicado para a avaliação de risco de cárie. De acordo com Burt (2001) os resultados de estudos transversais são menos fortes que aqueles obtidos em estudos longitudinais. Além disso, estes últimos são essenciais para distinguir causa e efeito.

Por sua vez, variáveis que apresentam associação/relação estatisticamente significativa com o incremento de cárie em um período de tempo são reconhecidas como fatores ou preditores de risco. O fator de risco é uma variável ambiental, comportamental ou biológica, usualmente confirmada por seqüência temporal em estudos longitudinais, que, se presente, aumenta diretamente a probabilidade de ocorrência da doença e, se ausente ou removida, reduz a probabilidade. Os fatores de risco são parte da ou expõem o hospedeiro à cadeia causal da doença (Beck, 1998). Segundo Kleinbaum *et al*. (1982), para que uma característica seja considerada fator de risco, ela deve satisfazer três critérios: a) deve estar estatisticamente associada ao desenvolvimento da doença; b) a presença do fator de risco deve preceder a ocorrência da doença; c) a associação observada entre a variável e a doença não pode ser inteiramente devida ao acaso ou ao erro amostral, ao envolvimento de outros fatores de risco ou a outros problemas com o delinamento do estudo ou com a análise de dados.

O preditor de risco ou também chamado marcador de risco está relacionado a um risco elevado da doença, mas não está correlacionado com suas causas (Beck, 1998), como por exemplo, a experiência passada de cárie que, apesar de estar fortemente associada com o incremento de cárie, não faz parte da cadeia causal da doença.

A maioria dos estudos longitudinais sobre avaliação de risco é realizada em crianças e adolescentes, principalmente pela facilidade de acesso em instituições de ensino. Seus resultados têm mostrado que variáveis clínicas, como a capacidade tampão, o fluxo salivar (Raitio *et al*., 1996), a presença de gengivite (Utriainen *et al*., 1998; Pienihäkkinen *et al*., 2004), a morfologia dental, observada pela presença de fóssulas e fissuras retentivas (Wandera *et al*., 2000), a concentração de fósforo e flúor na placa (Pearce *et al*., 2002) bem como algumas variáveis comportamentais, como a história de exposição ao flúor (Splieth & Benhardt, 1999; Wandera *et al*., 2000; Vanobbergen *et al*., 2001) não têm sido reconhecidos como preditores de cárie significativos, ao menos em crianças de até 14 anos de idade. O poder de predição dos hábitos dietéticos é controverso segundo os resultados de vários estudos (Ollila *et al*., 1998; Petti & Hausen, 2000; Rodrigues & Sheiham, 2000; Vanobbergen *et al*., 2001; Pearce *et al*., 2002; Pienihäkkinen *et al*., 2004; Mattila *et al*., 2005; Ollila & Larmas, 2007). A higiene oral deficiente, detectada no exame inicial (*baseline*), tem demonstrado ser fator de risco significativo por alguns pesquisadores (Reisine *et al*., 1994; Mattila *et al*., 1998, 2005; Petti & Hausen, 2000; Wandera *et al*., 2000; Vanobbergen *et al*., 2001; Leroy *et al*., 2005; Ollila & Larmas, 2007), enquanto que para outros não (Raitio *et al*., 1996; Lawrence & Sheiham, 1997; Petti & Hausen, 2000; Vanderas *et al*., 2000; Pearce *et al*., 2002; Seki *et al*., 2003).

As características microbiológicas, como a contagem de estreptococos do grupo *mutans*, lactobacilos e cândida na saliva ou no biofilme dental também têm mostrado poder de predição significativo em alguns estudos (Reisine *et al*., 1994; Raitio *et al*., 1996; Seki *et al*., 2003; Kopycka-Kedzierawski & Billings, 2004; Pienihäkkinen *et al*., 2004) enquanto que, em outros, tal fato não foi observado (Angulo *et al*., 1995; Petti & Hausen, 2000). Segundo Disney *et al*. (1992) e Hausen (1997), os níveis de bactérias cariogênicas melhoram, apenas moderadamente, o ajuste dos modelos com maior poder de predição. As variáveis sociodemográficas, com exceção dos modelos preditivos para crianças em idade pré-escolar, principalmente (Demers *et al*., 1992; Grindefjord *et al*., 1995; Mattila *et al*., 1998), têm demonstrado fraca ou nenhuma associação em modelos de predição (Disney *et al*., 1992; Mattila *et al*., 2001; Campain *et al*., 2003). Por fim, a experiência de cárie tem sido, dentre todas as variáveis, o mais valioso preditor da doença (Disney *et al*., 1992;

Alaluusua, 1993; Reisine *et al*., 1994; Gavazzi *et al*., 1995; Raitio *et al*., 1996; Hausen, 1997; Mattila *et al*., 1998; Utriainen *et al*., 1998; Rodrigues & Sheiham, 2000; Wandera *et al*., 2000; Vanobbergen *et al*., 2001; Källestål & Wall, 2002; Pearce *et al*., 2002; Stenlund *et al*., 2002; Seki *et al*., 2003; Pienihäkkinen *et al*., 2004; Vanderas *et al*., 2004; Leroy *et al*., 2005; Jeppesen & Foldspang, 2006; Skeie *et al*., 2006; Vallejos-Sánchez *et al*., 2006).

Além disso, os estudos sobre predição de cárie têm mostrado que algumas questões parecem estar bem estabelecidas na literatura, como a necessidade de estudos longitudinais a fim de confirmar fatores de risco prováveis e supostos, detectados em estudos transversais (Beck, 1998; Powell, 1998), o uso do incremento de doença em um determinado período de tempo como medida de resultado primária, empregada na maioria dos estudos (Slade & Caplan, 2000) e, por fim, o emprego preferível de modelos de regressão logística com múltiplos fatores, devido à etiologia complexa e multifatorial do processo de cárie (Beck, 1998; Powell, 1998).

Por outro lado, há dificuldades em se realizar uma avaliação precisa do risco de desenvolver cárie (Burt, 1998), especialmente nos indivíduos livres da doença, além disso, não há um consenso geral sobre qual é a melhor faixa etária para fazer o exame inicial (Powell, 1998).

Assim, torna-se de grande importância, a realização de estudos que contribuam para o tema predição de cárie, possibilitando a determinação de preditores de risco e identificando, de forma precisa, os indivíduos com maior probabilidade de desenvolver a doença. Adicionalmente, a maioria dos trabalhos disponíveis na literatura odontológica tem relatado períodos de estudo de no máximo três anos, havendo escassez de estudos mais longos, tanto em nível nacional quanto internacional.

Dessa forma, os objetivos desta tese foram: a) apresentar uma visão geral e atual da avaliação de risco de cárie dentária (Capítulo 1); e b) determinar quais variáveis clínicas, comportamentais, socioeconômicas e demográficas identificaram indivíduos com maior probabilidade de desenvolver incremento de cárie, em estudo longitudinal realizado em um período de sete anos (Capítulo 2).

CAPÍTULO 1

O presente artigo foi submetido ao periódico “Caries Research” (Anexo 1).

AN OVERVIEW OF CARIES RISK ASSESSMENT IN 0-18 YEAR-OLDS OVER THE LAST TEN YEARS (1997-2007)*

Tagliaferro EPS[1], Pardi V[2], Ambrosano GMB[1], Meneghim MC[1], Pereira AC[1]

[1]Department of Community Dentistry, Faculty of Dentistry of Piracicaba, State University of Campinas (UNICAMP), Piracicaba, SP, Brazil

[2]Graduate Program in Community Health, Faculty of Dentistry, University of Sagrado Coração, Bauru, SP, Brazil

Short Title: An overview of caries risk assessment in 0-18 year-olds

Key words: dental caries; risk; assessment; prediction

Corresponding Author:

Prof. Dr. Antonio Carlos Pereira

Av. Limeira 901 - 13414-903, Piracicaba, SP, Brazil

Telephone: + 55 19 2106 5209 Fax: +55 19 2106 5218

E-mail: apereira@fop.unicamp.br

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ABSTRACT

This study aimed to describe some important terms in caries risk assessment and to review the dental literature about the topic over the last 10 years, in order to show which variables have been considered caries risk factors/predictors in infants, preschool-, schoolchildren and adolescents. A MEDLINE search of the published English language literature from 1997 to 2007 was made for papers that reported on longitudinal studies, and caries risk. Studies were selected if they met the following criteria: longitudinal study conducted with children aged 0-18 years, providing information on sample size, age at initial examination (baseline), variables collected at baseline, study lasting, statistical tests used and outcome variable. Most of the studies were conducted in schoolchildren (n=19), followed by preschool children (n=11), adolescents (n=8), and infants (n=5). Variables such as caries experience, gingival status, microbiological counts, oral hygiene, plaque mineral concentration, fluoride history, socioeconomic and educational level, demographic, anthropometrical, oral, dietary and toothbrushing habits were collected. Past caries experience has been the predominant predictor for future caries in 0-18-years old subjects. Other predictors such as dietary habits, including sugar intake, and toothbrushing habits may also help to identify high-risk individuals. Variables related to caries experience continue to be the main predictor of caries increment.

INTRODUCTION

One of the main goals of Dentistry has been to prevent dental caries. The disease, according to Aoba and Fejerskov [2002], has been the predominant cause of tooth loss in all populations of the world.

In general two preventive strategies can be used to prevent and/or control the caries: the "high risk strategy" that is directed towards individuals particularly susceptible to developing dental caries [Fejerskov, 1995] and "the population strategy" which endeavors to protect all the people, including high and low caries risk individuals. Another strategy reported by Burt [1998], namely the "geographically targeted strategy", in which the preventive measures are targeted to a sub-group or a specific area of the city/country such as schools in the poor part of the city or an area of immigrant population. However, all the strategies have the same proposal: to prevent and/or to control the development of new carious lesions or to halt the progression of preexisting lesions.

Fortunately caries decline has occurred in many countries [Marthaler, 2002]. Fluoride delivered in toothpastes, water supply and oral health education have been important factors. Caries decline and increasing preventive measures have made caries risk assessment a difficult task, because the validity of a caries risk analysis is dependent on regional caries scores, sealant rates and use of fluoride [Splieth and Bernhardt, 1999].

In spite of increasing preventive measures, it seems that for a minority of children these procedures have been insufficient for preventing and controlling the disease, as the majority of carious lesions are concentrating in this group. Thus oral health administrators have been adopting the "high risk strategy" directed towards these individuals.

If individuals with risk for developing dental caries were correctly identified, planning specific measures for caries control and prevention may become a biological and socioeconomic measure, increasing the efficiency of preventive programs, as emphasized by Giannoni et al. [2005]. Moreover, identifying caries risk factors/predictors allows the individuals or population groups that will really benefit from preventive measures to be selected. This makes it possible to use specific and appropriate preventive measures in target people and may work as an alert for conducting a more detailed dental examination. In addition to the aforementioned advantages, knowing caries risk factors is decisive in detecting those with initial carious lesions, who may benefit from novel and emergent preventive technologies [Douglass, 1998]. Fontana and Zero [2006] discussing caries risk assessment in private practice have recommended that factors such as caries experience, dietary habits,

fluoride exposure, presence of cariogenic bacteria, salivary status, general medical history and sociodemographic characteristics should be evaluated when assessing the patient's caries risk.

The aim of this work was to describe some important terms in caries risk assessment and to review the dental literature about the topic over the last 10 years (1997-2007), in order to show which variables have been considered caries risk factors/predictors in infants, preschool-, schoolchildren and adolescents.

MATERIALS AND METHODS

A search of the published literature from 1997 to 2007 was made for articles that reported on caries risk assessment in the MEDLINE database using the following descriptors: longitudinal caries, risk. Furthermore MeSH Database PubMed Service was used with some of the cited terms: "Longitudinal Studies"[MeSH] AND "Dental Caries"[MeSH] AND "Risk"[MeSH]. The limits for the search included: Publication Date from 1997 to 2007, All Child: 0-18 years. Studies were selected if they met the following criteria: longitudinal study conducted with children aged 0-18 years, providing information on sample size, age at initial examination (baseline), variables collected at baseline, study lasting, statistical tests used and outcome variable.

RESULTS

Forty-three papers were reviewed; among them, 41 were easily accessed and two were obtained by contacting the corresponding author.

Before presenting the collected data from reviewed papers, it is important to be clear about some of the terms used when discussing caries risk assessment or caries prediction. They are described below.

Caries risk

"Caries risk is the probability of an individual to develop least a certain number of caries lesions and reaching a given stage of disease progression during a specific period of time, conditional on his or her exposure status remaining stable during the time in question" [Hausen et al., 1994].

Caries Risk Assessment

The assessment of caries risk consists of determining which individuals are more or less probable to prevent or to control dental caries in the future by means of knowing the variables associated with the disease [Douglass, 1998].

Caries risk assessment studies can be performed using cross-sectional data, in which subjects' data are colleted once, in general about a disease prevalence or severity, or longitudinal data, in which individuals are examined repeatedly through time. Apart from clinical variables, several others such as, socioeconomics, demographics, and behavioral characteristics can be used to assess their effects on caries levels (cross-sectional studies) or in caries incidence and/or increment (longitudinal studies). Although longitudinal studies are difficult and expensive to conduct, and depend on the participants´ willingness, their results are stronger than those obtained in cross-sectional studies, as pointed by Burt [2001]. Moreover, longitudinal studies are essential to distinguish cause and effect.

Risk Indicator

Risk indicators are those associated with the outcome variable only in cross-sectional studies. According to Burt [2001] a risk indicator may be a probable, or supposed, risk factor. To be a risk factor, the risk indicator should be a variable that causes significant effect on the outcome variable in longitudinal studies.

Risk Factor

One of the first definitions of risk factor comes from Last's Dictionary of Epidemiology, a standard dictionary of epidemiology. According to Last [2001], risk factor is defined as an "aspect of personal behavior or lifestyle, an environmental exposure, or an inborn or inherited characteristic which on the basis of epidemiological evidence is known to be associated with health-related condition(s) considered important to prevent." However, Burt [2001] emphasized that it is a wide and rather inexact definition that raises questions about the issues of causal role, strength of association, and modifiability.

Due to the uncertainness in risk definition, other meanings such as those cited by Burt [2001], e.g. "Risk marker (an attribute or exposure that is associated with increased probability of disease, but is not necessarily a causal factor) determinant (an attribute or exposure that increases the probability of occurrence of disease or other specified outcome) and modifiable risk factor (a determinant that can be modified by intervention, thereby reducing the probability of disease)" have been attributed to risk factors.

In attempt to clarify and to standardize the issues related to risk factor, Beck [1998] has stated the meaning of Risk factor that was adopted for the World Workshop on

Periodontics in 1996. Therefore Risk factor has been defined as "an environmental, behavioral, or biologic factor confirmed by temporal sequence, usually in longitudinal studies, which if present directly increases the probability of a disease occurring, and if absent or removed reduces the probability. Risk factors are part of the causal chain, or expose the host to the causal chain. Once disease occurs, removal of a risk factor may not result in a cure" [Beck, 1998].

Risk Predictor

Risk predictor is also named by Beck [1998] as a risk marker, and is defined as a characteristic associated with a high risk for the disease. The risk predictor predicts well but it is not thought to be part of the causal chain. As a good example, past caries experience has been strongly associated with a high risk for caries increment in the future. However, this variable is not part of the causal chain and therefore is considered a risk predictor. Moreover, it has been related that in case of preventive measures being introduced in the studied caries risk group, to reduce the disease activity, past caries experience becomes a risk predictor with reduced worth.

Risk Model and Prediction Model

They are multivariate statistical models with the aim of identifying which explanatory variables significantly increase the risk of developing the disease in a period of time or, in cross-sectional studies, which variable increases the risk of having the studied disease.

Risk model is a multivariable model developed when it is important to identify one or more risk factors for the disease, which may allow public health practitioners to plan intervention actions for reducing individuals' risk. In this kind of model, the risk predictors, such as past caries experience, should not be included because they are powerful and may dissemble potential risk factors [Beck, 1998].

The prediction model is also a multivariable model used when the etiology of the disease is already thought to be understood, with the main aim of identifying the individuals at high risk [Beck, 1998]. The advantage of this model is that the variables directly or indirectly related to the etiology of the disease as well as those that are not part of the causal chain may be included in the model. According to Beck [1998], a prediction model allows increase sensitivity and specificity (the proportions of individuals correctly classified with or without the disease) of the prediction.

Data from reviewed papers

In the Tables a detailed review of the papers published over the last ten years (1997-2007) about caries risks assessment in infants (<2 years), preschool children (2-5 years), schoolchildren (6-12 years) and adolescents (13-18 years) is presented. The division by age groups was based on that of MEDLINE. Most studies on caries risk assessment during the last 10 years were conducted in schoolchildren (n=19), followed by preschool children (n=11), adolescents (n=8), and infants (n=5). The majority of them were related to data collected in Finland (n=9), followed by Brazil (n=5), Sweden (n=4), China (n=3), Norway (n=3), USA (n=3), the Netherlands (n=3), Belgium (n=2), Greece (n=2), Japan (n=2), Australia (n=1), Denmark (n=1), Germany (n=1), Israel (n=1), Italy (n=1), Mexico (n=1) and New Zealand (n=1). As one can see, European countries have contributed a great deal to the dental literature on caries risk assessment over the last decade.

DISCUSSION

Researches on caries risk assessment have been conducted since the 1980's, focused on developing an easy tool for identifying high-caries-risk individuals [Moss and Zero, 1995]. Published studies in general have used clinical, microbiological, salivary, socioeconomic, demographic, medical history, dietary habits, fluoride history, use of dental services, and dental health behaviors variables, separately and in combination to identify high-caries-risk individuals.

According to dental literature, the use of caries increment during a period of time is the primary outcome measure [Slade and Caplan, 2000] and statistical analysis based on logistic regression with multiple factors are preferable because of the complex and multifactorial etiology of the caries process [Beck, 1998].

Caries risk assessment by age groups

There are few studies on this issue targeting infants at baseline examination, and these collected mainly dental variables (Table 1). These studies were conducted in Japan, Finland, and Brazil. Only one study [Pienihäkkinen et al., 2004] used logistic regression models with multiple variables for identifying risk predictors/factors (RP/RF) for caries development, which are the preferable model for this type of study, as dental caries presents a multifactorial and complex etiology [Beck, 1998]. In the Pienihäkkinen's et al. [2004] study, the mutans streptococcus counts, the presence of incipient caries lesions, and the use of candies were predictors for caries increment after a 3-year-follow-up. However, the results of other studies should not be ignored, as they showed that children with cavitated or non-

cavitated caries lesions, or high MS levels or lack of daily toothbrush at baseline were at risk for dental caries in the future (Table 1). Considering the small number of studies in this age group during the last 10 years, further studies should be conducted and make use of more appropriate statistical analysis.

As regards studies concerning preschool children (Table 2), 11 papers published over the last ten years were selected. Variables such as dental, socioeconomic, behavioral, diet, microbiological, medical, demographic have been collected in study periods ranging from 0.5 to 10 years. These studies were conducted in Brazil, China, Finland, Israel, Japan, Norway, Sweden, and USA. Most (n=8) studies used logistic regression models as statistical analyses and showed that the main caries risk predictors/factor were caries experience, sugar intake and the presence of plaque on teeth at baseline. Other important RP/RF were also detected, such as fluoride use, plaque strepctococcus mutans score, mothers' education, presence of plaque toothbrushing related habits, use of nursing bottle, pacifier-sucking and family related variables. The studies that used other statistical techniques demonstrated that microbiological counts, daily sucrose intake, presence of caries at baseline were variables that placed a child in a caries risk condition.

Schoolchildren have been the most studied group in caries risk assessment (Table 3). From 1997 to 2007, 19 papers were selected and reviewed. These studies were conducted in Belgium, Brazil, China, Denmark, Finland, Germany, Greece, Italy, Mexico, Norway, Sweden, The Netherlands, and USA. Study duration ranged from 1 to 8 years and, as usual, dental variables were collected at baseline in all the papers. Other variables that also were collected in a considerable number of studies were: socioeconomic, microbiological and behavioral characteristics. Among the studies that used regression techniques (n=16) in statistical analysis the predominant RP/RF was past caries experience (n=10) followed by other variables such as dietary factors, oral hygiene related habits, high salivary MS levels, mother's education, plaque calcium concentration, epinephrine levels, fluoride history, dietary habits, gender, and socioeconomic level. As previously reported, past caries experience detected at baseline is the variable that best indicates those at risk for developing new lesions in the future. Among the papers with no regression analyses as statistical procedures (n=3) only one found significant positive correlation between initial MS scores and caries development [Splieth and Bernhardt, 1999], and the other between caries increment and several salivary components [Kirstilä et al., 1998].

Eight studies involving caries risk assessment in adolescents (Table 4), conducted in Australia, Brazil, Finland, New Zealand, Sweden, and the Netherlands were found from

1997 to 2007. The researchers followed-up the participants from 1 to 10 years, and collected dental, behavioral, demographic, socioeconomic, anthropometric, dietary habits, medical, and microbiological variables. The RP/RF obtained in regression techniques were: past caries experience, fluoride level in the drinking water, toothbrushing frequency, gingival infection, gender and dietary habits.

Review of the papers was able to demonstrate that past dental caries was a predictor of the future disease for all age groups. Other predominant predictors were microbiological counts and toothbrushing habits. Sugar intake also deserves be pointed out mainly for young children. Except for past dental caries, which is relatively easy to collect data, the other predictors are determinants for caries development and it is not so difficult to gather information on them from a community point of view. On the other hand it may be unfeasible to collect data about microbiological variables, because of limitations inherent to resources and/or techniques. In fact, it has been suggested that in caries risk assessment, variables such as fluoride use, socioeconomic level status, caries experience and severity as well as plaque index should be collected before the application of the test for e.g. mutans streptococcus [Petti and Hausen, 2000]. As reported by Kopycka-Kedzierawski and Billings [2004], "a caries risk assessment protocol must involve the use of measures that are easily obtained, widely accepted, simple to use, reproducible and cost-effective".

CONCLUDING REMARKS

It is important to take into consideration that this study presents some limitations such as the absence of quality criteria for selecting the papers (no score for papers), and the selection of studies mainly from MEDLINE database. In spite of its limitations, by reviewing the published papers over the last ten years, this study could clearly demonstrate that past caries experience has been the predominant predictor for future caries in subjects from 0 to 18 years of age. Therefore those with the disease should receive good oral health education and should be made aware that they are subjects at risk for developing caries. Moreover, they should be continuously monitored to prevent the development of new lesions.

On the other hand, it would be unwise to wait for the presence of caries to know which subject will be more prone to develop further lesions in the future, as was already discussed by Tinanoff [1995]. Further studies involving a large number of caries-free individuals should be conducted on caries risk assessment. Nevertheless, the use of other predictors such as dietary habits, including sugar intake, and toothbrushing habits may help to

identify those caries-free subjects who might be more prone to have new carious lesions in the future.

In conclusion, the variables related to caries experience collected at the initial examination continue to be the main predictor of caries increment.

REFERENCES

Aoba T, Fejerskov O: Dental fluorosis: chemistry and biology. Crit Rev Oral Biol Med 2002;13:155-170.

Beck JD: Risk revisited. Community Dent Oral Epidemiol 1998;26:220-225.

Bjarnason S, Köhler B: Caries risk assessment in adolescents. Swed Dent J 1997;21:41-48.

Burt BA: Definitions of risk. J Dent Educ 2001;65:1007-1008.

Burt BA: Prevention policies in the light of the changed distribution of dental caries. Acta Odontol Scand 1998;56:179-186.

Campain AC, Morgan MV, Evans RW, Ugoni A, Adams GG, Conn JA, Watson MJ: Sugar-starch combinations in food and the relationship to dental caries in low-risk adolescents. Eur J Oral Sci 2003;111:316-325.

David J, Raadal M, Wang NJ, Strand GV: Caries increment and prediction from 12 to 18 years of age: a follow-up study. Eur Arch Paediatr Dent 2006;7:31-37.

Douglass CW: Risk assessment in dentistry. J Dent Educ 1998;62:756-761.

Fejerskov O: Strategies in the design of preventive programs. Adv Dent Res 1995;9:82-88.

Fontana M, Zero DT: Assessing patients' caries risk. J Am Dent Assoc 2006;137:1231-1239.

Giannoni M, D'Amario M, Gatto R, Barone A: Some tools for the identification of high caries risk individuals. A review. Minerva Stomatol 2005;54:111-127.

Hausen H, Seppä L, Fejerskov O: Can caries be predicted? in: Thylstrup A, Fejerskov O (eds): Textbook of clinical cariology. 2nd ed. Copenhagen: Munksgaard; 1994. pp 393–411.

Jeppesen BA, Foldspang A: Can the development of new dental caries in Danish schoolchildren be predicted from surveillance data in the School Dental Service? Community Dent Oral Epidemiol 2006;34:205-212.

Källestål C, Wall S: Socio-economic effect on caries. Incidence data among Swedish 12-14-year-olds. Community Dent Oral Epidemiol 2002;30:108-114.

Karjalainen S, Söderling E, Sewón L, Lapinleimu H, Simell O: A prospective study on sucrose consumption, visible plaque and caries in children from 3 to 6 years of age. Community Dent Oral Epidemiol 2001;29:136-142.

Kirstilä V, Häkkinen P, Jentsch H, Vilja P, Tenovuo J: Longitudinal analysis of the association of human salivary antimicrobial agents with caries increment and cariogenic micro-organisms: a two-year cohort study. J Dent Res 1998;77:73-80.

Kopycka-Kedzierawski DT, Billings RJ: A longitudinal study of caries onset in initially caries-free children and baseline salivary mutans streptococci levels: a Kaplan-Meier survival analysis. Community Dent Oral Epidemiol 2004;32:201-209.

Last JM (ed): A dictionary of epidemiology. 4th ed. New York: Oxford University Press; 2001.

Lawrence HP, Sheiham A: Caries progression in 12- to 16-year-old schoolchildren in fluoridated and fluoride-deficient areas in Brazil. Community Dent Oral Epidemiol 1997;25:402-411.

Leroy R, Bogaerts K, Lesaffre E, Declerck D: Multivariate survival analysis for the identification of factors associated with cavity formation in permanent first molars. Eur J Oral Sci 2005;113:145-152.

Li Y, Wang W: Predicting caries in permanent teeth from caries in primary teeth: an eight-year cohort study. J Dent Res 2002;81:561-566.

Marthaler TM: Dentistry between pathology and cosmetics. Community Dent Oral Epidemiol 2002;30:3-15.

Mattila ML, Paunio P, Rautava P, Ojanlatva A, Sillanpää M: Changes in dental health and dental health habits from 3 to 5 years of age. J Public Health Dent 1998;58:270-274.

Mattila ML, Rautava P, Aromaa M, Ojanlatva A, Paunio P, Hyssälä L, Helenius H, Sillanpää M: Behavioural and demographic factors during early childhood and poor dental health at 10 years of age. Caries Res 2005;39:85-91.

Mattila ML, Rautava P, Paunio P, Ojanlatva A, Hyssälä L, Helenius H, Sillanpää M: Caries experience and caries increments at 10 years of age. Caries Res 2001;35:435-441.

Mattos-Graner RO, Smith DJ, King WF, Mayer MPA: Water-insoluble glucan synthesis by mutans streptococcal strains correlates with caries incidence in 12- to 30-month-old children. J Dent Res 2000;79:1371-1377.

Meldrum AM, Thomson WM, Drummond BK, Sears MR: Is asthma a risk factor for dental caries? Findings from a cohort study. Caries Res 2001;35:235-239.

Moss ME, Zero DT: An overview of caries risk assessment, and its potential utility. J Dent Educ 1995;59:932-940.

Ollila P, Larmas M: A seven-year survival analysis of caries onset in primary second molars and permanent first molars in different caries risk groups determined at age two years. Acta Odontol Scand 2007;65:29-35.

Ollila P, Niemelä M, Uhari M, Larmas M: Prolonged pacifier-sucking and use of a nursing bottle at night: possible risk factors for dental caries in children. Acta Odontol Scand 1998;56:233-237.

Pearce EIF, Dong YM, Yue L, Gao XJ, Purdie GL, Wang JD: Plaque minerals in the prediction of caries activity. Community Dent Oral Epidemiol 2002;30:61-69.

Peretz B, Ram D, Azo E, Efrat Y: Preschool caries as an indicator of future caries: a longitudinal study. Pediatr Dent 2003;25:114-118.

Petti S, Hausen HW: Caries prediction by multiple salivary mutans streptococcal counts in caries-free children with different levels of fluoride exposure, oral hygiene and sucrose intake. Caries Res 2000;34:380-387.

Pienihäkkinen K, Jokela J, Alanen P: Assessment of caries risk in preschool children. Caries Res 2004;38:156-162.

Poorterman JHG, Aartman IHA, Kieft JA, Kalsbeek H: Approximal caries increment: a three-year longitudinal radiographic study. Int Dent J 2003;53:269-274.

Rodrigues CS, Sheiham A: The relationships between dietary guidelines, sugar intake and caries in primary teeth in low income Brazilian 3-year-olds: a longitudinal study. Int J Paediatr Dent 2000;10:47-55.

Scavuzzi AIF, Caldas-Junior AF, Couto GBL, Vasconcelos MMBV, Soares RPF, Valença PAM: Longitudinal study of dental caries in Brazilian children aged from 12 to 30 months. Int J Paediatr Dent 2007;17:123-128.

Seki M, Karakama F, Terajima T, Ichikawa Y, Ozaki T, Yoshida S, Yamashita Y: Evaluation of mutans streptococci in plaque and saliva: correlation with caries development in preschool children. J Dent 2003;31:283-290.

Skeie MS, Raadal M, Strand GV, Espelid I: Caries in primary teeth at 5 and 10 years of age: a longitudinal study. Eur J Paediatr Dent 2004;5:194-202.

Skeie MS, Raadal M, Strand GV, Espelid I: The relationship between caries in the primary dentition at 5 years of age and permanent dentition at 10 years of age - a longitudinal study. Int J Paediatr Dent 2006;16:152-160.

Slade GD, Caplan DJ: Impact of analytic conventions on outcome measures in two longitudinal studies of dental caries. Community Dent Oral Epidemiol 2000;28:202-210.

Splieth C, Bernhardt O: Prediction of caries development for molar fissures with semiquantitative mutans streptococci tests. Eur J Oral Sci 1999;107:164-169.

Stenlund H, Mejàre I, Källestål C: Caries incidence rates in Swedish adolescents and young adults with particular reference to adjacent approximal tooth surfaces: a methodological study. Community Dent Oral Epidemiol 2003;31:361-367.

Stenlund H, Mejàre I, Källestål C: Caries rates related to approximal caries at ages 11-13: a 10-year follow-up study in Sweden. J Dent Res 2002;81:455-458.

Tagliaferro EPS, Pereira AC, Meneghim MC, Ambrosano GMB: Assessment of dental caries predictors in a seven-year longitudinal study. J Public Health Dent 2006;66:169-173.

Thibodeau EA, O'Sullivan DM: Salivary mutans streptococci and caries development in the primary and mixed dentitions of children. Community Dent Oral Epidemiol 1999;27:406-412.

Tinanoff N: Critique of evolving methods for caries risk assessment. J Dent Educ 1995;59:980-985.

Utriainen P, Pahkala K, Kentala J, Laippala P, Mattila K: Changes in the oral health of adolescents treated by the Finnish public dental services between the ages of 13 and 15 years. Community Dent Oral Epidemiol 1998;26:149-154.

Vallejos-Sánchez AA, Medina-Solís CE, Casanova-Rosado JF, Maupomé G, Minaya-Sánchez M, Pérez-Olivares S: Caries increment in the permanent dentition of Mexican children in relation to prior caries experience on permanent and primary dentitions. J Dent 2006;34:709-715.

van Palenstein Helderman WH, Mikx FHM, Van't Hof MA, Truin GJ, Kalsbeek H: The value of salivary bacterial counts as a supplement to past caries experience as caries predictor in children. Eur J Oral Sci 2001a;109:312-315.

van Palenstein Helderman WH, van't Hof MA, van Loveren C: Prognosis of caries increment with past caries experience variables. Caries Res 2001b;35:186-192.

Vanderas AP, Kavvadia K, Papagiannoulis L: Development of caries in permanent first molars adjacent to primary second molars with interproximal caries: four-year prospective radiographic study. Pediatr Dent 2004;26:362-368.

Vanderas AP, Manetas K, Papagiannoulis L: Caries increment in children and urinary catecholamines: findings at one-year. J Dent Child 2000;67:355-359.

Vanobbergen J, Martens L, Lesaffre E, Bogaerts K, Declerck D: The value of a baseline caries risk assessment model in the primary dentition for the prediction of caries incidence in the permanent dentition. Caries Res 2001;35:442-450.

Wandera A, Bhakta S, Barker T: Caries prediction and indicators using a pediatric risk assessment teaching tool. J Dent Child 2000;67:408-412.

Yonezu T, Machida Y: Caries development in children from 1.5 to 3 years of age: a longitudinal study. Bull Tokyo Dent Coll 1998;39:25-29.

Zhang Q, Bian Z, Fan M, van Palenstein Helderman WH: Salivary mutans streptococci counts as indicators in caries risk assessment in 6-7-year-old Chinese children. J Dent 2007;35:177-180.

LEGENDS

Table 1. Review of literature on caries risk assessment in infants (0-2 years old) over the last ten years (1997-2007)

Table 2. Review of literature on caries risk assessment in preschool children (2-5 years old) over the last ten years (1997-2007)

Table 3. Review of literature on caries risk assessment in schoolchildren (6-12 years old) over the last ten years (1997-2007)

Table 4. Review of literature on caries risk assessment in adolescents (13-18 years old) over the last ten years (1997-2007)

Table 1

Author, year and local	Sample*	Age†	Variables collected at baseline (VB) Examination (EX)	Time‡	Data Analysis¶	Outcome Variable	Main results RP/RF§
Yonezu and Machida, 1998 (Tokyo), Japan	374	1.5	**VB**: Caries (cavitation): decayed or filled primary teeth (dft) **EX:** Mirror, explorer, optimal light after drying (cotton/air)	1.5	CS, St	Differences in dft scores	To develop caries before the age of 2 indicated that a child is at risk for dental caries
Mattos-Graner et al., 2000 (Piracicaba), Brazil	142/101	1-2.5	**VB**: Caries (initial + manifest lesions), plaque on the labial surfaces of upper incisors, mutans streptococci virulence factors (MS acidogenesis, water-insoluble glucan synthesis - WIG, adherence analysis) **EX**: Dental surfaces brushed and dried with gauze	1	MW, CS, CA	Caries incidence (high risk: ≥3 manifest caries)	Mean new lesions: 1.7 (9% developed ≥3 manifest caries) Caries incidence associated with high MS levels and positively correlated with WIG synthesis
Pienihäkkinen et al., 2004 (Saarijärvi), Finland	226•	2	**VB**: Caries – dmfs (incipient caries lesions in enamel + dentinal lesions), sealants (surface level), presence of visible plaque (VP), gingival bleeding (GB) on buccal tooth surfaces, Mutans streptococci (MS) from proximal surface of a central maxilar incisor and of the most distal mandibular right molar, questionnaire (consumption of fluorides and candies) **EX:** Dental unit with good light and compressed air, mirror with 1.6 -fold magnification, blunt periodontal probe and fiber-optic transillumination	3	MLR, ROC	Increment of cavitated carious lesions and or fillings >0	RP/RF: MS strip, incipient caries lesions, use of candies None of the studied variable reached an accuracy of 80%
Scavuzzi et al., 2007 (Feira de Santana), Brazil	217/186	1-2.5	**VB**: Caries (presence of white spots -WS on the buccal surfaces of the upper incisors; dmf index - WHO criteria), presence of visible plaque (VP) **EX**: A dentist/child in a knee-to-knee position, well-lit room of the urban social center, plain mouth mirror, white light, nº 5 blunt exploratory probe (removing dental plaque)	1	MN, W	Dental caries status	Strong association between initial caries prevalence, WS and/or cavities and the condition observed in the final examination Statistically significant increase in the dmfs index for both children with WS and VP
Ollila and Larmas, 2007 (Oulu), Finland	183	2	**VB**: Caries (initial: restricted to the enamel + manifest caries: in dentin needing restorative dental care), questionnaire (consumption of candies, use of fluoride tablets, toothbrushing, pacifier sucking, use of a nursing bottle at night, prolonged breastfeeding) **EX**: Local health center dentists (normal routines)	7	SA	Timing of caries onset on primary and permanent molars	Consumption of candies and lack of daily toothbrushing: major impact on caries onset

*Sample size at initial/final examination; †Age at baseline (years); ‡Study lasting (years); ¶Statistical tests: CA=Correlation analysis; CS=Chi-square; MLR=Multiple logistic regression; MN=McNemar; MW=Mann-Whitney; ROC=Receiver operator characteristic curves; SA=Survival analysis; St=Student´s t-test; W=Wilcoxon; §RP/RF: Risk predictors/Risk factors obtained in Regression Analyses. •Prevention included health education and/or fluoride varnish treatments

Table 2

Author, year and local	Sample*	Age†	Variables collected at baseline (VB) Examination (EX)	Time‡	Data Analysis¶	Outcome Variable	Main results RP/RF§
Mattila et al., 1998 (Turku), Finland	1292/1003	3	**VB**: Caries (enamel lesions + dmf index), dental cleanliness (no disclosing solution), questionnaire (basic educational level, occupational education, occupation, toothbrushing behaviors, use of xylitol chewing gum, snacking on sweets and frequency of snacking, drinking something other than pure water) **EX**: Public dental centers	2	CS, MW, KW, W, MLR	Changes in dmf index	RP/RF: Mothers' education (up to nine years of basic education), presence of plaque, presence of caries
Ollila et al., 1998 (Oulu), Finland	166/152	2.5 (mean)	**VB**: Caries (initial + manifest caries), salivary lactobacilli and candida, questionnaire (pacifier- and thumb-sucking, breastfeeding, bottle-feeding at night, social class of the family) EX: At dental health centers	2	CS, MLR	Occurrence of caries (yes/no)	RF/RP: use of nursing bottle at night, pacifier-sucking ≥ 2 years
Thibodeau and O'Sullivan, 1999 (Hartford), USA	85/83	3.8 (mean)	**VB**: Caries (Radike method), mutans streptococci counts in saliva **EX**: Portable dental chair, mirror, #23 explorer, focusable flashlights	6	KW, MW	Differences in caries scores	High caries risk children at baseline (> 50 colony forming units): significantly greater caries scores at final examination
Rodrigues and Sheiham, 2000 (Recife), Brazil	650/510	3	**VB**: Caries (WHO criteria), enamel hypoplasia (DDE index – Developmental Defects of Enamel), nutritional status, sugar intake during 3 non-consecutive days, daily frequency of sugar intake, 24-h period dietary recall at home, questionnaire (socioeconomic, medical, demographic, dietary history and dental-related information) **EX**: Classroom, head lamp, mouth mirror, probes	1	MLR	Caries increment	RP/RF: not attending nurseries with guidelines for sugar intake, frequency and amount of sugar intake, previous caries experience (most important factor), fluoride usage, toothbrushing related habits
Karjalainen et al., 2001 (Turku), Finland	148/135	3	**VB**: Caries (WHO criteria; 2 groups: caries-free or caries experience), visible plaque after drying, questionnaire (mother's education, child's sweet intake frequency, daily toothbrushing with fluoride toothpaste, other sources of fluoride, general health, episodes of otitis media and adenoidectomy, antimicrobial medications and allergies), food records (4-day food diary obtained at 36 and 72 months of age) **EX:** Visual inspection, dental mirror, artificial light	3	MN, MR, St	Dental status at final examination	Children who developed caries: daily sucrose intake at baseline statistically higher than that of children who stayed caries-free
Li and Wang, 2002 (Beijing), China	504/362	3-5	**VB**: Caries (dmf/DMF- WHO criteria) on entire dentition and on subsets of teeth: maxillary incisors, maxillary anterior teeth, maxillary first and second molars, mandibular first and second molars, all primary molars **EX**: Classroom setting, natural light, mouth mirrors, explorers	8	MLR, CA, PV	Developing caries in permanent dentition	Children with caries in their primary teeth: significantly three times more likely to develop caries in their permanent teeth. Caries on primary molars: the highest predictive value (85.4%)
Peretz et al., 2003, (Jerusalem and Petah Tikva), Israel	150	3-5	**VB**: Caries: 3 groups with 50 children each being caries free children (CF), children with early childhood caries (ECC), and children with posterior caries only (PC) **EX**: Files of two private pediatric dental clinics, radiographic examinations	7-10	ANOVA, Sch	New affected surfaces per year	Children with ECC had the highest number of new affected surfaces per year, followed by the children with posterior caries and the caries-free children. ECC groups differed statistically from caries-free group and posterior caries group
Seki et al., 2003 (Tokyo), Japan	147/129	1.5-5	**VB**: Caries (WHO criteria), dental plaque (visually on the labial surface of the maxillary incisors without disclosing solution), oral microbiology (unstimulated saliva and plaque in four proximal surfaces: 54-d, 55-m, 74-d, 75-m) **EX**: Visual inspection	0.5	Sn, Sp, PV, CS, MLR	≥1 new carious surface	Mean dmfs: 4.43 at baseline and 6.78 at follow-up. Groups with high Mutans Streptococci (MS) and/or high plaque MS scores: significantly higher caries incidence RP/RF: caries experience at baseline and high plaque MS score
Skeie et al., 2004 (Bergen), Norway	217/186	5	**VB**: Caries (enamel + dentine lesions) **EX**: Teeth polished and dried, probes, plain, mirrors, favorable light conditions, bitewing radiographs	5	St, MLR	Taking part of a risk group (caries increment in primary teeth)	Mean increment (enamel+dentin lesions): 3.05 Strongest predictor: having one or more lesions on approximal surfaces of the primary molars
Mattila et al., 2005 (Turku and Pori), Finland	1074	3	**VB**: Dental status, dental plaque, questionnaire (sociodemographic variables, parents´ previous caries, parents´ toothbrushing habits, child's dietary factors, child's dental health habits) **EX**: Mirror probe, FOTI, at public health care centers	7	CS, MW, MLR	Poor dental health (dmft+DMFT≥5)	RP/RF: father's young age, father's irregular toothbrushing, mother's previous caries, child's frequent use of sweets, plaque on teeth
Skeie et al., 2006 (Bergen), Norway	217/186	5	**VB**: Caries (enamel + dentin caries; visual inspection) **EX**: Teeth polished with prophylactic paste, air-dried/cotton rolls, operating lights, bitewing radiographs	5	CS, St, CA, MLR, Sn, Sp, PV, ROC	Taking part of a risk group (based on caries increment in permanent teeth)	Significant correlation between caries in the primary dentition and in permanent teeth RF/RP: ≥1 carious lesion on primary second molars Highest sum of Sn and Sp (148%): predictor "more than two lesions in primary second molars"

*Sample size at initial/final examination; †Age at baseline (years); ‡Study lasting (years); ¶Statistical tests: ANOVA=Analysis of Variance; CA=Correlation analysis; CS=Chi-square; KW=Kruskall Wallis; MLR=Multiple logistic regression; MN=McNemar; MR=Method of Rothman; MW=Mann-Whitney; PV=Predictive values; ROC=Receiver operator characteristic curves; Sch=Scheffe; Sn=Sensitivity; Sp=Specificity; St=Student´s t-test; W=Wilcoxon; §RP/RF: Risk predictors/Risk factors obtained in Regression Analyses

Table 3

Author, year and local	Sample*	Age†	Variables collected at baseline (VB) Examination (EX)	Time‡	Data Analysis¶	Outcome Variable	Main results RP/RF§
Kirstilä et al., 1998 (Turku), Finland	69/63	12	**VB**: Caries (DMF/dmf - WHO criteria, white spots lesions), periodontal status (bleeding and calculus), usage of fluoridated dentifrices, saliva samples (buffer capacity, hypothiocyanite assay, total streptococci and mutans streptococci, lactoferrin and lysozyme analysis, agglutination assay, total salivary peroxidase activity, total and specific IgA and IgG antibodies) **EX**: Visual-tactile method + FOTI	2	St, CA	DMF increment >0	Mean caries increment: 0.95 DMFS Caries increment: negative correlations with baseline lactoferrin, total IgG and total anaerobes; positive correlation with specific anti-S. mutans, IgG antibody levels, mutans streptococci, lactobacilli and specific anti-S. mutans IgG. Children with significantly higher baseline concentrations of hypothiocyanite, total IgG antibodies and total anaerobes: no new caries lesions
Splieth and Bernhardt, 1999, Germany	230/169	6-7	**VB**: Caries (DMFS/dmfs – WHO criteria, initial lesions), sealants for all molar fissures, occlusal plaque samples from teeth 16 and 36 (mutans streptococci tests), plaque index (Quigley-Hein) **EX**: Explorer without pressure, light source	2	CA, KW, MW, Sn, Sp	Caries development	Mean caries incidence: 0.69 DMFS Significant correlation between initial MS scores and caries development
Petti and Hausen, 2000 (Rome), Italy	314/304 (Caries-free)	6-7	**VB**: Caries (WHO criteria), plaque index (Silness and Löe), microbiological analysis of mutans streptococci - MS, (unstimulated saliva samples), questionnaire (sucrose intake, fluoride exposure) **EX**: Clinical examination, visual inspection, bitewing radiographs	2	CS, Sn, Sp, PV, MLR, CA	DMFT increment ≥1	Mean caries increment: 0.68 teeth The more often the MS test positive, the higher the proportion of children who developed caries lesion RP/RF: MS, fluoride
Vanderas et al., 2000, Greece	314/270	6-8	**VB**: Caries (DMF/dmf), dental plaque, catecholamine content in urine sample, body weight, parental age, education and profession, medical history and medications **EX**: Bitewing radiographs	1	St, LiRA, MLR	Caries increment	Epinephrine levels: affected the child's probability of having new caries
Wandera et al., 2000 (Michigan), USA	140	0.9-11	**VB**: Charts of patients with: medical, dental and fluoride history, diet, oral hygiene, retentive pits and fissures, existing restorations, newly erupted teeth, caries/decalcifications, pulpits/abscess, gingivitis, crowding, behavior, age, gender **EX**: Variables colleted at patient's charts (retrospective longitudinal study)	2.5	CS, MLR, ANOVA	Cumulative future caries lesions (high risk: ≥ 5 new surface lesions)	RP/RF: presence of decayed teeth and decalcifications (most significant), dietary factors, poor oral hygiene
Mattila et al., 2001 (Turku), Finland	1074	7	**VB**: Caries (DMFT/dmft), questionnaire (socioeconomic, demographic, family factors, diet, dental hygiene, parents' own earlier dental health habits, parents´ previous dental health, children's diseases and physical symptoms) **EX**: Mirror, probe, fibre-optic light	3	CS, MLR	Caries increment	Mean caries increment: 0.45 dmft/DMFT RP/RF - tooth brushing only occasionally and mother's previous caries (deciduous teeth), child frequent use of sweets and child's bedtime after 9 p.m. (permanent teeth), eat sweets frequently at 3 years of age (both dentitions)
Vanobbergen et al., 2001 (Flanders), Belgium	3303/3002	7	**VB**: Caries (BASCD criteria – cavitation level), oral hygiene (plaque index of Silness and Löe and plaque index on occlusal surfaces - index of Carvalho), eruption stage, questionnaire (oral hygiene, dietary habits, fluoride exposure, access to oral health care services, medical history, socioeconomic level) **EX**: Mobile dental clinic, WHO/CPITN probe	3	MLR, Sn, Sp, ROC, CS	DMFS increment ≥2 on permanent 1º molars	RP/RF: dmfs, educational system, frequency of brushing; daily use of sugar-containing drinks
van Palenstein Helderman et al., 2001b (Tiel, Culemborg) The Netherlands	318/287	7.5	**VB**: Caries (non cavitated and cavitated caries, filling) and sealants **EX**: Visual examination, dental probe, dental lamp and small mouth-light, bitewing radiographs	8	CA, MLR, ROC	High caries increment (ΔD_3 surfaces >0; >2; >4, >7)	RP/RF: number of cavitated and non-cavitated fissures of the newly erupted permanent first molar
van Palenstein Helderman et al., 2001a (Culemborg), The Netherlands	69/62	7.5	**VB**: Caries (incipient + cavitated lesions + fillings), mutans streptococci - MS and lactobacilli (LB) counts (stimulated saliva) **EX**: Visual observation, dried surfaces, dental lamp, small mouth-light, radiographs	4	CA, MLR	Caries increment	No statistically significant predictor ($p>0.05$)
Pearce et al., 2002 (Beijing), China	175/164	12	**VB**: Caries (cavitation level), plaque score (Quigley and Hein index), fluorosis score (TF index), inorganic compounds in dental plaque (supragingival plaque collection from buccal and lingual surfaces after 3 days with no oral hygiene), toothbrushing frequency, snacks use, parents´ occupation **EX**: Child seated in an upright chair, adequate illumination, sharp probe	2	MW, W, MLR	DMFS increment ≥3	Mean DMFS increment: 1.14 RP/RF: plaque Ca concentration, baseline DMFS score (useful predictor) and toothbrushing frequency

Table 3 – cont.

Author, year and local	Sample*	Age†	Variables collected at baseline (VB) Examination (EX)	Time‡	Data Analysis¶	Outcome Variable	Main results RP/RF§
Källestål and Wall, 2002, Sweden	3373/3107	12	**VB**: Caries (DMF + enamel caries), sealants, questionnaire (ethnicity, residential area, socioeconomic level) **EX**: Clinical setting: mirror, good operating light, compressed air, cotton rolls, two bitewings radiographs	2	PR	Caries increment	Mean DMFS increment: 1.0 (including enamel lesion=1.88) RP/RF: previous experience of caries and socioeconomic level
Kopycka-Kedzierawski and Billings, 2004 (New York), USA	464*/160 *caries-free	6-7	**VB**: Caries (visual-tactile criteria of Radike), microbiological (MS counts in whole stimulated saliva: if $\geq 10^6$ CFU/ml high levels of MS) **EX**: Fiberoptic lights, plane mirrors, nº 23 explorers (cleaning of surfaces and detecting of sealants)	6	SA, W	Time to caries onset	High MS levels: greater risk for caries onset Low MS levels: significant effect on the longer survival times
Vanderas et al., 2004, Greece	314/196	6-8	**VB**: Caries (presence of caries on the primary second molars' distal surfaces - PSMDS), age, gender **EX**: Bitewing radiographs	4	MLR, Sn, Sp, PV	Caries on mesial surfaces of permanent 1º molars (MSPFM)	Presence of caries on PSMDS significantly affected development of carious on MSPFM Sn= 45% to 97%; Sp= 80% to 89%
Leroy et al., 2005 (Flanders), Belgium	4468	6	**VB**: Caries (BASCD criteria), presence of plaque on the occlusal surfaces of permanent first molars (PFM), timing of tooth emergence, gender, questionnaire (oral hygiene and dietary habits) **EX**: Visual inspection	6	SA	Survival time of a PFM	RP/RF: occlusal plaque accumulation, reported brushing frequency, gender (girls - for lower molars), cavity experience in the deciduous dentition
David et al., 2006 (Bergen), Norway	159/112	12	**VB**: Caries (enamel + dentin lesions), questionnaire (gender, mother's education) **EX**: Teeth polished and dried, plane mouth mirror, probe, bitewing radiographs in equipped dental clinics	6	St, Sn, Sp	Caries (dentin level) increment on approximal surfaces (DFS > 0, 1, 2, 3 and 4	Mean caries increment: 4.2 (enamel + dentinal lesions) Highest predictive power: approximal lesions in premolars and second molars
Jeppesen and Foldspang, 2006 (Aarhus), Denmark	3705	7-12	**VB**: Caries (dmfs, DMFS, nº of surfaces with initial caries, nº of surfaces with primary and secondary caries, nº of filled surfaces, nº of surfaces missing due to caries), gender, year of birth, nº of children in household, nº of adults in household, citizenship **EX**: Danish routine dental and socioeconomic registers	1	CS, MLR, Sn, Sp, PV, ROC	Caries incidence	DMFS increase: positively associated with dmfs increase and with initial caries RP/RF: past caries experience Area under ROC curve: 76%
Tagliaferro et al., 2006 (Piracicaba), Brazil	480/206	6-8	**VB**: Caries (DMF/dmf -WHO criteria, initial caries lesions), plaque score (Simplified Oral Hygiene Index), dental fluorosis (Dean index), questionnaire (toothbrushing frequency, type of preventive topical method, father's and mother's educational level, gender, race, number of working people living in the household, monthly family income, dental visits in the year prior to baseline, reason for dental visit, daily sugar consumption, number of sugar spoons in beverages, number of between-meal snacks oral hygiene habits) **EX**: Dental probe and mirror, under natural light in outdoor setting at schools	7	CS, MN, MLR, Sn, Sp, PV, ROC	DMFS≥1 increment	Mean DMFS increment: 2.63 RP/RF: dmfs, DMFS, mother's education dmfs>0: highest Sn (69%) DMFS>0: highest Sp (92%).
Vallejos-Sánchez et al., 2006 (Campeche), México	580/452	6-9	**VB**: Caries (DMFT, dmft – WHO criteria, caries in any first permanent molar, caries in any permanent upper molars, caries in any permanent lower molars, caries severity), age, gender **EX**: Dental mirror, teeth dried with gauze, natural daylight, at schools	2	CS, MW, KW, CA, W, RA	DMFT≥1 increment	Total DMFT increment: 0.52 RP/RF: caries in permanent molars, DMFT, caries severity
Zhang et al., 2007 (Wuhan), China	650/433	6-7	**VB**: Caries (enamel + dentin lesions), Mutans Streptococci (MS) counts in saliva **EX**: Teeth dried, fiber-optic light on a mouth mirror, dental probe (removal of plaque, detection of fissure sealants)	2	CA, MRA	Caries increment (dentin level)	Significant, but weak, correlation between MS counts and caries

*Sample size at initial/final examination; †Age at baseline (years); ‡Study lasting (years); ¶Statistical tests: ANOVA=Analysis of Variance; CA=Correlation analysis; CS=Chi-square; KW=Kruskall Wallis; LiRA=Linear regression analysis; MLR=Multiple logistic regression; MN=McNemar; MRA=Multiple regression analysis; MW=Mann-Whitney; PR=Poisson Regression; PV=Predictive values; RA=Regression analysis; ROC=Receiver operator characteristic curves; SA=Survival Analysis; Sn=Sensitivity; Sp=Specificity; St=Student´s t-test; W=Wilcoxon; §RP/RF: Risk predictors/Risk factors obtained in Regression Analyses

Table 4

Author, year and local	Sample*	Age†	Variables collected at baseline (VB) Examination (EX)	Time‡	Data Analysis¶	Outcome Variable	Main results RP/RF§
Bjarnason and Köhler, 1997, Sweden	155/87	15-16	**VB**: Caries (cavitation and incipient lesions), mutans streptococci (MS) and lactobacillus (LB) counts in stimulated saliva **EX**: Clinical + radiographic examination	3	CA, MRA, Sn, Sp, PV	DFS increment ≥5 DFS increment ≥3	Incipient caries experience and salivary microorganisms: significant correlation with DFS increment Incipient + manifest lesions: combined values of Sn and Sp allowed to predict caries development in the majority of individuals
Lawrence and Sheiham, 1997 (Rio de Janeiro, Mangaratiba and Angra dos Reis), Brazil	420/290	12-16	**VB**: Caries (DMFS index – WHO criteria), dental plaque (Patient Hygiene Performance-PHP index), malocclusion (WHO criteria), enamel defects (Developmental Defects of Enamel-DDE index), at baseline and final examination, interview (age, gender, socioeconomic status, race, fluoride exposure, residence histories, preventive dental health behaviors, use of dental services, toothbrushing frequency, toothpaste brand used, professionally applied fluoride gel rinses, varnishes or sealants, home use of fluoride mouthrinses, use of fluoride supplements during early childhood, number of years of residence in the research area, sources of domestic drinking water) **EX:** Head lamp, plane mirror, caries explorer, CPITN probe, drying at dental surgeries or classrooms at schools, posterior bitewings	1	St, W, CS, MLR	Caries progression	RP/RF: Fluoride level in the drinking water, caries prevalence, number of cavitated carious lesions and toothbrushing frequency
Utriainen et al., 1998 (Kokola, Pietarsaari, Vaasa, Seinäjoki), Finland	2422/1472	13	**VB**: Caries (DMF index, D component), gingivitis (CPITN index), questionnaire (information on smoking) **EX**: Annual dental examinations in health centers and at schools, radiographic examinations	2	MLR	Number of cavitated teeth during the period	Subjects with no cavities at baseline: 60% remained cavities-free Subjects with gingival health at baseline: 47% remained healthy at the final examination RP/RF: DMFT>2, DT>0, great gingival infection, gender (males)
Meldrum et al., 2001 (Otago), New Zealand	976/781	15	**VB**: Caries (WHO criteria), parental socioeconomic level, asthma status. (*Note: 206 individuals having no history of asthma were used as the comparison group)* **EX:** Fiber-optic light, plane dental mirror and sickle explorer	3	CS, MW	DFS increment	Mean DFS increment: 2.06 Asthmatic groups: no significantly higher caries increment than the non-asthmatic group
Stenlund et al., 2002 (Stockholm), Sweden	536/534	11-13	**VB**: Approximal surfaces status: caries-free or in a caries state **EX**: Only radiographic examination	10	SA, PR	Incidence of the first new approximal caries lesion	Median time to the first new approximal caries lesion: 2 years Individuals with no approximal lesions at baseline: 0.031 surface/year Individuals with 3 approximal lesions at baseline: 0.077 surface/year
Campain et al., 2003 (Melbourne), Australia	645/504	12-13	**VB**: Caries (WHO criteria), height and weight ("estimation of subjects' basal metabolic rate"), four day diet records, questionnaire (household income, education level, occupation and ethnicity) **EX**: Fiber-optic light source, plane mouth mirror, sickle probe, at schools	2	MLR	Total DMFS increment; pit and fissure DMF increment; smooth surface DMF increment ≥1	Mean DFS and DMFS increment: 0.98 and 1.10, respectively RP/RF: low sugar-high starch foods for caries increment on all surfaces and pit and fissures surfaces
Poorterman et al., 2003, The Netherlands	202	14, 17, 20	**VB**: Caries, questionnaire (dental knowledge, oral health behavior, oral health care attitudes) **EX**: Clinical and radiographic examination	3	St, MLR	Differences between scores from baseline and final examination	Caries increment: related to oral health behavior and oral health concern for only those aged 17 years at baseline
Stenlund et al., 2003 (Stockholm), Sweden	536	11-13	**VB**: Caries (surface level) **EX**: Only radiographic examination	10	RR	Pair of adjacent approximal surfaces	A sound surface next to a carious surface: risk increased 1.6-32.3 times Distal surface of the first permanent molar: developed caries more often than the mesial surface of the second molar

*Sample size at initial/final examination; †Age at baseline (years); ‡Study lasting (years); ¶Statistical tests: ANOVA=Analysis of Variance; CA=Correlation analysis; CS=Chi-square; MLR=Multiple logistic regression; MRA=Multiple regression analysis; MW=Mann-Whitney; PR=Poisson Regression; PV=Predictive values; RR=Relative risk; Sn=Sensitivity; Sp=Specificity; St=Student´s t-test; W=Wilcoxon; §RP/RF: Risk predictors/Risk factors obtained in Regression Analyses

CAPÍTULO 2

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ASSESSMENT OF DENTAL CARIES PREDICTORS IN A SEVEN-YEAR LONGITUDINAL STUDY*

ELAINE PEREIRA DA SILVA TAGLIAFERRO, DDS, MSc

ANTONIO CARLOS PEREIRA, DDS, MPH, DrPH

MARCELO DE CASTRO MENEGHIM, DDS, MSc, PhD

GLÁUCIA MARIA BOVI AMBROSANO, Agr.Eng., MSc, PhD

Department of Community Dentistry

School of Dentistry of Piracicaba – UNICAMP (State University of Campinas)

Author responsible for correspondence and for reprints:

Antonio Carlos Pereira

School of Dentistry of Piracicaba – UNICAMP

Av. Limeira, 901, Piracicaba, SP, 13414-900, Brazil

Tel: +55 19 34125209 Fax: +55 19 34125218

e-mail: apereira@fop.unicamp.br

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ASSESSMENT OF DENTAL CARIES PREDICTORS IN A SEVEN-YEAR LONGITUDINAL STUDY

ABSTRACT

Objective: To identify, in a group of 6-8-year-old schoolchildren, risk factors for dental caries increment in permanent dentition.

Methods: Two hundred and six children from three different schools in Piracicaba, Brazil, were examined at baseline and after 7 years by the same two calibrated dentists. Data on dental caries (dmfs, DMFS, presence of initial lesions), fluorosis, oral hygiene and presence of sealant were collected at the clinical examination that was performed in an outdoor setting, under natural light, using a dental mirror and probe following the WHO recommendations. Information on socioeconomic level, fluoride usage, dental service utilization, dietary and oral hygiene habits was also obtained at baseline in a semi-structured questionnaire sent to the parents. The dependent variable was the 7-year DMFS increment. A univariate analysis was performed to test the association of independent variables in caries increment. Then a logistic regression model was used to estimate the adjusted Odds Ratio for caries increment.

Results: Clinical (dmfs, DMFS) and non-clinical variables (daily toothbrushing, use of preventive topical methods, parents' educational level) were entered in the multiple logistic regression analysis. The prediction model included the clinical and socioeconomic variables, DMFS, dmfs and mother's educational level. The best caries predictor was the dmfs variable.

Conclusion: Caries experience and mother's educational level were predictors of caries increment in permanent dentition.

Key Words: dental caries, prediction, logistic regression

INTRODUCTION

Caries risk assessment is a relevant issue in dentistry since the skewed distribution of the disease has been requiring the development or the optimization of preventive strategies targeted for high-caries risk individuals. The early identification of these subjects at individual or population level allows program planners to plan measures for caries prevention and to increase the efficiency of preventive programs.

During the past decades several studies have been published regarding caries prediction (1-10); many have found the most powerful predictor for dental caries to be past caries experience (1,3,5,7-9,11). Poor oral hygiene has been detected as a significant risk factor by some researchers (4,5,7) whereas others have not found similar results (3,8). Data on salivary and dental biofilm microbiological characteristics, such as Streptococcus mutans, lactobacillus, and candida counts have also shown contrasting results regarding caries prediction (3,4). According to Disney *et al.* (1) and Hausen (11), the presence of cariogenic bacterial levels moderately improves caries prediction models. Socioeconomic and demographic variables have been associated with caries increment only in prediction models for young children (12,13). On the other hand, some variables such as buffer capacity, salivary rate, presence of gingivitis (3), dental morphology especially related to retentive pit and fissures (5), calcium, phosphorus and fluoride plaque concentration (8), fluoride history (5,7), and dietary habits (4,7,8) have not been identified as significant caries predictors for children aged up to 14 years.

In this context, an accurate caries risk assessment is difficult (14). Moreover, most studies have been conducted for short periods - between 11 and 48 months (1,3-5,7,8). Longer studies are scarce in the literature and encompass only clinical variables in the prediction models (6,9,15). Therefore, the aim of this research was to identify, in a group of 6-8-year-old

schoolchildren, which clinical, behavioral, demographic and socioeconomic variables could be considered predictors of caries increment in permanent dentition.

METHODS

Ethical aspects

The study was approved by the Research Ethics Committee of the School of Dentistry of Piracicaba, State University of Campinas. The parents' consent was also obtained prior to the survey.

Sample

All 6-8-year-old children (n=480, mean age 7.1 years) attending three different schools in Piracicaba, Brazil (average fluoride concentration=0.7 ppm in drinking water, since 1971) participated in this seven-year longitudinal study. The sample included children of both genders (251 boys and 229 girls), with no systemic diseases or communication and/or neuromuscular problems, whose had parental consent. The individuals were examined by two trained dentists while their parents were asked to complete a semi-structured questionnaire. In 2004, the dentists re-examined the individuals (n=274) for dental caries and fluorosis status. For this study, 206 13-16-year-old (mean age=14.4 years) individuals were considered full participants, since they were examined both at baseline and after 7 years, and their parents had completed the semi-structured questionnaire in 1997.

Examination methodology

The dental examinations carried out in 1997 and in 2004 followed the same protocol. Prior to the examinations, a calibration process on caries diagnosis was performed between the two examiners. The consistency intra and inter-examiner was assessed by Kappa statistics (16) with values higher than 0.85.

The dentists examined all children using a dental probe and mirror, under natural light in outdoor setting. Data were collected on dental caries status, number of sealed surfaces, presence of dental fluorosis, and plaque score at baseline. At the final examination (2004) children were re-examined for dental caries and fluorosis status.

Prior to the examination, each individual received a toothbrush with fluoridated dentifrice and performed toothbrushing supervised by a dental hygienist. Dental caries were registered using the DMFS and dmfs indexes according to World Health Organization recommendations (17). Initial caries lesions detected in any dental surface were also diagnosed (18). Plaque score was performed using the Simplified Oral Hygiene Index (19). Presence of dental fluorosis was examined in all buccal surfaces of teeth that showed more than 2/3 of erupted crown and no filling, using the Dean index (20). The differential diagnosis between very mild signs of dental fluorosis and nonfluorotic enamel opacities followed the Russel criteria (21).

Questionnaire

The children's parents were asked to complete a semi-structured questionnaire concerning their socioeconomic level, fluoride usage, dental service utilization, dietary and oral hygiene habits of their children at baseline in 1997.

Data Analysis

The Chi-square test (α=0.05) was used to compare the caries prevalence between full participants and those lost before the follow-up. The McNemar test (α=0.05) was used to compare the caries prevalence of full participants between 1997 and 2004.

The dependent variable (DMFS increment or any caries increment) was dichotomized in presence or absence of any caries increment over the 7-year period. The independent variables (clinical, socioeconomic and behavioral variables) were also dichotomized. A univariate analysis was performed to test the influence of independent variables in the DMFS

increment, using the Chi-square (χ^2) and Fisher's Exact tests (α=0.05). The multiple logistic regression analysis using the stepwise procedure was performed in order to identify the risk factors for caries increment. In order to eliminate variables that would make little contribution to the model, only the independent variables that showed $p \leq 0.15$ in the univariate analysis were selected for logistic regression model. Adjusted Odds Ratios (OR), their 95% confidence intervals and significance levels were estimated. A variable was considered a significant caries predictor if it remained in the final model at $p<0.05$. Then sensitivity, specificity, predictive values and area under the receiver-operating characteristic (ROC) curve (A_z) were determined for the predictor variables remained in the prediction model (22). All statistical tests were performed using the software SAS (23) at 5% significance level.

RESULTS

For 480 children examined at baseline, 350 questionnaires had been completed by a parent (response rate for questionnaire = 72.9%). At final examination 274 individuals, including those with and without questionnaires were reexamined (response rate for clinical examination = 57.1%) and among them 206 were considered full participants since they were examined both at baseline and final examination and their parents had completed the questionnaire (response rate for questionnaire + final examination = 42.9%). Many individuals had moved out of the schools where the research was conducted, and some refused to take part in the final examination. Baseline caries prevalence was not significantly different (p=0.4) between full participants and those lost to follow-up.

Among full participants, 45% were male and 55% female. The majority of individuals had not visited a dentist in the year prior to baseline examination (86.9%) and had not used other topical preventive method other than fluoridated dentifrices (74.8%). Concerning socioeconomic variables, most fathers (61.2%) and mothers (71.8%) had attended school for 5

to 11 years and most families (52.4%) received wages from 1 to 5 times the Brazilian minimum wage in 1997.

Table 1 shows the dmfs, dmft, DMFS, DMFT indexes, mean number of white spot lesion and pit and fissure sealants according to year of examination, for full participants. Dental caries prevalence had not reduced significantly (p=0.3) among full participants over the study period. Over two fifths (44.17%) of the children exhibited one or more DFS, and the mean caries increment for them was 2.63 ± 4.06.

The univariate analysis showed that the variables dmfs (p=0.001), DMFS (p=0.01), daily toothbrushing frequency (p=0.05), type of preventive topical method (p=0.1), father's (p=0.06) and mother's (p=0.04) educational level presented $p \leq 0.15$ under the Chi-square test. On the other hand, number of white spot lesions, plaque score, number of dental sealants, dental fluorosis, gender, race, number of working people living in the household, monthly family income, dental visits in the year prior to baseline, reason for dental visit, daily sugar consumption, number of sugar spoons in beverages, number of between-meal snacks presented $p>0.15$ when in association with any caries increment.

The final prediction model showed that dmfs (OR=2.29), DMFS (OR=2.49) and mother's education (OR=1.88) were risk factors for caries increment over the period at $p<0.05$ (Table 2). No sign of models inadequacy was observed.

Predictive values, sensitivity, specificity and A_z are presented in Table 3. Out of the predictor variables, caries in primary dentition (dmfs>0) showed the highest sensitivity (69%) and the highest A_z (0.61). Caries in permanent dentition (DMFS>0) exhibited the highest specificity (92%).

DISCUSSION

This is the first long-term Brazilian study on caries risk assessment. The major hindrance in this type of study is that a great number of individuals may move out of the school, making it difficult to follow-up. Out of the 480 children, 206 took part in the present study since they were examined both at baseline and final examination and their parents completed a semi-structured questionnaire. Caries prevalence at baseline was not significantly different between full participants and those lost to follow-up, providing more confidence that the model's findings might be generalizable to the population studied.

The results showed that the mean value for DMFT among full participants examined in 2004 was 2.16. According to the last national epidemiological survey carried out in 2002-2003 (24) the mean DMFT for 15-19-year-old individuals was 6.17 in Brazil and 5.94 in the Southeast region where Piracicaba is located. It may be observed that the caries experience among full participants was much lower than that reported for 15-19-year-old individuals and even lower for 12-year-old children, for whom DMFT has ranged from 2.6 to 4.8 in recent Brazilian surveys (24,25). Between baseline and final examinations, the mean number of sealants more than tripled (Table 1). All children from the schools participated in a preventive program with application of dental sealants in sound permanent teeth, regardless of their caries risk.

Predicting future caries is important for monitoring individuals at risk of developing caries (9). This study has attempted to collect socioeconomic, demographic and behavioral characteristics in addition to clinical variables and to use them in a multiple regression analysis based on 7-year caries increment since the etiology of dental caries is multifactorial. Clinical variables (dmfs and DMFS) collected at baseline were risk factors for caries increment in the permanent dentition (Table 2) and caries in deciduous teeth (dmfs) were the best predictors. Children with caries in primary teeth were 2.3 times more likely to experience

new caries over the 7-year period. In other words, no caries experience at baseline was a protector factor against caries increment. A few long-term studies (6,9,15) and many others (1,3,5,7-9,11) have demonstrated that past caries experience is a good predictor for future caries. According to van Palenstein Helderman *et al*. (6) past caries activity with no changes in the oral health habits will remain and can provide useful information on future caries activity. However, Tinanoff (2) emphasized that caries risk assessment based on past caries may not be enough for public health since it only may be used if an individual has the disease. In fact, an accurate caries risk assessment is difficult (14), especially for caries-free individuals, demanding the accomplishment of studies only with individuals free of caries.

The mother's educational level was also a risk factor for caries increment since children whose mothers had attended school for less than 8 years exhibited 1.9 more chance of caries increment. It has been claimed that lower educational level indicates less understanding of disease-preventive behavior (26). Some studies have included socioeconomic variables (1,7,8,12,13), and only a few have found they are good predictors of caries increment. Demers *et al*. (12) collected clinical, microbiological, socioeconomic and fluoride usage variables on 5-year-old children who were followed during 12 months. They found that caries experience, lactobacillus counts and parents' education were significant predictors of caries increment. Grindefjord *et al*. (13) followed up 1-year-old children during 3.5 years and found that one of the significant predictors of caries increment were mother's education equal to or lower than 9 years of schooling. The present study demonstrated that with the exception of mother's educational level, socioeconomic variables were not good predictors of future caries. The results of this study suggest that schoolchildren with caries experience and those whose mothers have less than eight years of schooling are at higher risk for future caries and should thus be continuously monitored.

The results also showed the lack of association between dietary habits (sugar consumption) and caries increment, which is in line with previous reported data (4,8).

To measure the prognostic ability of caries predictors, the sensitivity, specificity, predictive values and area under the ROC curves (A_z) were determined. The A_z obtained in this study varied from 0.56 to 0.61. There were no variables with both high sensitivity and specificity for the identification of individuals at risk before they develop caries. Future research varying the percentage of individuals at risk of developing caries as well as in populations with different levels of caries occurrence should be carried out in order to reach the optimal balance between sensitivity and specificity.

The variable DMFS>0 showed the highest specificity (Sp=92%), which means that the absence of caries in permanent teeth (DMFS=0) accurately predicted no caries increment over the period. Nevertheless, it presented poor sensitivity (Sn=20%) not predicting well individuals at risk to caries increment.

The variable mother's educational level showed better sensitivity than DMFS, but lower specificity than clinical variables.

The variable dmfs>0 was the best predictor for caries increment. Most children (69%) who developed caries in permanent dentition presented caries in primary teeth at baseline examination. However, this variable did not predict successfully those individuals who would not develop caries increment (Sp=56%, Table 3).

Considering that the sensitivity cannot be useful if this value is less than 50%, that a balance with the specificity is desired, and that a variable with some predictive power presents A_z>0.5, (7) the variable caries experience in primary teeth (dmfs>0) was the main contributor to the accuracy of caries prediction. It should be noted that a comparison among different studies concerning sensitivity and specificity is impossible since statistical uncertainty (standard error) is not given for these estimates (13).

According to the results, it can be concluded that 6-8-year-old children who presented caries experience at baseline and/or mother's educational level lower than 8 years of schooling had more chances of developing caries in the permanent dentition over the studied period.

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REFERENCES

1. Disney JA, Graves RC, Stamm JW, Bohannan HM, Abernathy JR, Zack DD. The University of North Carolina Caries Risk Assessment study: further developments in caries risk prediction. Community Dent Oral Epidemiol 1992;20:64-75.
2. Tinanoff N. Critique of evolving methods for caries risk assessment. J Dent Educ 1995;59:980-5.
3. Raitio M, Pienihakkinen K, Scheinin A. Multifactorial modeling for prediction of caries increment in adolescents. Acta Odontol Scand 1996;54:118-21.
4. Petti S, Hausen HW. Caries prediction by multiple salivary mutans streptococcal counts in caries-free children with different levels of fluoride exposure, oral hygiene and sucrose intake. Caries Res 2000;34:380-7.
5. Wandera A, Bhakta S, Barker T. Caries prediction and indicators using a pediatric risk assessment teaching tool. J Dent Child 2000;67:408-12.
6. van Palenstein Helderman WH. Mulder J, van't Hof MA, Truin GJ. Validation of a Swiss method of caries prediction in Dutch children. Community Dent Oral Epidemiol 2001;29:341-5.
7. Vanobbergen J, Martens L, Lesaffre E, Bogaerts K, Declerck D. The value of a baseline caries risk assessment model in the primary dentition for the prediction of caries incidence in the permanent dentition. Caries Res 2001;35:442-50.
8. Pearce EIF, Dong YM, Yue L, Gao XJ, Purdie GL, Wang JD. Plaque minerals in the prediction of caries activity. Community Dent Oral Epidemiol 2002;30:61-9.
9. Stenlund H, Mejare I, Kallestal C. Caries rates related to approximal caries at ages 11-13: a 10-year follow-up study in Sweden. J Dent Res 2002;81:455-8.
10. Bader JD, Perrin NA, Maupome G, Rindal B, Rush WA. Validation of a simple approach to caries risk assessment. J Public Health Dent 2005;65:76-81.

11. Hausen H. Caries prediction – state of the art. Community Dent Oral Epidemiol 1997;25:87-96.

12. Demers M, Brodeur JM, Mouton C, Simard PL, Trahan L, Veilleux G. A multivariate model to predict caries increment in Montreal children aged 5 years. Community Dent Health 1992;9:273-81.

13. Grindefjord M, Dahllof G, Nilsson B, Modeer T. Prediction of dental caries development in 1-year-old children. Caries Res 1995;29:343-8.

14. Burt BA. Prevention policies in the light of the changed distribution of dental caries. Acta Odontol Scand 1998;56:179-86.

15. Li Y, Wang W. Predicting caries in permanent teeth from caries in primary teeth: an eight-year cohort study. J Dent Res 2002;81:561-6.

16. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics 1977;33:159-74.

17. World Health Organization, 1987. Oral Health Surveys. Basic Methods. 3rd ed. Geneva: WHO.

18. Rimmer PA, Pitts NB. Effects of diagnostic threshold and overlapped approximal surfaces on reported caries status. Community Dent Oral Epidemiol 1991;19:205-12.

19. Greene JC, Vermillion, JR. The simplified oral hygiene index. J Am Dent Assoc 1964;68:7-13.

20. Dean HT. Classification of mottled enamel diagnosis. J Am Dent Assoc 1934;21:1421-6.

21. Russel AL. The differential diagnosis of fluoride and non-fluoride enamel opacities. J Public Health Dent 1961;21:143-6.

22. Krasse B. Biological factors as indicators of future caries. Int Dent J 1988;38:219-25.

23. SAS Institute Inc (2001). SAS/STAT 8.2. Guide for personal computers. Cary: SAS Institute.

24. Brazil. Health Ministry of Brazil. SB Brazil 2003 Project - Oral health conditions of the Brazilian population 2002-2003. Brasília, DF, 2004 (in Portuguese). Available at <http://portalweb02.saude.gov.br/portal/arquivos/pdf/ relatorio_brasil_sorridente.pdf>. Accessed June 2005.

25. Tagliaferro EPS, Cypriano S, Sousa MLR, Wada RS. Caries experience among schoolchildren in relation to community fluoridation status and town size. Acta Odontol Scand 2004;62:124-8.

26. Burt BA. Concepts of risk in dental public health. Community Dent Oral Epidemiol 2005;33:240-7.

Table 1. Caries prevalence (%), mean (SD) of caries indexes, white spots lesion, and pit and fissure sealants according to year of examination, for full participants (n=206)

Variable	**Year of examination**	
	1997	**2004**
Caries prevalence (%)	60.19%	48.54%
dmfs	3.38 (4.32)	0.02 (0.28)
dmft	2.14 (2.54)	0.01 (0.14)
DMFS	0.29 (0.85)	2.91 (4.29)
DMFT	0.24 (0.71)	2.16 (3.05)
White spots lesion	0.21 (0.71)	0.32 (0.96)
Pit and fissure sealants	1.07 (1.69)	3.50 (4.31)

Table 2. Stepwise logistic regression with DMFS increment as dependent variable (n=206)

Predictor	DMFS increment ≥ 1		OR*	95%CI†	p value
	n	%			
DMFS					
0	73	40.78	1.00		
> 0	18	66.67	2.49	1.02-6.04	0.04
dmfs					
0	28	31.46	1.00		
> 0	63	53.85	2.29	1.24-4.23	0.001
Mother's education					
> 8 years of schooling	32	35.96	1.00		
≤ 8 years of schooling	58	50.43	1.88	1.03-3.45	0.03

*OR = odds ratio
†$CI_{95\%}$ = 95% confidence interval

Table 3. Sensitivity [Sn (%)], specificity [Sp (%)] predictive values [PV (%)], area under ROC curve (A_z) and its 95% Confidence Interval (CI) of the variables remained in the prediction model

Variables	**Sn**	**Sp**	**PV+**	**PV-**	**A_z**	**95%CI**
DMFS>0	20%	92%	67%	59%	0.56	0.33-0.79
dmfs>0	69%	53%	54%	69%	0.61	0.51-0.71
Mother's education ≤8 years of schooling	64%	50%	50%	64%	0.57	0.47-0.67

CONSIDERAÇÕES GERAIS

A doença cárie, um problema de saúde pública no Brasil, ainda acomete um grande número da população adolescente, adulta e idosa, apesar de ter mostrado indícios de declínio nas últimas décadas, especialmente em crianças. Apesar disso, a minoria delas concentra a maior parte da doença, o chamado grupo de polarização. Neste contexto, a identificação precoce desses indivíduos de alto risco permite que gestores de saúde bucal planejem medidas específicas para prevenção da doença e aumentem a eficiência de programas preventivos. Além disso, a identificação desses indivíduos favorece a melhor alocação de recursos humanos e financeiros uma vez que os esforços serão direcionados aos grupos de maior risco de desenvolvimento da doença cárie.

Entretanto, a correta identificação de indivíduos de risco de cárie não é uma tarefa fácil e deve ser baseada em evidência científica. Nos estudos observacionais longitudinais, alguma característica detectada no exame inicial e que seja estatisticamente relacionada ao incremento da doença cárie é considerada fator ou preditor de risco e ajuda na identificação de indivíduos com alto risco de cárie. Além disso, nesses estudos é importante que se conheça o comportamento das variáveis quando inseridas juntas em modelos de predição multivariados, servindo como uma boa ferramenta na avaliação de risco de cárie.

Esta tese, composta por dois artigos, objetivou apresentar uma visão geral e atual da avaliação de risco de cárie dentária, em um artigo de revisão da literatura, bem como determinar quais variáveis clínicas, comportamentais, socioeconômicas e demográficas identificaram indivíduos com maior probabilidade de desenvolver incremento de cárie, em estudo longitudinal realizado em um período de sete anos.

No capítulo 1, em que uma revisão da literatura sobre a avaliação de risco de cárie em crianças e adolescentes é apresentada, ficou evidenciado que a experiência de cárie foi o mais forte preditor de desenvolvimento da doença no futuro, para todos os grupos etários avaliados. De fato, a detecção da experiência de cárie no *baseline* sugere que um desequilíbrio no processo des-remineralização vem ocorrendo freqüentemente na interface dente-biofilme. Outros preditores de risco importantes encontrados na revisão de literatura se referem à contagem microbiológica e aos hábitos de escovação, além da ingestão de açúcar que foi uma variável importante, principalmente para crianças menores. Com

relação às publicações selecionadas, mais de 40% delas se referem às crianças em idade escolar, provavelmente pela facilidade de acesso e de acompanhamento ao longo do tempo. Adicionalmente, além das variáveis clínicas, que são as mais simples de coletar, outras características como propriedades salivares, aspectos socioeconômicos e demográficos, história médica, hábitos comportamentais e dietéticos, uso de serviços odontológicos também são variáveis utilizadas para identificar os indivíduos com risco de cárie futura. Outro aspecto interessante que vale ser salientado é o importante papel das publicações brasileiras dentro do tema de predição de cárie, ocupando o segundo lugar em quantidade de artigos sobre o tema, ficando atrás somente das publicações finlandesas.

No capítulo 2, sobre um estudo longitudinal conduzido no período de 7 anos, pôde-se verificar que no modelo de predição utilizando regressão logística multivariada, em que se incluíram características clínicas, comportamentais, socioeconômicas e demográficas, as variáveis relacionadas à experiência de cárie em dentes permanentes e decíduos, bem como a escolaridade da mãe foram importantes na identificação de crianças com maior risco de incremento de cárie. Assim, nesse primeiro artigo científico brasileiro com um longo período de acompanhamento, os resultados corroboraram os achados da literatura, evidenciando que para os escolares brasileiros, a experiência passada de cárie também foi o melhor preditor da doença na dentição permanente. Um achado importante e pouco documentado foi o papel da escolaridade da mãe na identificação dos indivíduos de alto risco, dentre todas as variáveis socioeconômicas. De fato, quanto maior a escolaridade da mãe, maiores são seus conhecimentos acerca da prevenção de doenças e maior é o acesso à informação e aos serviços de saúde, além obviamente desta variável ter relação direta com aspectos socioeconômicos.

Portanto, os resultados desta tese sugerem que os indivíduos que apresentam experiência de cárie necessitam ser constantemente monitorados e, dependendo da atividade de cárie presente, submetidos a métodos efetivos na prevenção da doença cárie. Assim, podem servir como uma ferramenta aos gestores de saúde bucal no sentido de auxiliar o planejamento de ações preventivas. Por outro lado, pode-se sugerir também que estudos com crianças livres de cárie no exame inicial sejam conduzidos para se determinar quais variáveis seriam capazes de selecionar os indivíduos que desenvolveriam a doença no

futuro em um grupo onde o principal preditor, que é a experiência passada de cárie, não esteja presente.

CONCLUSÃO

Os resultados dos estudos desta tese permitem concluir que o nível educacional materno pode identificar os escolares com maior chance de desenvolvimento da doença cárie e que as variáveis relacionadas à experiência passada de cárie continuam sendo o principal preditor de risco.

REFERÊNCIAS[*]

Alaluusua S. Salivary counts of mutans streptococci and lactobacilli and past caries experience in caries prediction. Caries Res. 1993; (Suppl 1): 68-71.

Angulo M, Zinemanas E, Pivel L, Jorysz E, Casamayou R, Krasse B. Caries incidence, effect of preventive measures, and caries prediction in Uruguayan children. Acta Odontol Scand. 1995; 53: 1-6.

Bastos JL, Nomura LH, Peres MA. Tendência de cárie dentária em escolares de 12 e 13 anos de idade de uma mesma escola no período de 1971 a 2002, em Florianópolis, Santa Catarina, Brasil. Cad Saude Publica. 2004; 20: 117-22.

Batchelor PA, Sheiham A. Grouping of tooth surfaces by susceptibility to caries: a study in 5-16 year-old children. BMC Oral Health. 2004; 4: 2.

Beck JD. Risk revisited. Community Dent Oral Epidemiol. 1998; 26: 220-5.

Bonecker M, Cleaton-Jones P. Trends in dental caries in Latin American and Caribbean 5-6- and 11-13-year-old children: a systematic review. Community Dent Oral Epidemiol. 2003; 31: 152-7.

Brasil. Ministério da Saúde. Levantamento epidemiológico em saúde bucal: Brasil, zona urbana, 1986. Brasília, DF: Ministério da Saúde; 1988.

Brasil. Ministério da Saúde. SB Brasil 2003 - Projeto. Condições de saúde bucal da população brasileira: 2002-2003. Brasília, DF: Ministério da Saúde; 2004.

Burt BA. Definitions of risk. J Dent Educ. 2001; 65: 1007-8.

Burt BA. Prevention policies in the light of the changed distribution of dental caries. Acta Odontol Scand. 1998; 56: 179-86.

Campain AC, Morgan MV, Evans RW, Ugoni A, Adams GG, Conn JA *et al*. Sugar-starch combinations in food and the relationship to dental caries in low-risk adolescents. Eur J Oral Sci. 2003; 111: 316-25.

Campus G, Sacco G, Cagetti M, Abati S. Changing trend of caries from 1989 to 2004 among 12-year old Sardinian children. BMC Public Health. 2007; 7: 28.

[*] 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.

Chawla HS, Gauba K, Goyal A. Trend of dental caries in children of Chandigarh over the last sixteen years. J Indian Soc Pedod Prev Dent. 2000; 18: 41-5.

Cury JA, Tenuta LMA, Ribeiro CCC, Paes Leme AF. The importance of fluoride dentifrices to the current dental caries prevalence in Brazil. Braz Dent J. 2004; 15: 167- 74.

David J, Raadal M, Wang NJ, Strand GV. Caries increment and prediction from 12 to 18 years of age: a follow-up study. Eur Arch Paediatr Dent. 2006; 7: 31-7.

Demers M, Brodeur JM, Mouton C, Simard PL, Trahan L, Veilleux G. A multivariate model to predict caries increment in Montreal children aged 5 years. Community Dent Health. 1992; 9: 273-81.

Disney JA, Graves RC, Stamm JW, Bohannan HM, Abernathy JR, Zack DD. The University of North Carolina Caries Risk Assessment study: further developments in caries risk prediction. Community Dent Oral Epidemiol. 1992; 20: 64-75.

Douglass CW. Risk assessment in dentistry. J Dent Educ. 1998; 62: 756-61.

Fejerskov O. Changing paradigms in concepts on dental caries: consequences for oral health care. Caries Res. 2004; 38: 182-91.

Gavazzi JC, Höfling JF, Moreira BHW, Peters CF, Usberti AC, Cury JA. Previsores do incremento de cárie em crianças escolares brasileiras. Rev Ass Paul Cir Dent. 1995; 49: 40-6.

Grindefjord M, Dahllof G, Nilsson B, Modeer T. Prediction of dental caries development in 1-year-old children. Caries Res. 1995; 29: 343-8.

Hausen H. Caries prediction – state of the art. Community Dent Oral Epidemiol. 1997; 25: 87-96.

Hintze H. Approximal caries prevalence in Danish recruits and progression of caries in the late teens: a retrospective radiographic study. Caries Res. 2001; 35: 27-35.

Irigoyen ME, Sánchez-Hinojosa G. Changes in dental caries prevalence in 12-year-old students in the State of Mexico after 9 years of salt fluoridation. Caries Res. 2000; 34: 303-7.

Jeppesen BA, Foldspang A. Can the development of new dental caries in Danish schoolchildren be predicted from surveillance data in the School Dental Service? Community Dent Oral Epidemiol. 2006; 34: 205-12.

Källestål C, Wall S. Socio-economic effect on caries. Incidence data among Swedish 12-14-year-olds. Community Dent Oral Epidemiol. 2002; 30: 108-14.

Kleinbaum D, Kupper L, Morgenstern H. Epidemiologic research: principles and quantitative methods. Belmont (CA): Lifetime Learning Publications; 1982. *Apud* Beck JD. Risk revisited. Community Dent Oral Epidemiol. 1998; 26: 220-5.

Kopycka-Kedzierawski DT, Billings RJ. A longitudinal study of caries onset in initially caries-free children and baseline salivary mutans streptococci levels: a Kaplan-Meier survival analysis. Community Dent Oral Epidemiol. 2004; 32: 201-9.

Lawrence HP, Sheiham A. Caries progression in 12- to 16-year-old schoolchildren in fluoridated and fluoride-deficient areas in Brazil. Community Dent Oral Epidemiol. 1997; 25: 402-11.

Leroy R, Bogaerts K, Lesaffre E, Declerck D. Multivariate survival analysis for the identification of factors associated with cavity formation in permanent first molars. Eur J Oral Sci. 2005; 113: 145-52.

Marthaler TM. Changes in dental caries 1953-2003. Caries Res. 2004; 38: 173-81.

Mattila ML, Paunio P, Rautava P, Ojanlatva A, Sillanpää M. Changes in dental health and dental health habits from 3 to 5 years of age. J Public Health Dent. 1998; 58: 270-4.

Mattila ML, Rautava P, Aromaa M, Ojanlatva A, Paunio P, Hyssälä L *et al*. Behavioural and demographic factors during early childhood and poor dental health at 10 years of age. Caries Res. 2005; 39: 85-91.

Mattila ML, Rautava P, Paunio P, Ojanlatva A, Hyssälä L, Helenius H *et al*. Caries experience and caries increments at 10 years of age. Caries Res. 2001; 35: 435-41.

Meneghim MC, Tagliaferro EPS, Tengan C, Meneghim ZMP, Pereira AC, Ambrosano GMB *et al*. Trends in caries experience and fluorosis prevalence in 11- to 12-year-old Brazilian children between 1991 and 2004. Oral Health Prev Dent. 2006; 4: 193-8.

Moberg Skold U, Birkhed D, Borg E, Petersson LG. Approximal caries development in adolescents with low to moderate caries risk after different 3-year school-based supervised fluoride mouth rinsing programmes. Caries Res. 2005; 39: 529-35.

Narvai PC, Frazão P, Roncalli AG, Antunes JLF. Cárie dentária no Brasil: declínio, iniqüidade e exclusão social. Rev Panam Salud Publica. 2006; 19: 385–93.

Ollila P, Larmas M. A seven-year survival analysis of caries onset in primary second molars and permanent first molars in different caries risk groups determined at age two years. Acta Odontol Scand. 2007; 65: 29-35.

Ollila P, Niemelä M, Uhari M, Larmas M. Prolonged pacifier-sucking and use of a nursing bottle at night: possible risk factors for dental caries in children. Acta Odontol Scand. 1998; 56: 233-7.

Pakshir HR. Oral health in Iran. Int Dent J. 2004; 54(Suppl 1): 367-72.

Pearce EIF, Dong YM, Yue L, Gao XJ, Purdie GL, Wang JD. Plaque minerals in the prediction of caries activity. Community Dent Oral Epidemiol. 2002; 30: 61-9.

Pereira AC, Cunha FL, Meneghim MC, Werner CW. Dental caries and fluorosis prevalence study in a nonfluoridated Brazilian community: trend analysis and toothpaste association. J Dent Child. 2000; 67: 132-5.

Pereira SM, Tagliaferro EPS, Ambrosano GMB, Cortellazzi KL, Meneghim MC, Pereira AC. Dental caries in 12-year-old schoolchildren and its relationship with socioeconomic and behavioral variables. Oral Health Prev Dent. 2007; 5: 299-306.

Petti S, Hausen HW. Caries prediction by multiple salivary mutans streptococcal counts in caries-free children with different levels of fluoride exposure, oral hygiene and sucrose intake. Caries Res. 2000; 34: 380-7.

Pienihäkkinen K, Jokela J, Alanen P. Assessment of caries risk in preschool children. Caries Res. 2004; 38: 156-62.

Pieper K, Schulte AG. The decline in dental caries among 12-year-old children in Germany between 1994 and 2000. Community Dent Health. 2004; 21: 199-206.

Poulsen S, Scheutz F. Dental caries in Danish children and adolescents 1988-1997. Community Dent Health. 1999; 16: 166-70.

Powell LV. Caries prediction: a review of the literature. Community Dent Oral Epidemiol. 1998; 26: 361-71.

Raitio M, Pienihakkinen K, Scheinin A. Multifactorial modeling for prediction of caries increment in adolescents. Acta Odontol Scand. 1996; 54: 118-21.

Reisine S, Litt M, Tinanoff N. A biopsychosocial model to predict caries in preschool children. Pediatr Dent. 1994; 16: 413-8.

Rodrigues CS, Sheiham A. The relationships between dietary guidelines, sugar intake and caries in primary teeth in low income Brazilian 3-year-olds: a longitudinal study. Int J Paediatr Dent. 2000; 10: 47-55.

Rugarabamu PG, Poulsen S, Masalu JR. A longitudinal study of occlusal caries among schoolchildren in Dar es Salaam, Tanzania. Community Dent Oral Epidemiol. 2002; 30: 47-51.

Sales-Peres SH, Bastos JR. Perfil epidemiológico de cárie dentária em crianças de 12 anos de idade, residentes em cidades fluoretadas e não fluoretadas, na Região Centro-Oeste do Estado de São Paulo, Brasil. Cad Saude Publica. 2002; 18: 1281-8.

Seki M, Karakama F, Terajima T, Ichikawa Y, Ozaki T, Yoshida S *et al*. Evaluation of mutans streptococci in plaque and saliva: correlation with caries development in preschool children. J Dent. 2003; 31: 283-90.

Seppä L. The future of preventive programs in countries with different systems for dental care. Caries Res. 2001; 35(Suppl 1): 26-9.

Skeie MS, Raadal M, Strand GV, Espelid I. The relationship between caries in the primary dentition at 5 years of age and permanent dentition at 10 years of age - a longitudinal study. Int J Paediatr Dent. 2006; 16: 152-60.

Slade GD, Caplan DJ. Impact of analytic conventions on outcome measures in two longitudinal studies of dental caries. Community Dent Oral Epidemiol. 2000; 28: 202-10.

Splieth C, Bernhardt O. Prediction of caries development for molar fissures with semiquantitative mutans streptococci tests. Eur J Oral Sci. 1999; 107: 164-9.

Stenlund H, Mejàre I, Källestål C. Caries rates related to approximal caries at ages 11-13: a 10-year follow-up study in Sweden. J Dent Res. 2002; 81: 455-8.

Tickle M. The 80:20 phenomenon: help or hindrance to planning caries prevention programmes? Community Dent Health. 2002; 19: 39-42.

Utriainen P, Pahkala K, Kentala J, Laippala P, Mattila K. Changes in the oral health of adolescents treated by the Finnish public dental services between the ages of 13 and 15 years. Community Dent Oral Epidemiol. 1998; 26: 149-54.

Vallejos-Sánchez AA, Medina-Solís CE, Casanova-Rosado JF, Maupomé G, Minaya-Sánchez M, Pérez-Olivares S. Caries increment in the permanent dentition of Mexican children in relation to prior caries experience on permanent and primary dentitions. J Dent. 2006; 34: 709-15.

van Wyk PJ, van Wyk C. Oral health in South Africa. Int Dent J. 2004; 54(Suppl 1): 373-7.

Vanderas AP, Kavvadia K, Papagiannoulis L. Development of caries in permanent first molars adjacent to primary second molars with interproximal caries: four-year prospective radiographic study. Pediatr Dent. 2004; 26: 362-8.

Vanderas AP, Manetas K, Papagiannoulis L. Caries increment in children and urinary catecholamines: findings at one-year. J Dent Child. 2000; 67: 355-9.

Vanobbergen J, Martens L, Lesaffre E, Bogaerts K, Declerck D. The value of a baseline caries risk assessment model in the primary dentition for the prediction of caries incidence in the permanent dentition. Caries Res. 2001; 35: 442-50.

Wandera A, Bhakta S, Barker T. Caries prediction and indicators using a pediatric risk assessment teaching tool. J Dent Child. 2000; 67: 408-12.

Anexo 1

From “r.p.shellis@bristol.ac.uk”
To epstag@gmail.com,

Date Oct 16, 2007 7:55 AM
Subject Ms. No. 200710009, Caries Research

MS: 200710009

Dear Dr. Tagliaferro,

Thank you for submitting your manuscript entitled "AN OVERVIEW OF CARIES RISK ASSESSMENT IN 0-18 YEAR-OLDS OVER THE LAST TEN YEARS (1997-2007)" to "Caries Research". It will now be submitted to review and we shall inform you as soon as possible of the decision reached by the editorial board. The manuscript reference number is 200710009. Please use this number on all correspondence about the manuscript, which should be sent to the "Caries Research" editorial office at the address listed below.

For information regarding the status of your manuscript and for future submissions you can access this system by logging into the journal's online peer review system as follows:

http://www.karger.com/cre

With kind regards,

R P Shellis
(Editor-in-Chief, Caries Research)
Division of Restorative Dentistry
Bristol University Dental School, Bristol BS1 2LY, U.K.
Fax. +44 117-928-4778
Tel. +44 117-928-4328
r.p.shellis@bristol.ac.uk

Anexo 2

LIBERAÇÃO PARA INCLUSÃO EM TESE DO ARTIGO "ASSESSMENT OF DENTAL CARIES PREDICTORS IN A SEVEN-YEAR LONGITUDINAL STUDY", PUBLICADO NO "JOURNAL OF PUBLIC HEALTH DENTISTRY"

from Pam Tolson <pam4assn@assn-srvs.com> hide details 11/27/06
reply-to pam4assn@assn-srvs.com
to epstag@gmail.com
date Nov 27, 2006 1:59 PM
subject FW: JPHD Manuscript 098-120511--request to use in dissertation
mailed-by assn-srvs.com

Elaine: You are welcome to use the manuscript in your dissertation, we only ask that you give proper credit to its publication in the Journal of Public Health Dentistry. I will save this e-mail as your official request to do so.

Pamela J. Tolson, CAE
American Assn of Public Health Dentistry
Executive Director

From: Gift, Helen [mailto:hgift@brevard.edu]
Sent: Friday, November 24, 2006 9:21 AM
To: pam4assn@assn-srvs.com; Betty Hardin
Subject: JPHD Manuscript 098-120511--request to use in dissertation
Importance: High

Please respond to this author. I think it's fine, but I don't know the process.

Anexo 2

From: Elaine P. S. Tagliaferro [mailto:epstag@gmail.com]
Sent: Thursday, November 23, 2006 7:08 AM
To: Gift, Helen
Cc: epstag@gmail.com
Subject: JPHD Manuscript 098-120511

Helen C. Gift, Ph.D.
Interim Editor
Journal of Public Health Dentistry

Dear Dr. Helen

Recently, the Journal of Public Health Dentistry has published the paper "Assessment of dental caries predictors in a seven-year longitudinal study", v.66, n.3, p. 169-173, written by me and my colleagues. As I am expecting to complete my Doctoral Dissertation at the University of Campinas, Piracicaba Dental School, next year, I kindly would like to know if it is possible to obtain a special permission to include in my Dissertation the above-mentioned article. In positive case, should I complete a specific form or may I prepare a document for it? Thank you very much for your attention.

I am looking forward to hearing from you.

Sincerely

Elaine P.S. Tagliaferro

COMITÊ DE ÉTICA EM PESQUISA

UNIVERSIDADE ESTADUAL DE CAMPINAS

FACULDADE DE ODONTOLOGIA DE PIRACICABA

CERTIFICADO

Certificamos que o Projeto de pesquisa "Avaliação de fatores de risco para cárie dental", protocolo CEP nº **026/2004**, dos Pesquisadores ***Elaine Pereira da Silva Tagliaferro*** e ***Antonio Carlos Pereira***, está de acordo com a Resolução 196/96 do Conselho Nacional de Saúde - MS e foi aprovado pelo Comitê de Ética em Pesquisa da Faculdade de Odontologia - UNICAMP.

We certify that the research project "Assessment of risk factors for dental caries", register number **026/2004**, of ***Elaine Pereira da Silva Tagliaferro*** and ***Antonio Carlos Pereira***, is in agreement with the recommendations of 196/96 Resolution of the National Health Committee – Brazilian Health Department and was approved by the Research Ethics Committee of the School of Dentistry of Piracicaba - State University of Campinas - UNICAMP.

Piracicaba - SP, Brasil, 07/04/2004

Profa. Dra. Cinthia Pereira Machado Tabchoury
Secretaria
CEP/FOP/UNICAMP

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

Anexo 3

Anexo 4

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Voluntário:_____

Responsável:_____ R.G.:_____

Endereço:_____

Cidade: _____ Telefone: _____

Solicitamos que leia atentamente este termo cujos objetivos são esclarecê-lo com relação à pesquisa que será desenvolvida e obter sua autorização para participação.

As informações contidas neste termo foram fornecidas pelo Prof. Dr. Antonio Carlos Pereira e pela aluna de pós-graduação Elaine Pereira da Silva Tagliaferro, com o objetivo de firmar acordo por escrito, mediante o qual o voluntário, objeto da pesquisa, autoriza sua participação com pleno conhecimento da natureza dos procedimentos e riscos aos quais se submeterá, com capacidade de livre arbítrio e sem qualquer coação. As normas estão de acordo com o Código de Ética Profissional Odontológico, segundo a Resolução do Conselho Federal de Odontologia 179/93, com a Declaração de Helsinque e com a Resolução nº 196 de 10/10/1996 do Conselho Nacional de Saúde do Ministério da Saúde.

I. Título da Pesquisa - "AVALIAÇÃO DE FATORES DE RISCO PARA CÁRIE DENTAL"

II. Justificativa - A identificação de indivíduos com maior risco de desenvolver a doença cárie é de extrema importância na odontologia. No entanto, é uma tarefa difícil, uma vez que não há, entre os pesquisadores, uma concordância geral sobre quais características são importantes indicadores de risco futuro de cárie, especialmente nos indivíduos livres da doença, ou qual é a melhor faixa etária para se realizar o exame clínico inicial, justificando a realização de estudos referentes ao tema.

III. Objetivo - Esta pesquisa procurará identificar quais características orais clínicas, comportamentais e/ou socioeconômicas estão mais fortemente associadas ao risco de desenvolver a doença cárie.

IV. Procedimentos utilizados na pesquisa - O voluntário selecionado para o estudo será submetido a um exame clínico odontológico a ser realizado no pátio das escolas, utilizando-se instrumental esterilizado, após escovação supervisionada. Serão coletadas informações sobre cárie dental, higiene bucal, forma dental, presença de selante e fluorose dental.

V. Desconfortos e Riscos - A pesquisa não oferece qualquer risco ao voluntário, uma vez que os métodos empregados para avaliação são atraumáticos, não causando dor ou desconforto.

VI. Benefícios esperados - Neste estudo o voluntário passará por uma avaliação detalhada de sua condição bucal, será orientado sobre saúde bucal e cuidados de higiene oral e, caso seja necessário, será encaminhado para realização de tratamento odontológico.

VII. Métodos alternativos - Não há métodos alternativos para se obter as informações necessárias.

VIII. Forma de acompanhamento e assistência - Os pesquisadores envolvidos na pesquisa serão responsáveis pelo encaminhamento do voluntário ao tratamento odontológico, caso seja necessário.

IX. Garantia de esclarecimentos - O voluntário e seus pais ou responsáveis têm garantia de que receberão resposta ou esclarecimento de qualquer dúvida quanto aos procedimentos, riscos, benefícios e outros assuntos relacionados à pesquisa ainda que isso possa afetar a vontade do indivíduo em continuar participando. Qualquer dúvida ou problema, por favor, comunicar-nos com a maior brevidade possível pelo telefone: 3412-5209 (Secretaria do Departamento de Odontologia Social) ou pelo endereço: Av. Limeira, 901 – CEP 13414-903 – Piracicaba-SP (FOP-UNICAMP).

X. Liberdade para se recusar em participar da pesquisa - A decisão de fazer parte desta pesquisa é voluntária. O indivíduo pode escolher se quer ou não participar, assim como poderá desistir de participar a qualquer momento, sem penalidades ou perda dos benefícios que tenha direito.

XI. Garantia de sigilo - Os pesquisadores asseguram a privacidade do voluntário quanto aos dados confidenciais envolvidos na pesquisa. Os resultados deste estudo poderão ser apresentados em congressos ou publicados em revista científica, porém a identidade do voluntário não será divulgada.

XII. Formas de ressarcimento - O voluntário não terá despesas decorrentes da participação nesta pesquisa, uma vez que os exames clínicos serão realizados no pátio das escolas.

XIII. Formas de indenização - A pesquisa não inclui a possibilidade de indenização pois não há danos previsíveis decorrentes do estudo.

XIV. Consentimento livre e esclarecido

Eu,_____,

declaro que, tendo lido as informações contidas neste ***Termo de Consentimento Livre e Esclarecido*** e suficientemente esclarecido(a) de todos os itens pelo Prof. Dr. Antonio Carlos Pereira e pela aluna de pós-graduação Elaine Pereira da Silva Tagliaferro, estou plenamente de acordo com a realização da pesquisa. Também declaro estar ciente de poder desistir de participar do estudo a qualquer momento, sem quaisquer penalidades. Assim, autorizo a participação de _____na pesquisa "**Avaliação de fatores de risco para cárie dental**" e concordo plenamente com a utilização de todos os registros obtidos para fins de ensino e pesquisa, além da publicação em revistas científicas e/ou apresentação em congressos. Por ser verdade, firmo o presente.

Piracicaba, _____ de_____200___.

Nome:_____

RG:_____

Assinatura: _____

ATENÇÃO: A SUA PARTICIPAÇÃO EM QUALQUER TIPO DE 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/FOP, CEP 13414-903 - Piracicaba, SP

Anexo 5

DECLARAÇÃO

As cópias de artigos de minha autoria ou de minha co-autoria, já publicados ou submetidos para publicação em revistas científicas ou anais de congressos sujeitos a arbitragem, que constam da minha Tese de Doutorado, intitulada "Avaliação de risco de cárie dentária: estado da arte e estudo longitudinal sobre preditores de risco em escolares" não infringem os dispositivos da Lei nº 9.610/98, nem o direito autoral de qualquer editora.

Campinas, 05 de dezembro de 2007.

Elaine Pereira da Silva Tagliaferro
RG nº 24383618-1

Prof. Dr. Antonio Carlos Pereira
RG nº 17209399