UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL
FACULDADE DE ODONTOLOGIA
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Linha de Pesquisa:
Epidemiologia, Etiopatogenia e Repercussão das Doenças da Cavidade Bucal e Estruturas Anexas

CÁRIE DENTÁRIA EM ESCOLARES DE 12 ANOS DE PORTO ALEGRE, RS

Tese apresentada ao Programa de Pós-Graduação em Odontologia como parte dos requisitos obrigatórios para a obtenção do título de Doutor em Clínica Odontológica/Dentística-Cariologia

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"Saber muito não lhe torna inteligente. A inteligência se traduz na forma como você recolhe, julga, maneja e, sobretudo, onde e como aplica esta informação"

Carl Sagan

Se os resultados deste estudo puderem contribuir para melhorar as condições de vida da população, a ciência estará atingindo seu objetivo maior...

DEDICATÓRIA

Aproximadamente 12 meses de coleta de dados, 1.528 escolares examinados, incontáveis quilômetros percorridos, inúmeras linhas de transporte coletivo conhecidas, intermináveis telefonemas realizados... Alguns beijinhos e abraços de agradecimento, outros de pura carência... Dois meses (de janeiro!) de digitação dos dados... Muitos meses de análises estatísticas e redação dos manuscritos... Enfim, chegamos aqui.

Dedico este trabalho:

A *Deus*, pela presença constante em todos os dias da minha vida.

À *minha família*, sem a qual nada seria possível.

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SUMÁRIO

APRESENTAÇÃO

A presente tese baseia-se nos seguintes artigos, referidos no texto pelos seus números romanos:

Artigo I: Alves LS, Susin C, Damé-Teixeira N, Maltz M. Impact of different diagnostic criteria on prevalence, extent and risk indicators for dental caries among 12-year-old Brazilian schoolchildren.

Artigo II: Alves LS, Susin C, Damé-Teixeira N, Maltz M. Tooth loss due to dental caries among 12-year-old schoolchildren from South Brazil.

Artigo III: Alves LS, Susin C, Damé-Teixeira N, Maltz M. Overweight and obesity are not associated with dental caries among 12-year-old South Brazilian schoolchildren. Community Dent Oral Epidemiol 2012. (In press).

Artigo IV: Alves LS, Damé-Teixeira N, Susin C, Maltz M. Association among quality of life, dental caries treatment and intraoral distribution in 12-year-old South Brazilian schoolchildren. Community Dent Oral Epidemiol 2012 Aug 11; doi: 10.1111/j.1600-0528.2012.00707.x. [Epub ahead of print].

RESUMO

Objetivos: O objetivo desta tese foi estudar a população de escolares de 12 anos de Porto Alegre, RS, em relação: (1) à prevalência e extensão de cárie dentária; (2) ao impacto do uso de diferentes critérios de diagnóstico sobre a prevalência e extensão de cárie e a identificação de fatores sócio-demográficos a ela associados; (3) à prevalência e indicadores de risco de perda dentária; (4) à associação entre cárie dentária e obesidade; e (5) à associação entre cárie dentária e qualidade de vida relacionada à saúde bucal. **Metodologia**: Um estudo transversal de base populacional foi conduzido entre Setembro de 2009 e Dezembro de 2010. Uma estratégia de amostragem probabilística em múltiplos estágios foi utilizada para selecionar uma amostra representativa. 1.837 escolares foram selecionados a partir de 9 escolas particulares e 33 escolas públicas. Um questionário contendo perguntas sobre características socioeconômicas, escolaridade dos pais, condição de moradia, acesso a serviços odontológicos e hábitos de higiene oral foi enviado aos pais ou responsáveis dos escolares selecionados. O "Child Perceptions Questionnaire" (CPQ_{11-14}) foi aplicado aos próprios escolares. O peso e a altura dos escolares foram registrados. O exame clínico foi conduzido a fim de registrar o Índice de Sangramento Gengival e o Índice de Cárie Dentária. Três diferentes critérios de diagnóstico de cárie foram definidos: OMS (apenas lesões cavitadas), OMS modificado (cavidades e lesões não cavitadas brancas) e ICDAS (cavidades e lesões não cavitadas, brancas e pigmentadas). Para avaliar a associação entre tratamento da cárie dentária e qualidade de vida, os escolares foram classificados em: sem necessidade de tratamento; com cárie tratada; e com cárie não tratada. Para avaliar a associação entre a distribuição intraoral da cárie e qualidade de vida, os indivíduos foram classificados em: livres de cárie; cárie apenas em dentes posteriores; e cárie em pelo menos um dente anterior. Regressão de Poisson foi utilizada para avaliar a associação entre os desfechos cárie dentária/perda dentária e as variáveis preditoras estudadas. Nas análises dos dados de qualidade vida, modelos de Regressão Binomial Negativa foram utilizados. **Resultados**: 1.528 escolares participaram do estudo (taxa de resposta de 83,17%). Quanto mais sensível o critério de diagnóstico utilizado, maiores foram as estimativas encontradas. As prevalências de cárie observadas foram de 55,23% (OMS), 63,33% (OMS modificado) e 79,82% (ICDAS). Com relação à extensão de doença, o índice CPO-D de 1,39 (OMS) aumentou para 1,95 (OMS modificado) e para 3,78 (ICDAS). O impacto da inclusão das lesões não

cavitadas foi maior entre os escolares de nível socioeconômico mais elevado. Todas as características socioeconômicas avaliadas foram significativamente associadas com a prevalência e extensão de cárie independentemente do critério de diagnóstico utilizado. Apesar da manutenção da significância estatística, a magnitude das associações diminuiu à medida que o critério de diagnóstico se tornou mais sensível, principalmente quando as lesões não cavitadas pigmentadas foram incluídas. 5,81% dos escolares examinados apresentou pelo menos um dente permanente perdido por cárie. Na análise ajustada, nível socioeconômico, ano escolar, tipo de serviço odontológico, frequência de escovação e sangramento gengival se mantiveram significativamente associados à perda dentária. Independentemente do desfecho utilizado (prevalência ou extensão), não foi observada associação significativa entre cárie dentária e obesidade. Foi observado que os escolares com cárie não tratada apresentaram uma pior qualidade de vida quando comparados aos escolares sem necessidade de tratamento, com associação negativa nos domínios sintomas orais e bem estar emocional. Por outro lado, os escolares com cárie tratada apresentaram uma melhor qualidade de vida do que os escolares sem necessidade de tratamento (associação positiva observada no CPQ_{11-14} total e nos domínios limitações funcionais e bem estar emocional). Com relação à distribuição intraoral da cárie, observou-se que os escolares com experiência de cárie em dentes anteriores apresentaram uma pior qualidade de vida do que os escolares livres de cárie (domínios sintomais orais e bem estar social). **Conclusões**: (1) A experiência de cárie da população estudada pode ser considerada baixa; (2) a inclusão de lesões não cavitadas causou um importante impacto nas estimativas de prevalência e extensão de cárie; (3) a magnitude das associações entre indicadores de risco sócio-demográficos e cárie dentária foi severamente reduzida quando lesões pigmentadas foram contabilizadas; (4) a prevalência de perda dentária foi considerada alta, tendo em vista a idade da população estudada e sua baixa experiência de cárie; (5) indicadores socioeconômicos e comportamentais foram significativamente associados à perda dentária; (6) escolares com sobrepeso ou obesos não apresentaram maior probabilidade de possuir cárie; e (7) a presença de cárie tratada esteve positivamente associada à qualidade de vida ao passo que a presença de cárie não tratada ou cárie em dentes anteriores esteve negativamente associada à qualidade de vida relacionada à saúde bucal dos indivíduos avaliados.

ABSTRACT

Aims: The aim of this thesis was to study the population of 12-year-old schoolchildren from Porto Alegre, RS, in regards to: (1) the prevalence and extent of dental caries; (2) the impact of different diagnostic criteria on caries prevalence and extent and on the assessment of socio-demographic risk indicators for dental caries; (3) the prevalence and risk indicators for tooth loss; (4) the association between dental caries and obesity; and (5) the impact of dental caries on oral health related quality of life. **Methods**: A cross-sectional population-based study was conducted between September 2009 and December 2010. A multistage probability sampling strategy was used to select a representative sample. 1,837 schoolchildren attending 9 private and 33 public schools were selected. A questionnaire was sent to parents/legal guardians of each selected student in order to gather information on socioeconomic characteristics, mother's and father's education, housing conditions, access to dental services, and oral hygiene habits. The schoolchildren answered the Child Perceptions Questionnaire (CPQ_{11-14}). Heigth and weight were registered. Clinical examination was conducted at schools in order to register the gingival bleeding index and dental caries. Three different diagnostic criteria for dental caries were defined: WHO criteria (only cavitated lesions), modified WHO criteria (cavitated lesions and white noncavitated lesions), and ICDAS (cavitated lesions and all noncavitated ones, whites and browns). To assess the association between dental caries treatment and quality of life, schoolchildren were classified into: no treatment needs; treated caries; and untreated caries. To assess the association between caries intraoral distribution and quality of life, individuals were classified as follows: caries free students; schoolchildren with caries only in posterior teeth; and schoolchildren with caries in at least one anterior tooth. Poisson regression models were used to assess the association between dental caries/tooth loss and the predictor variables. Regarding quality of life data, negative binomial regression was used. **Results**: 1,528 schoolchildren were included in the study (response rate of 83.17%). Caries prevalence and extent increased as the diagnostic criteria became more sensitive. Prevalence rates were 55.23% (WHO), 63.33% (modified WHO), and 79.82% (ICDAS). Regarding caries extent, the DMF-T index of 1.39 (WHO) increased to 1.95 (modified WHO) and 3.78 (ICDAS). The impact of including noncavitated lesions was higher among students of better socioeconomic conditions. All socioeconomic variables were significantly associated with caries prevalence and extent irrespective of the

diagnostic criteria. Despite the maintenance of the statistical significance, the strength of the associations decreased steadily as the diagnostic criteria became more sensitive, mainly when brown noncavitated lesions were included. 5.81% of schoolchildren presented at least one permanent tooth missed due to caries. In the adjusted analysis, socioeconomic status, school year, type of dental service, brushing frequency, and gingival bleeding remained significantly associated with tooth loss. Irrespective of the outcome (prevalence or extent), no significant association was found between dental caries and obesity. It was observed that schoolchildren with untreated caries had a poorer quality of life than did schoolchildren without treatment needs, with negative association on oral symptoms and emotional well-being domains. On the other hand, individuals with treated caries presented an improved quality of life compared with individuals without treatment needs (positive association on the overall CPQ_{11-14} scores and functional limitations and emotional well-being domains). Regarding caries intraoral distribution, it was observed that schoolchildren with caries experience in anterior teeth had a poorer quality of life than caries free students (oral symptoms and social well-being domains). **Conclusions**: (1) Caries experience in this population can be considered low; (2) the inclusion of noncavitated caries lesions promoted in important impact on estimates of caries prevalence and extent; (3) the magnitude of the associations between socio-demographic risk indicators and dental caries were dramatically reduced when brown lesions were included; (4) the prevalence of tooth loss can be considered high, considering the age group of this population and its low caries experience; (5) socioeconomic indicators and behavioral characteristics were significantly associated with tooth loss; (6) overweight or obese schoolchildren were not at higher likelihood to present dental caries; and (7) treated caries was positively associated with quality of life while untreated caries and caries affecting anterior teeth were negatively associated with oral health-related quality of life of the examined schoolchildren.

Epidemiologia da cárie dentária

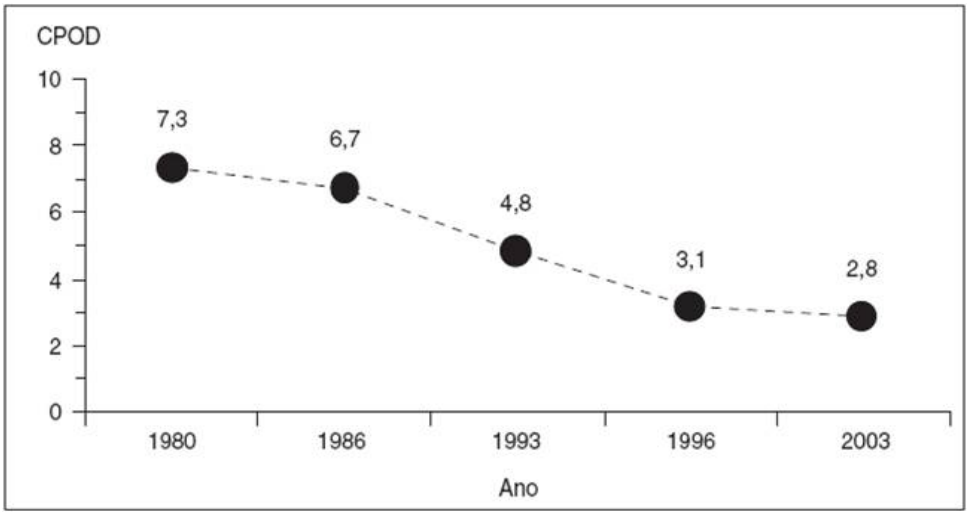
A epidemiologia pode ser definida como o estudo da distribuição e dos determinantes de estados ou eventos relacionados à saúde em populações específicas e a aplicação deste conhecimento no controle dos problemas de saúde (LAST, 2001). Dois pressupostos fundamentam essa definição e, portanto, a epidemiologia em si: (i) as doenças, condições de saúde e seus determinantes não se distribuem ao acaso na população; (ii) o conhecimento desses fatores tem uma aplicação prática no controle e na prevenção das doenças e agravos à saúde (PERES; ANTUNES, 2006).

Historicamente, o Brasil apresentou um importante papel no perfil epidemiológico da cárie dentária no mundo. Na Europa, a doença era pouco prevalente e típica das classes sociais mais privilegiadas até que as leis que regulamentavam as importações do açúcar vindo "do novo mundo" popularizaram o seu consumo em todas as classes sociais a partir de 1850. Assim, com a Revolução Industrial, a crescente industrialização e urbanização que dela decorreram, a ampliação do consumo de açúcar e as alterações no padrão alimentar, a cárie tornou-se uma doença altamente prevalente nas populações (NIKIFORUK, 1985). No Brasil, com a farta e contínua disponibilidade de açúcar a baixo custo e de amplo acesso popular em todo o território nacional, não é difícil deduzir o significado epidemiológico desta singularidade brasileira (NARVAI e FRAZÃO, 2008). A cárie dentária, atacando severamente a população e causando dor, infecção e perda de dentes, foi relatada já pelos primeiros portugueses que chegaram ao território brasileiro (NARVAI e FRAZÃO, 2008). A alta prevalência e severidade da doença perdurou até que um momento de transição passou a se delinear a partir das décadas de 70 e 80 do século passado. A ocorrência de cárie passou a diminuir gradualmente ao longo das décadas, sendo o acesso aos produtos fluoretados, primeiramente na água de abastecimento, e em seguida, nos dentifrícios, um dos principais responsáveis por esta modificação. Ao analisar a evolução da experiência de cárie dentária e a sua distribuição entre escolares brasileiros no período de 1980 a 2003, Narvai *et al.* (2006) observaram um declínio importante do índice CPO-D nesta população. Como é possível observar na Figura 1, um CPO-D médio de 7,3 em 1980 diminuiu para 2,8 em 2003. Dados recentemente publicados de outro levantamento epidemiológico de base populacional realizado no Brasil demonstraram que o índice

CPO-D médio aos 12 anos diminuiu para 2,1 em 2010 (MINISTÉRIO DA SAÚDE, 2011). Com relação à prevalência de cárie (proporção de crianças afetadas pela doença), um padrão semelhante tem sido observado. Uma prevalência de cárie aos 12 anos de 96,3% observada em 1986 reduziu para 68,9% em 2003 (NARVAI *et al*.; 2006) e para 56% em 2010 (MINISTÉRIO DA SAÚDE, 2011).

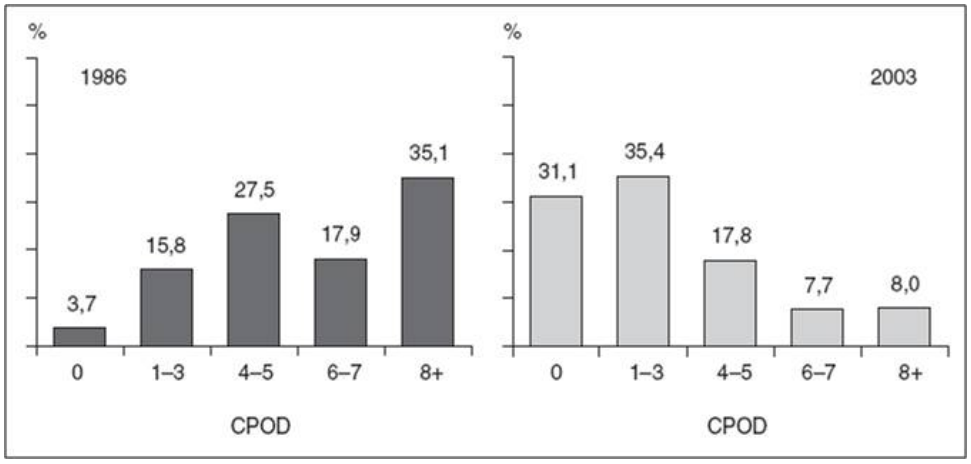
A despeito da melhora, Narvai *et al*. (2006) relatam que a distribuição da cárie ainda é desigual. Os dentes atingidos por cárie passaram a se concentrar numa proporção menor de indivíduos, caracterizando um fenômeno denominado polarização. No Brasil, 20% da população de escolares passaram a concentrar cerca de 60% da carga de doença. A drástica redução da experiência de cárie e a polarização da doença podem ser observadas na Figura 2. Em 2003, embora a maioria dos indivíduos de 12 anos se encontre livre de cárie ou com índices CPO-D menores do que 3, uma menor parcela da população continua sendo severamente afetada pela doença.

Figura 1. Índice CPO-D aos 12 anos de idade, Brasil, de 1980 a 2003.



Fonte: Narvai *et al.* (2006).

Figura 2. Distribuição percentual do índice CPO-D aos 12 anos de idade, Brasil, 1986 e 2003.



Fonte: Narvai *et al.* (2006).

Além desta parcela da população concentrando grande parte da carga de doença, em alguns indivíduos, a progressão das lesões cariosas é tal que chega a destruir a estrutura dentária em um curto período de tempo. Este é o caso de crianças e adolescentes que apresentam dentes permanentes perdidos por cárie. A redução da experiência de cárie observada no Brasil tem sido acompanhada pela redução proporcional do componente P do índice CPO. Em 1980, o componente P era responsável por 17,24% do CPO-D aos 12 anos (PINTO, 1983), reduzindo para 13,18% em 1986, 9,42% em 1996, 6,4% em 2003 (MINISTÉRIO DA SAÚDE, 2006) e 5,8% em 2010 (MINISTÉRIO DA SAÚDE, 2011). Apesar desta redução gradual, uma certa parcela da população de crianças e adolescentes ainda apresenta dentes permanentes extraídos por cárie. Como demonstrado no Quadro 1, taxas de prevalência de perda dentária aos 14-19 anos entre 16,1% e 40,9% têm sido encontradas em diferentes populações (CASANOVA-ROSADO *et al*., 2005; SUSIN *et al*., 2005; ATIEH, 2008; BARBATO e PERES, 2009). Embora a idade de 12 anos seja considerada uma idade-índice para o diagnóstico e monitoramento da cárie dentária a nível mundial, a literatura acerca da prevalência de perda dentária nesta idade é escassa. O único estudo disponível foi realizado no Chile, e apresentou uma prevalência de perda dentária de 8,9% em escolares de 12-14 anos (LÓPEZ e BAELUM, 2006). Mais estudos são necessários para avaliar a ocorrência de perda dentária e seus fatores associados em adolescentes de 12 anos de idade tendo em vista o curto período de tempo em risco.

Quadro 1. Estudos avaliando a prevalência de perda dentária em adolescentes.

Autores, ano	Local	N	Idade	Prevalência	Fatores associados
CASANOVA-ROSADO *et al*., 2005	México	392 132	14-19 >19	16,1 34,7	Idade Estilo de vida Má oclusão
SUSIN *et al.*, 2006	Brasil	263 180 169	14-19 20-24 25-29	26,2 49,1 60,2	Idade Nível socioeconômico Fumo
LÓPEZ e BAELUM, 2006	Chile	2.062 6.368 733	12-14 15-17 18-21	8,9 11,5 21,1	Sexo Renda Educação dos pais Frequência de escovação Última visita ao dentista
ATIEH, 2008	Arábia Saudita	484	14-16 17-19	38,9 61,1 Média = 40,9	Consumo de açúcar Fumo Frequência de escovação Frequência de visita ao dentista
BARBATO e PERES, 2009	Brasil	16.833	15-19	38,9	Localização geográfica Sexo Raça Idade Renda Educação Acesso ao serviço Água fluoretada

A constatação de que certos grupos populacionais são mais suscetíveis à cárie dentária têm incentivado a condução de estudos que visam identificar os fatores associados a esta maior suscetibilidade. Neste sentido, muitos estudos de natureza transversal têm sido desenvolvidos. Embora a inferência de associações causais a partir deste tipo de delineamento não seja adequada devido à impossibilidade de determinar seqüência temporal (HILL, 1965), tais estudos são de fundamental importância na construção do conhecimento acerca da distribuição da cárie dentária nas populações e da identificação dos fatores associados à doença.

Dentre as diversas características estudadas até o presente momento, nível socioeconômico tem sido um fator consistentemente associado à cárie dentária e à perda dentária em diferentes populações. Diversos indicadores socioeconômicos têm sido utilizados, como renda (PERES; BASTOS; LATORRE, 2000; LÓPEZ e BAELUM, 2006; PEREIRA *et al.,* 2007; BARBATO e PERES, 2009; PIOVESAN *et al*., 2011), grau de escolaridade dos pais (PERES *et al*., 2005; LÓPEZ e BAELUM, 2006; PEREIRA *et al.,* 2007; PIOVESAN *et al*., 2011), *status* profissional do chefe da família (PERINETTI; CAPUTI; VARVARA, 2005), tipo de escola (pública ou particular) (MALTZ; BARBACHAN e SILVA, 2001; ANTUNES *et al*., 2006) e localização da escola (urbana ou rural) (ANTUNES *et al*., 2006). Independente do indicador utilizado para inferir o nível socioeconômico, os estudos são unânimes em demonstrar que crianças de classes sociais menos favorecidas apresentam maior experiência de cárie dentária e perda dentária. A associação entre experiência de cárie e nível socioeconômico, consistentemente demonstrada em estudos transversais, já foi confirmada por uma coorte prospectiva de 15 anos (PERES *et al*., 2007), o que nos permite definir nível socioeconômico como um fator de risco para cárie. Outras características como estrutura familiar (família nuclear, número de filhos) e condição de moradia e ambiente social (tamanho do domicílio, propriedade, medidas de aglomeração domiciliar) têm gerado interesse na comunidade acadêmica, por refletirem as condições de vida do indivíduo (LÓPEZ e BAELUM, 2006; PEREIRA *et al*., 2007; MENDES *et al*., 2010).

A maioria das doenças bucais são condições crônicas relacionadas à dieta, higiene, fumo, álcool e estresse. Como tais características também estão associadas a uma série de doenças sistêmicas, a adoção de estratégias que abordem estes fatores de risco comuns parece mais racional do que a adoção de estratégias específicas para determinadas doenças (SHEIHAM e WATT, 2000). Baseados na hipótese de que o

consumo excessivo de açúcar poderia ser um fator de risco comum para obesidade e cárie dentária, alguns estudos têm investigado a associação entre estas doenças. Apesar de plausível, esta relação não tem sido consistentemente observada. No que concerne à dentição permanente, cinco estudos com amostras representativas estão disponíveis na literatura. Como é possível observar no Quadro 2, dois estudos demonstraram uma associação positiva entre obesidade e experiência de cárie (GERDIN *et al.*, 2008; HONNE *et al*., 2011), dois demonstraram ausência de associação (TRAMINI *et al*., 2009; JAMELLI *et al.*, 2010) e outro demonstrou associação inversa na amostra coletada entre 1988-1994 e ausência de associação na amostra obtida em 1999-2002 (KOPYCKA-KEDZIERAWSKI *et al*., 2008). Uma revisão sistemática da literatura investigando a relação entre obesidade e cárie relatou que nenhuma conclusão clara pôde ser tirada a partir das evidências existentes, e que mais estudos bem delineados são necessários (KANTOVITZ *et al*., 2006).

Quadro 2. Estudos avaliando a associação entre obesidade e cárie dentária em adolescentes.

Autores, ano	Local	n	Idade	Resultado
GERDIN *et al.*, 2008	Suécia	2.303	12	Associação positiva
KOPYCKA-KEDZIERAWSKI *et al*., 2008	EUA	2.777 (1988-1994) 3.954 (1999-2002)	12-18	1988-1994: Associação inversa 1999-2002: Sem associação
TRAMINI *et al*., 2009	França	835	12	Sem associação
JAMELLI *et al.*, 2010	Brasil	689	12	Sem associação
HONNE *et al*., 2011	Índia	463	13-15	Associação positiva

Critérios de diagnóstico de cárie dentária

Além da expressiva redução da ocorrência da cárie dentária, tem-se observado também a redução da velocidade de progressão das lesões cariosas, que tendem a permanecer por mais tempo em seus estágios iniciais, sem cavidade. Tais modificações ensejaram o aprimoramento dos métodos de diagnóstico da cárie dentária.

O critério tradicionalmente utilizado para detecção clínica da cárie em estudos epidemiológicos é o índice CPO, que contabiliza o número de dentes (CPO-D) ou superfícies (CPO-S) cariadas, perdidas por cárie ou restauradas. Proposto inicialmente

por Klein e Palmer (1937) e recomendado pela Organização Mundial da Saúde para uso em estudos epidemiológicos, o índice CPO registra apenas lesões cariosas cavitadas, não preconizando a realização de limpeza e secagem das superfícies dentárias. Embora este índice seja mais reprodutível e de mais rápida execução quando comparado com critérios de diagnóstico mais detalhados (BRAGA *et al*., 2009), ele não realiza a detecção de lesões não cavitadas.

Com o avanço dos conhecimentos acerca da etiopatogenia da cárie dentária, a detecção das lesões não cavitadas passou a ser realizada em estudos clínicos e epidemiológicos. Enquanto alguns estudos incluíram apenas as lesões não cavitadas ativas, brancas e opacas (GUSTAFSSON *et al*., 1954; ZICKERT; LINDVALL; AXELSSON, 1982; BARBACHAN e SILVA; MALTZ, 2001; MALTZ; SCHOENARDIE; CARVALHO, 2001), outros incluíram também as lesões não cavitadas pigmentadas, entendidas como inativas (MACHIULSKIENE; NYVAD; BAELUM, 1998; CARVALHO *et al*., 1998; 2009). Embora estes estudos realizem o registro das lesões não cavitadas inativas, elas não são contabilizadas no cálculo da experiência de cárie do indivíduo (índice CPO) (CARVALHO *et al*., 2009).

Recentemente, uma equipe de pesquisadores internacionais propôs um novo método de detecção da cárie dentária, denominado International Caries Detection and Assessment System (ICDAS) (ISMAIL *et al.*, 2007). O ICDAS classifica as lesões cariosas em sete estágios de acordo com sua severidade, variando de 0 (hígido) a 6 (ampla cavidade em dentina). Este índice é bastante detalhado, não só realizando o diagnóstico de lesões não cavitadas, como também diferenciando aquelas passíveis de visualização úmidas (grau 2) ou apenas após secagem (grau 1). Além desta primeira diferenciação, o ICDAS também distingue lesões não cavitadas brancas e pigmentadas.

A inclusão de lesões incipientes causa um importante impacto nos resultados obtidos em estudos epidemiológicos. É sabido que os levantamentos epidemiológicos clássicos, nos quais apenas as cavidades cariosas são registradas, subestimam a experiência de cárie da população, superestimando o número de indivíduos livres de cárie (PITTS; FYFFE, 1988; AMARANTE; RAADAL; ESPELID, 1998; ASSAF *et al*., 2004; PITTS, 2008). Em geral, a adição das lesões não cavitadas ativas promove um aumento ao redor de 15-30% no índice CPO-D aos 12 anos (BARBACHAN e SILVA; MALTZ, 2001; CARVALHO *et al*., 2009), ao passo que a inclusão de todas as lesões não cavitadas, inclusive as pigmentadas, praticamente triplica este índice (AMARANTE; RAADAL; ESPELID, 1998; AGUSTSDOTTIR *et al*., 2010). Dessa

forma, quando estudos epidemiológicos incluem lesões cavitadas brancas e pigmentadas, taxas de prevalência de cárie ao redor de 80% são observadas aos 12 anos (AGUSTSDOTTIR *et al*., 2010). Com estimativas de prevalência e extensão de cárie tão altas, a grande maioria dos indivíduos passa a ser vista como portadora da doença, o que pode comprometer a capacidade de diferenciar grupos de risco à cárie, principalmente quando o desfecho avaliado é a prevalência da doença (MENDES *et al*., 2010). Ainda não estão disponíveis na literatura estudos que comparem os três critérios de diagnósticos descritos acima (apenas cavidades, cavidades + lesões não cavitadas ativas, cavidades + qualquer lesão não cavitada) no que concerne às estimativas de prevalência, extensão e fatores associados à cárie dentária.

Qualidade de vida relacionada à saúde bucal

O uso isolado de medidas clínicas de doença é incapaz de documentar todo o impacto das desordens bucais em pacientes e populações (LEÃO; LOCKER, 2006). Os problemas funcionais e sociais aos quais os indivíduos estão submetidos são, muitas vezes, as condições mais importantes para determinar a busca por tratamento. É sabido que a avaliação diagnóstica normativa, feita exclusivamente pelo profissional e baseada na presença ou ausência de doença, é insuficiente para avaliar o impacto das condições bucais na qualidade de vida dos indivíduos.

Qualidade de vida relacionada à saúde bucal é um construto multidimensional que representa o quanto a vida diária de um indivíduo é afetada por problemas bucais (BAKER, 2007). O valor destas medidas tem sido reconhecido na última década, e diversos estudos têm sido conduzidos a fim de avaliar o impacto de diferentes condições bucais na qualidade de vida dos indivíduos.

No que concerne à cárie dentária, os estudos podem ser divididos em dois grupos de acordo com a forma como a população é categorizada. Enquanto a maioria dos estudos classifica os indivíduos de acordo com a experiência de cárie (CPO=0 ou CPO≥1) (DO; SPENCER, 2007; MASHOTO *et al.,* 2009; NURELHUDA *et al.,* 2010; CASTRO *et al.,* 2011), alguns consideram apenas a presença de cavidades de cárie não tratadas (NURELHUDA *et al.,* 2010; PIOVESAN *et al.,* 2010). Independente da forma como a população é classificada, estes estudos têm mostrado que a cárie dentária causa um impacto negativo na qualidade de vida dos indivíduos afetados. Este impacto geralmente está relacionado a problemas funcionais, uma vez que os molares são os

dentes mais frequentemente afetados por cárie nesta faixa etária. Estudos avaliando a associação entre cárie dentária e qualidade de vida em crianças e adolescentes são mostrados no Quadro 3.

Quadro 3. Estudos avaliando a associação entre cárie dentária e qualidade de vida em crianças e adolescentes.

Autores, ano	Local	n	Idade	Classificação	Resultado
DO e SPENCER, 2007	Austrália	304 334	8-10 11-13	ceo-s/CPO-S = 0 ceo-s/CPO-S =1-2 ceo-s/CPO-S = 3-4 ceo-s/CPO-S ≥ 5	8-10 anos: Associação positiva 11-13 anos: Sem associação
MASHOTO *et al.,* 2009	Tanzânia	1745	10-19	CPO-D=0 CPO-D≥ 1	Associação positiva
NURELHUDA *et al.,* 2010	Sudão	1109	12	Experiência de cárie CPO-D=0 CPO-D≥ 1 Cavidade de cárie C=0 C≥ 1	Experiência de cárie: Sem associação Cavidade de cárie: Associação positiva
PIOVESAN *et al.,* 2010	Brasil	792	12	Cavidade de cárie: C=0 C≥ 1	Associação positiva
CASTRO *et al.,* 2011	Brasil	571	11-12	ceo-d/CPO-D = 0 ceo-d/CPO-D ≥ 1	Associação positiva

Embora NURELHUDA *et al. (*2010) e PIOVESAN *et al. (*2010) tenham avaliado a associação entre cárie não tratada e qualidade de vida, os indivíduos livres de cárie e aqueles com cárie tratada foram agrupados na mesma categoria, impossibilitando o estudo do impacto do tratamento da cárie dentária na qualidade de vida. Dois estudos de intervenção demonstraram que o tratamento da cárie promove um impacto positivo na qualidade de vida de crianças e adolescentes (MASHOTO *et al*., 2010; CUNNION *et al*., 2010); no entanto, não existem na literatura estudos transversais conduzidos com amostras representativas avaliando o impacto da cárie tratada e não tratada na qualidade de vida de crianças e adolescentes.

Apesar das evidências descritas, ainda existem questões acerca da epidemiologia da cárie dentária que, uma vez respondidas, poderiam contribuir para o melhor entendimento da sua distribuição nas populações.

A realização destes estudos não resulta simplesmente no conhecimento da prevalência e distribuição das doenças ou fatores que podem contribuir para a sua ocorrência, mas também fornecem dados que servem como base para o planejamento e implementação de estratégias de prevenção e controle de acordo com as necessidades da população estudada.

OBJETIVOS

Objetivo geral

Estudar a cárie dentária em uma amostra representativa de escolares de 12 anos de Porto Alegre, RS.

Objetivos específicos

- Estudar a prevalência e extensão da cárie dentária em escolares de 12 anos de Porto Alegre, RS (Artigo I);
- Avaliar o impacto do uso de diferentes critérios de diagnóstico sobre as estimativas de prevalência e extensão de cárie dentária e a identificação de fatores sócio-demográficos a ela associados (Artigo I);
- Estudar a prevalência e os indicadores de risco de perda dentária em escolares de 12 anos de Porto Alegre, RS (Artigo II);
- Investigar a associação entre cárie dentária e obesidade em escolares de 12 anos de Porto Alegre, RS (Artigo III);
- Avaliar a associação entre cárie dentária e qualidade de vida relacionada à saúde bucal na população estudada (Artigo IV).

METODOLOGIA

Delineamento do estudo

Estudo transversal de base populacional.

Cálculo do tamanho da amostra

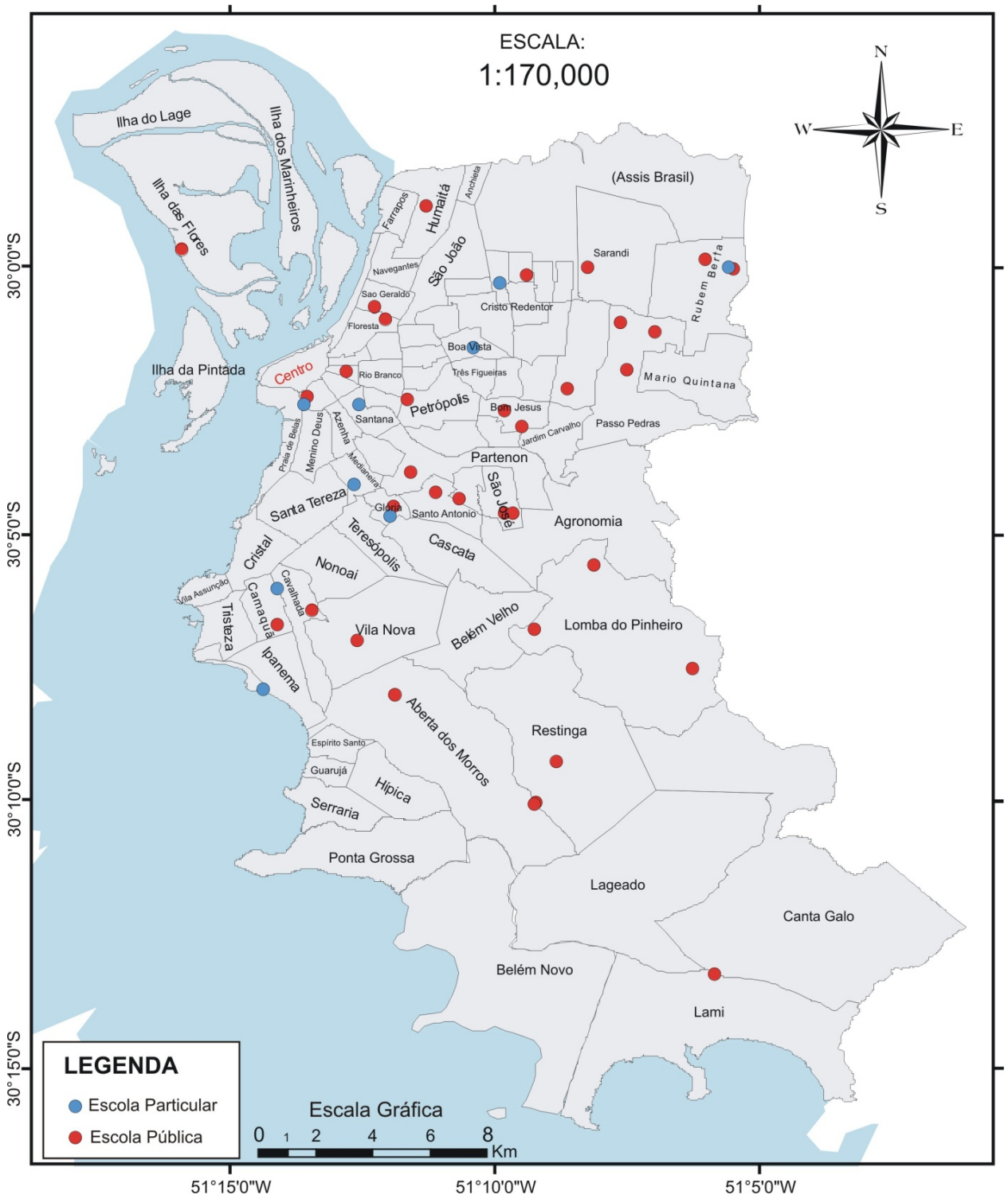
Considerando-se uma prevalência de cárie dentária de 60% (BARBACHAN e SILVA; MALTZ, 2001), intervalo de confiança de 95% e precisão de 3%, foi estimado que 1.024 indivíduos seriam necessários para a realização do presente estudo. A esta estimativa foi adicionado um efeito de desenho de 1,3, resultando em uma amostra de 1.331 escolares, à qual foi adicionada ainda uma taxa de não-participação de 40%, totalizando 1.863 escolares. Esta amostra foi estratificada de acordo com o tipo de escola, sendo 18,85% estudantes de escolas particulares e 81,15% estudantes de escolas públicas, proporcionalmente à população estudada. Este número de escolares foi suficiente para estimar uma prevalência de perda dentária de 10% (LÓPEZ e BAELUM, 2006) considerando os mesmos parâmetros.

Estratégia de amostragem

Uma estratégia de amostragem probabilística em múltiplos estágios foi adotada para selecionar uma amostra representativa da população de escolares de 12 anos de Porto Alegre, RS. Inicialmente, o município foi dividido em cinco áreas geográficas, correspondentes às áreas de abrangência das Estações de Tratamento de Água (ETAs). Dentro de cada área, as escolas foram selecionadas aleatoriamente, em número proporcional ao número de escolares matriculados em cada ETA em cada tipo de escola. Um total de 42 escolas foram incluídas, sendo 9 da rede particular e 33 da rede pública de ensino. Em cada escola selecionada, foi confeccionada uma lista com os indivíduos elegíveis, representados pelos estudantes regulamente matriculados e nascidos no ano de 1997 ou 1998 (12 anos completos até o final de 2009 ou 2010, conforme o ano da coleta de dados). A partir desta lista, os participantes foram aleatoriamente selecionados, sendo o número de alunos selecionados em cada escola proporcional ao

tamanho da escola. A Figura 3 apresenta a localização geográfica das escolas incluídas no estudo.

Figura 3. Localização geográfica das escolas incluídas no estudo.



Coleta de dados

Realizada entre Setembro de 2009 e Dezembro de 2010, incluiu aplicação de dois questionários, registro das medidas antropométricas e exame clínico, descritos a seguir.

Questionários

Um questionário estruturado contendo perguntas sobre características socioeconômicas (poder de compra da família), grau de escolaridade dos pais, número de cômodos da moradia e número de pessoas vivendo na moradia, acesso a serviços odontológicos, hábitos de higiene oral, entre outros, foi enviado aos pais ou responsáveis dos escolares selecionados.

O "Child Perceptions Questionnaire" (CPQ_{11-14}), forma reduzida com 16 questões (JOKOVIC; LOCKER; GUYATT, 2006), foi aplicado aos próprios escolares previamente ao exame clínico. O CPQ_{11-14} é um instrumento que visa avaliar o impacto das condições de saúde bucal na auto-percepção e qualidade de vida relacionada à saúde bucal, desenvolvido especificamente para indivíduos de 11 a 14 anos, validado (FOSTER PAGE *et al.*, 2005) e adaptado culturalmente ao português brasileiro (GOURSAND *et al*., 2008). O CPQ_{11-14} contém perguntas sobre a ocorrência de eventos relacionados à saúde bucal nos últimos três meses, e apresenta cinco alternativas de resposta: "nunca", "uma ou duas vezes", "algumas vezes", "freqüentemente" ou "todos os dias ou quase todos os dias". Uma pontuação específica é atribuída para cada resposta, variando de 0 ("nunca") a 4 ("todos os dias ou quase todos os dias"). Pela somatória de todos os pontos obtém-se o escore total. Quanto maior o escore do CPQ_{11-14}, maior o impacto da saúde bucal na qualidade de vida do indivíduo.

Registro das medidas antropométricas

O peso e a altura dos escolares foram registrados previamente ao exame clínico. Uma balança de plataforma (Techline®, Diadema, SP, Brasil) foi utilizada para a medição do peso dos escolares. Cada escolar foi pesado duas vezes, para o posterior cálculo da média. A altura dos escolares foi medida com uma fita métrica inextensível, presa em uma parede plana sem rodapé.

Para o registro das medidas antropométricas, os escolares estavam descalços e vestindo roupas leves.

Os dados referentes ao peso e à altura dos escolares foram utilizados para o cálculo do índice de massa corporal (IMC).

Exame clínico

Foi realizado em sala da escola, com a utilização de refletor, compressor (Inalar Compact®, NS, São Paulo, SP, Brasil) e aspirador portáteis (Nevoni®, Med-Sinal, São Paulo, SP, Brasil). Tríades compostas por odontoscópio, sonda periodontal milimetrada e pinça clínica foram utilizadas.

O exame clínico seguiu a seguinte sistemática:

1. Determinação do Índice de Sangramento Gengival (AINAMO e BAY, 1975);
2. Remoção do biofilme dental com escova, dentifrício e fio dental, realizado por um membro da pesquisa;
3. Isolamento relativo e secagem dos dentes;
4. Determinação do Índice de Cárie Dentária, com a inclusão de lesões cariosas cavitadas e não cavitadas, ativas e inativas (MALTZ *et al*., 2003), conforme descrito no Quadro 4.

Quadro 4. Descrição do Índice de Cárie Dentária utilizado no estudo.

0	Hígido
1	Lesão não cavitada inativa
2	Lesão não cavitada ativa
3	Lesão cavitada inativa
4	Lesão cavitada ativa
5	Sombreamento em dentina
6	Restauração
7	Selante
8	Extração indicada
9	Extraído por cárie

Treinamento e Calibração

Uma única examinadora realizou o Índice de Sangramento Gengival. Previamente ao início da coleta de dados, foi realizado treinamento com periodontistas.

O exame de cárie dentária foi realizado por outra examinadora. A verificação da reprodutibilidade intra-examinador foi averiguada previamente ao início do estudo a aferida regularmente ao longo da coleta de dados através da realização de exames duplos em 5% da amostra. O período mínimo de intervalo entre os exames foi de dois dias. Foi observado um coeficiente Kappa não ponderado mínimo de 0,8.

Controle do viés de participação

Esforços foram empreendidos para aumentar a taxa de participação no estudo: (1) os participantes e seus responsáveis receberam informação detalhada acerca do levantamento, com telefones de contato das pesquisadoras para o esclarecimento de possíveis dúvidas; (2) as atividades foram agendadas de forma a facilitar a adesão dos participantes; (3) um sistema de acompanhamento foi utilizado para encorajar os escolares a participar.

A fim de controlar o viés de participação, informações sobre os não-respondentes foram coletadas. Os pais ou responsáveis dos escolares que não participarem do estudo foram contatados por telefone para registro do motivo para a não participação. Quando possível, algumas questões sócio-demográficas foram coletadas a fim de caracterizar esta subpopulação.

Análise dos dados

Com o objetivo de minimizar o efeito do viés de participação sobre os resultados do estudo, uma variável de peso foi criada e utilizada nas análises estatísticas. Calculou-se quantos sujeitos da população base foram representados por cada participante (número de representantes na população base/número de estudantes examinados).

Os pesos atribuídos de acordo com a população base (estratificado por ETA, tipo de escola e gênero) estão descritos no Quadro 5. Por exemplo, cada estudante do gênero feminino, de escola privada e da ETA 1 representou 15,41 estudantes com as mesmas características na população base.

Quadro 5. Pesos atribuídos de acordo com a população base (estratificado por ETA, tipo de escola e gênero).

ETA	Tipo de escola	Gênero	
		Masculino	Feminino
Moinhos de Vento	Particular	18,35	15,41
	Pública	12,35	21,37
José Loureiro da Silva/ Menino Deus	Particular	15,60	23,03
	Pública	12,01	11,47
São João/ Ilha da Pintada	Particular	19,51	17,62
	Pública	13,29	12,47
Tristeza/Lami	Particular	19,33	16,09
	Pública	19,33	14,36
Lomba do Sabão	Pública	11,78	16,38

Prevalência de cárie foi definida como a porcentagem de indivíduos apresentando pelo menos um dente cariado, perdido por cárie ou restaurado (CPO-D≥1). Extensão de cárie foi definida como o número de dentes cariados, perdidos por cárie ou restaurados. Três diferentes critérios de diagnóstico foram definidos a partir da utilização de diferentes pontos de corte: OMS, quando apenas lesões cavitadas foram contabilizadas; OMS modificado, quando além de cavidades, lesões não cavitadas brancas também foram incluídas; ICDAS, quando todas as lesões não cavitadas, brancas e pigmentadas, foram contabilizadas, além das cavidades. Diferenças absolutas e taxas de inflação foram calculadas para comparar os critérios da OMS modificado e do ICDAS com o critério convencional da OMS. O Teste de Wald foi utilizado para avaliar a significância dos coeficientes.

Análises preliminares foram realizadas utilizando-se o Teste de Wald. Regressão de Poisson foi utilizada para avaliar a associação entre os desfechos cárie dentária/perda dentária e as variáveis preditoras estudadas. Nas análises dos dados de qualidade vida (em que os desfechos são os escores do CPQ_{11-14}), modelos de Regressão Binomial Negativa foram utilizados devido à grande dispersão dos dados. Inicialmente, modelos não ajustados foram realizados e as variáveis que apresentaram valor de $p < 0,25$ foram incluídas no modelo ajustado. Apenas as variáveis com valor de $p < 0,05$ foram mantidas nos modelos finais, a menos que um fator de confusão fosse identificado. Os pressupostos estatísticos para a utilização destes modelos foram avaliados, bem como a presença de fatores de confusão e modificadores de efeito. Todas as análises foram realizadas no software STATA, versão 11.1 (Stata Corporation, College Station, Texas, EUA).

Nível socioeconômico foi categorizado de acordo com os pontos de corte propostos pelo Critério de Classificação Econômica Brasil (ABEP, 2009) em: baixo (≤13 pontos), médio-baixo (≥14 a ≤22 pontos), médio-alto (≥23 a ≤28 pontos) e alto (≥29 pontos). Aglomeração domiciliar foi calculada dividindo-se o número de pessoas vivendo na moradia pelo número de cômodos da mesma, e categorizada em baixa (≤0,6 pessoa/cômodo), média (>0,6 a ≤1 pessoa/cômodo) e alta (>1 pessoa/cômodo), de acordo com a distribuição dos dados. Sangramento gengival foi categorizado de acordo com os tertis. Para a classificação dos escolares de acordo com seu estado nutricional, foram calculados os escores Z do IMC por idade através do software AnthroPlus (WHO, Geneva, Suíça) e utilizados os pontos de corte propostos pela OMS (DE ONIS *et al*., 2007): normal (≤ +1 desvio padrão), sobrepeso (> +1desvio padrão até ≤ +2 desvios padrão) e obeso (> + 2 desvios padrão).

Para avaliar a associação entre tratamento da cárie dentária e qualidade de vida, a amostra foi categorizada em: escolares sem necessidade de tratamento (livres de cárie ou portadores de pequenas cavidades inativas); escolares com cárie tratada (dentes restaurados ou extraídos); e escolares com cárie não tratada (cavidades cariosas ou dentes com extração indicada). Para avaliar a associação entre a distribuição intraoral da cárie e qualidade de vida, os indivíduos foram classificados em: livres de cárie (esta categoria também incluiu os escolares com pequenas cavidades inativas); cárie tratada/não tratada apenas em dentes posteriores; e cárie tratada/não tratada em pelo menos um dente anterior. Para as análises referentes à qualidade de vida, apenas as lesões cariosas cavitadas foram consideradas.

Considerações éticas

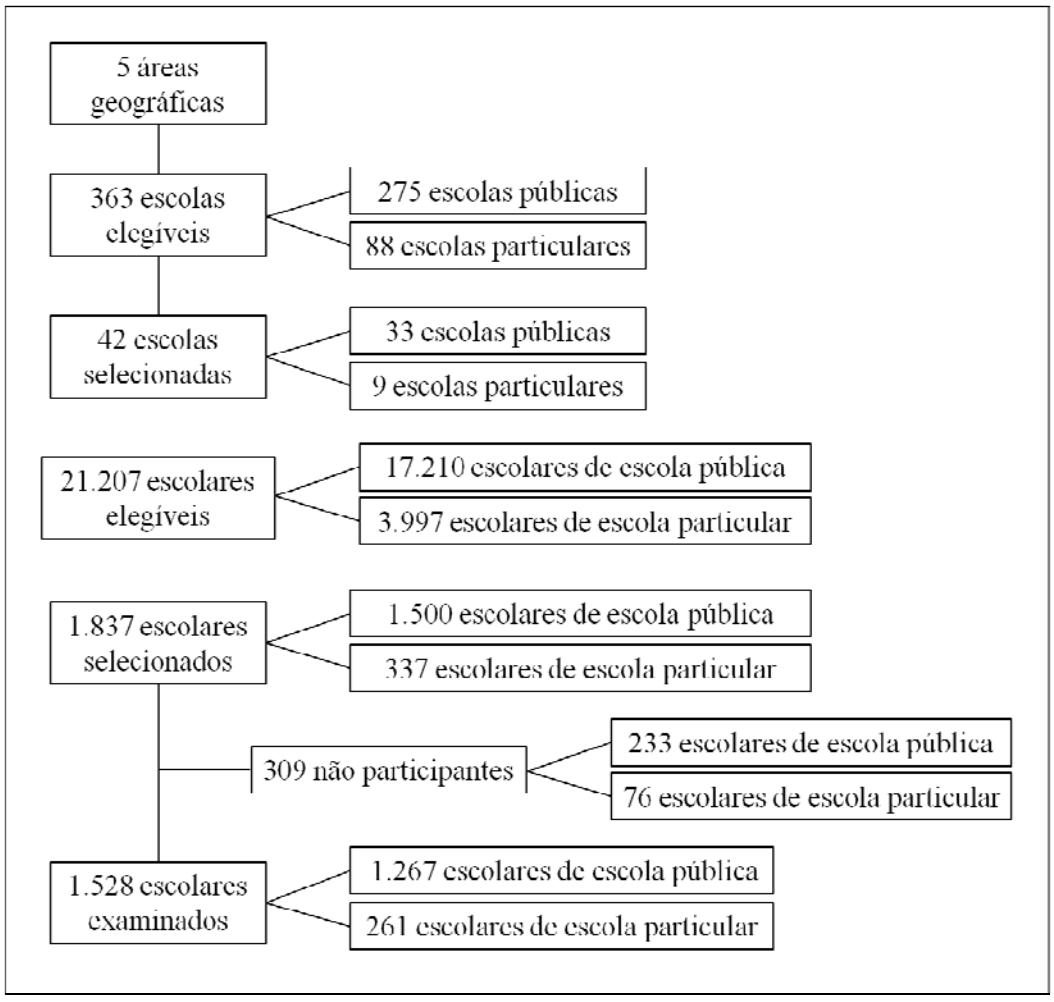
O protocolo desta pesquisa foi aprovado pelo Comitê de Ética em Pesquisa da Faculdade de Odontologia da UFRGS (processo 299/08) e pelo Comitê de Ética em Pesquisa da Secretaria Municipal de Saúde de Porto Alegre (processo 001.049155.08.3).

Os pais ou responsáveis e os próprios estudantes assinaram um Termo de Consentimento Livre e Esclarecido. Posteriormente ao exame clínico, cada escolar recebeu um relatório sobre suas condições de saúde oral, assim como a indicação de locais que ofereçam atendimento odontológico.

RESULTADOS

Conforme demonstrado na Figura 4, 1.528 escolares participaram do estudo. A taxa de resposta foi de 83,17%, sendo 77,44% nas escolas particulares e 84,46% nas escolas públicas. Contato telefônico foi estabelecido com 176 pais ou responsáveis dos 309 escolares que não participaram do estudo. Em 27% dos casos, os próprios escolares recusaram-se a participar, 26% dos pais ou responsáveis contatados relataram não ter interesse por já possuírem acesso a serviço odontológico e 4% relataram preocupações com biossegurança ou recusaram-se a responder as questões socioeconômicas presentes no questionário. Apesar do consentimento dos pais, 24% dos escolares não retornaram o termo de consentimento ou o questionário em tempo hábil e 19% não estavam presentes na escola no dia da coleta de dados.

Figura 4. Fluxograma do estudo.



A distribuição da amostra está descrita na Tabela 1.

Tabela 1. Distribuição da amostra.

	n (%)
Gênero	
Feminino	758 (49,7)
Masculino	770 (50,3)
Nível socioeconômico	
Alto	141 (9,23)
Médio-alto	358 (23,43)
Médio-baixo	871 (57,00)
Baixo	158 (10,34)
Escolaridade da mãe†	
Ensino superior	216 (14,20)
Ensino médio	516 (33,93)
Ensino fundamental	789 (51,87)
Escolaridade do pai†	
Ensino superior	203 (14,23)
Ensino médio	436 (30,55)
Ensino fundamental	788 (55,22)
Aglomeração domiciliar†	
Baixa	351 (23,0)
Média	826 (54,1)
Alta	350 (22,9)
Escola	
Particular	261 (17,1)
Pública	1.267 (82,9)
Ano escolar	
Regular (5ª, 6ª or 7ª)	1.219 (79,8)
Atrasado (4ª ou menos)	309 (20,2)
Última visita ao dentista	
≤ 1 ano atrás	844 (55,24)
≥ 2 anos atrás	354 (23,17)
Nunca foi ao dentista	330 (21,6)
Tipo de serviço odontológico	
Sistema público	487 (31,9)
Convênio/Particular	711 (46,5)
Nunca foi ao dentista	330 (21,6)
Frequência de escovação	
≤ 1 vez ao dia	341 (22,3)
2 vezes ao dia	677 (44,3)
≥3 vezes ao dia	510 (33,4)
Sangramento gengival	
≤ 45%	507 (33,3)
45% to 60%	516 (33,8)
> 60%	502 (32,9)
Estado nutricional	
Normal	986 (64,53)
Sobrepeso	335 (21,92)
Obeso	207 (13,55)
TOTAL	1.528 (100)

† Dados faltantes.

A Tabela 2 apresenta a prevalência de cárie dentária de acordo com as variáveis preditoras estudadas conforme os critérios de diagnóstico da OMS, OMS modificado e ICDAS, suas diferenças absolutas e taxas de inflação. É possível observar que quanto mais sensível o critério de diagnóstico utilizado, maiores foram as estimativas encontradas. A prevalência de cárie de 55,23% encontrada de acordo com o critério preconizado pela OMS aumentou para 63,33% quando as lesões não cavitadas brancas foram incluídas. Com o uso do ICDAS, quando lesões não cavitadas brancas e pigmentadas foram contabilizadas, aproximadamente 80% da população estudada apresentou experiência de cárie.

A Tabela 3 apresenta os dados referentes à extensão de doença. Tendência semelhante foi observada, com um aumento importante das estimativas com o uso de um critério de diagnóstico mais sensível. Um índice CPO-D de 1,39 (OMS) aumentou para 1,95 (OMS modificado) e para 3,78 (ICDAS).

É possível observar que a inclusão das lesões não cavitadas causou maior impacto entre os escolares de nível socioeconômico mais elevado, tanto para prevalência quanto extensão de doença.

Tabela 2. Prevalência de cárie dentária de acordo com as variáveis preditoras, conforme os critérios de diagnóstico da OMS, OMS modificado e ICDAS, diferenças absolutas e taxas de inflação. Média (intervalo de confiança 95%).

	OMS	OMS modificado	ICDAS	Diferença absoluta		Taxa de inflação	
				OMS modif - OMS	ICDAS - OMS	OMS modif./OMS	ICDAS/OMS
Gênero							
Feminino	57,98 (45,18-70,78)	66,34 (56,16-76,52)	81,82 (73,19-90,44)	8,35** (4,53-12,18)	23,83** (13,34-34,32)	1,14*** (1,05-1,23)	1,41*** (1,15-1,66)
Masculino	52,56 (44,93-60,18)	60,42 (53,05-67,78)	77,88 (72,64-83,12)	7,85** (4,63-11,07)	25,32*** (22,62-28,02)	1,14*** (1,07-1,22)	1,48*** (1,36-1,60)
Escola							
Particular	37,46 (22,54-52,38)	48,02 (37,88-58,15)	66,85 (56,04-77,66)	10,55** (5,54-15,56)	29,39*** (24,03-34,74)	1,28** (0,99-1,57)	1,78** (1,26- 2,30)
Pública	60,24 (50,53-69,95)	67,65 (60,11-75,20)	83,48 (80,38-86,58)	7,41** (4,46-10,36)	23,23*** (15,53-30,93)	1,12*** (1,05-1,18)	1,38*** (1,19-1,57)
Nível socioeconômico							
Alto	43,13 (30,22-56,03)	52,10 (40,51-63,70)	71,11 (54,65-87,57)	8,97*** (6,75-11,20)	27,98*** (18,49-37,47)	1,20*** (1,10-1,31)	1,64*** (1,36-1,93)
Médio-alto	44,51 (39,70-49,33)	54,32 (49,16-59,48)	72,21 (67,81-76,60)	9, 80** (5,30-14,30)	27,69*** (25,47-29,91)	1,22*** (1,10-1,33)	1,62*** (1,52-1,72)
Médio-baixo	60,79 (51,70-69,88)	68,31 (59,83-76,80)	84,17 (79,99-88,36)	7,52** (5,24-9,80)	23,38*** (17,57-29,19)	1,12*** (1,07-1,17)	1,38*** (1,23-1,53)
Baixo	65,92 (57,41-74,44)	71,83 (68,58-75,09)	85,22 (81,27-89,17)	5,91 (–1,62-13,44)	19,29** (8,7-29,89)	1,08*** (0,96-1,21)	1,29*** (1,09-1,48)
Escolaridade da mãe							
Ensino superior	40,47 (26,96-53,98)	52,56 (46,07-59,04)	69,82 (58,81-80,82)	12,08* (4,69-19,48)	29,34*** (21,52-37,17)	1,29*** (1,01-1,57)	1,72*** (1,33-2,11)
Ensino médio	51,38 (45,30-57,45)	58,30 (51,01-65,58)	77,16 (74,06-80,25)	6,92***(5,50-8,33)	25,77*** (21,38-30,17)	1,13*** (1,11-1,15)	1,50*** (1,36-1,64)
Ensino fundamental	63,33 (53,54-73,12)	70,97 (63,28-78,65)	85,56 (83,04-88,08)	7,63** (4,90-10,36)	22,23*** (14,67-29,79)	1,12*** (1,06-1,18)	1,35*** (1,17-1,52)
Escolaridade do pai							
Ensino superior	36,24 (30,15-42,32)	47,16 (45,31-49,02)	66,33 (55,60-77,06)	10,92* (4,36-17,49)	30,09*** (20,49-39,69)	1,30** (1,02-1,57)	1,83*** (1,45-2,20)
Ensino médio	53,04 (46,85-59,23)	60,36 (54,49-66,23)	76,76 (73,04-80,48)	7,32** (5,05-9,59)	23,72*** (20,66-26,77)	1,13*** (1,08-1,18)	1,44*** (1,34-1,55)
Ensino fundamental	62,84 (54,59-71,09)	70,31 (62,82-77,81)	85,67 (81,99-89,34)	7,47***(6,54-8,40)	22,82*** (16,75-28,89)	1,11*** (1,08-1,14)	1,36*** (1,22-1,50)
Aglomeração domiciliar							
Baixa	45,52 (36,93-54,11)	55,03 (49,23-60,84)	71,32 (63,40-79,25)	9,51** (4,57-14,45)	25,80*** (22,11-29,48)	1,20*** (1,06-1,34)	1,56*** (1,40-1,72)
Média	54,63 (45,61-63,64)	62,71 (55,43-69,99)	80,41 (75,29-85,53)	8,08** (4,92-11,24)	25,78*** (21,15-30,41)	1,14*** (1,07-1,22)	1,47*** (1,31-1,63)
Alta	68,58 (61,28-75,88)	75,07 (68,99-81,15)	88,80 (85,17-92,44)	6,48*** (4,40-8,56)	20,22** (9,31-31,12)	1,09*** (1,05-1,13)	1,29*** (1,10-1,48)
TOTAL	55,23 (45,26-65,19)	63,33 (55,20-71,46)	79,82 (73,89-85,75)	8,10** (5,60-10,60)	24,59*** (18,70-30,48)	1,14*** (1,07-1,21)	1,44*** (1,26-1,62)

OMS = Organização Mundial da Saúde; ICDAS = International Caries Detection and Assessment System.
* p<0.05; ** p<0.01; *** p<0.001 (Wald test).

Tabela 3. Extensão de cárie dentária de acordo com as variáveis preditoras, conforme os critérios de diagnóstico da OMS, OMS modificado e ICDAS, diferenças absolutas e taxas de inflação. Média (intervalo de confiança 95%).

	OMS	OMS modificado	ICDAS	Diferença absoluta		Taxa de inflação	
				OMS modif - OMS	ICDAS - OMS	OMS modif./OMS	ICDAS/OMS
Gênero							
Feminino	1,46 (1,11-1,81)	2,03 (1,60-2,45)	4,10 (3,09-5,10)	0,56*** (0,45-0,68)	2,63*** (1,71-3,56)	1,38*** (1,30-1,47)	2,80*** (2,05-3,55)
Masculino	1,32 (1,02-1,63)	1,88 (1,57-2,19)	3,47 (3,09-3,86)	0,55*** (0,50-0,60)	2,15*** (1,84-2,45)	1,41*** (1,31-1,52)	2,62*** (2,14-3,09)
Escola							
Particular	0,73 (0,36-1,10)	1,18 (0,81-1,55)	2,95 (1,63-4,28)	0,45*** (0,37-0,52)	2,22** (1,23-3,21)	1,61** (1,21-2,02)	4,03*** (3,15-4,90)
Pública	1,58 (1,30-1,85)	2,17 (1,89-2,44)	4,01 (3,56-4,46)	0,59*** (0,49-0,69)	2,43*** (1,90-2,96)	1,37*** (1,27-1,47)	2,54*** (2,01-3,07)
Nível socioeconômico							
Alto	0,88 (0,54-1,22)	1,19 (0,78-1,59)	2,77 (1,90-3,65)	0,30*** (0,23-0,38)	1,89** (1,12-2,66)	1,34*** (1,28-1,41)	3,14*** (2,02-4,26)
Médio-alto	1,09 (0,83-1,35)	1,53 (1,34-1,72)	3,28 (2,63-3,94)	0,43*** (0,34-0,53)	2,19*** (1,58-2,79)	1,40*** (1,23-1,57)	3,00*** (2,26-3,73)
Médio-baixo	1,56 (1,27-1,85)	2,22 (1,89-2,56)	4,09 (3,48-4,71)	0,66*** (0,52-0,80)	2,53*** (1,95-3,11)	1,42*** (1,31-1,53)	2,62*** (2,11-3,12)
Baixo	1,81 (1,67-1,95)	2,41 (2,32-2,50)	4,47 (3,34-5,61)	0,60*** (0,44-0,75)	2,66** (1,50-3,82)	1,33*** (1,22-1,43)	2,46*** (1,79-3,14)
Escolaridade da mãe							
Ensino superior	0,80 (0,60-1,01)	1,22 (0,96-1,47)	2,74 (1,80-3,68)	0,41** (0,23-0,58)	1,93** (1,12-2,74)	1,51*** (1,25-1,77)	3,40*** (2,55-4,24)
Ensino médio	1,25 (1,00-1,50)	1,70 (1,34-2,07)	3,46 (2,79-4,12)	0,45** (0,27-0,63)	2,20*** (1,73-2,68)	1,36*** (1,23-1,49)	2,76*** (2,46-3,05)
Ensino fundamental	1,70 (1,37-2,04)	2,40 (2,07-2,73)	4,38 (3,91-4,85)	0,69*** (0,61-0,77)	2,68*** (1,96-3,39)	1,40*** (1,31-1,50)	2,57*** (1,87-3,26)
Escolaridade do pai							
Ensino superior	0,77 (0,61-0,93)	1,15 (1,03-1,28)	2,68 (1,93-3,43)	0,38** (0,22-0,55)	1,91*** (1,29-2,53)	1,50** (1,14-1,86)	3,48*** (2,87-4,10)
Ensino médio	1,27 (1,06-1,49)	1,72 (1,48-2,01)	3,45 (2,85-4,05)	0,47*** (0,36-0,58)	2,17*** (1,69-2,66)	1,37*** (1,27-1,46)	2,70*** (2,32-3,08)
Ensino fundamental	1,65 (1,32-1,99)	2,33 (1,95-2,71)	4,33 (3,62-5,03)	0,67*** (0,61-0,74)	2,67*** (1,91-3,43)	1,40*** (1,34-1,47)	2,61*** (1,95-3,26)
Aglomeração domiciliar							
Baixa	0,99 (0,76-1,22)	1,42 (1,15-1,69)	3,16 (2,26-4,07)	0,42*** (0,32-0,53)	2,17*** (1,40-2,94)	1,43*** (1,29-1,57)	3,18*** (2,51-3,86)
Média	1,36 (1,09-1,63)	1,91 (1,60-2,23)	3,68 (3,07-4,29)	0,55** (0,39-0,71)	2,32*** (1,78-2,85)	1,40*** (1,26-1,54)	2,70*** (2,20-3,19)
Alta	1,95 (1,70-2,19)	2,69 (2,48-2,90)	4,78 (3,93-5,63)	0,74*** (0,62-0,86)	2,83*** (1,83-3,83)	1,38*** (1,28-1,47)	2,45*** (1,80-3,10)
TOTAL	1,39 (1,07-1,71)	1,95 (1,59-2,31)	3,78 (3,11-4,45)	0,56** (0,48-0,64)	2,39*** (1,77-3,00)	1,40*** (1,31-1,49)	2,71*** (2,10-3,32)

OMS = Organização Mundial da Saúde; ICDAS = International Caries Detection and Assessment System.
* p<0.05; ** p<0.01; *** p<0.001 (Wald test).

As associações entre prevalência e extensão de cárie e as variáveis preditoras estudadas utilizando diferentes critérios de diagnóstico estão descritas nas Tabelas 4 e 5, respectivamente. Todas as características socioeconômicas avaliadas se mostraram significativamente associadas com a prevalência de cárie independentemente do critério de diagnóstico utilizado. Apesar da manutenção da significância estatística, quanto mais sensível o critério de diagnóstico, menor a magnitude das associações encontradas.

Com relação à extensão de cárie, todas as variáveis avaliadas foram significativamente associadas com o índice CPO-D utilizando-se os três critérios de diagnóstico. O uso do critério da OMS modificado resultou em associações ligeiramente mais fracas do que aquelas observadas com o critério convencional da OMS. Quando o ICDAS foi utilizado, uma redução expressiva da magnitude das associações foi abservada.

Tabela 4. Associação entre prevalência de cárie e as variáveis sócio-demográficas utilizando diferentes critérios de diagnóstico (Regressão de Poisson).

	OMS		OMS modificado		ICDAS	
	RP (IC 95%)	p	RP (IC 95%)	p	RP (IC 95%)	p
Gênero						
Feminino	1,00		1,00		1,00	
Masculino	0,90 (0,84-0,97)	0,009	0,91 (0,84-0,98)	0,01	0,95 (0,88-1,01)	0,15
Escola						
Particular	1,00		1,00		1,00	
Pública	1,60 (1,17-2,20)	0,003	1,40 (1,19-1,66)	<0,001	1,24 (1,13-1,37)	<0,001
Nível socioeconômico						
Alto	1,00		1,00		1,00	
Médio-alto	1,03 (0,84-1,25)	0,75	1,04 (0,85-1,26)	0,67	1,01 (0,86-1,19)	0,85
Médio-baixo	1,40 (1,22-1,62)	<0,001	1,31 (1,19-1,43)	<0,001	1,18 (1,02-1,36)	0,01
Baixo	1,52 (1,26-1,84)	<0,001	1,37 (1,19-1,59)	<0,001	1,19 (1,03-1,38)	0,01
Escolaridade da mãe						
Ensino superior	1,00		1,00		1,00	
Ensino médio	1,26 (1,00-1,61)	0,05	1,10 (1,00-1,22)	0,04	1,10 (1,01-1,20)	0,02
Ensino fundamental	1,56 (1,26-1,93)	<0,001	1,35 (1,23-1,47)	<0,001	1,22 (1,10-1,36)	<0,001
Escolaridade do pai						
Ensino superior	1,00		1,00		1,00	
Ensino médio	1,43 (1,32-1,62)	<0,001	1,27 (1,19-1,36)	<0,001	1,15 (1,02-1,31)	0,02
Ensino fundamental	1,76 (1,55-1,93)	<0,001	1,49 (1,37-1,61)	<0,001	1,29 (1,16-1,43)	<0,001
Aglomeração domiciliar						
Baixa	1,00		1,00		1,00	
Média	1,20 (1,09-1,31)	<0,001	1,13 (1,11-1,16)	<0,001	1,12 (1,06-1,19)	<0,001
Alta	1,50 (1,31-1,72)	<0,001	1,36 (1,30-1,42)	<0,001	1,24 (1,15-1,34)	<0,001

OMS = Organização Mundial da Saúde; ICDAS = International Caries Detection and Assessment System.
RP = Razão de Prevalências; IC = Intervalo de Confiança.

Tabela 5. Associação entre extensão de cárie e as variáveis sócio-demográficas utilizando diferentes critérios de diagnóstico (Regressão de Poisson).

	OMS		OMS modificado		ICDAS	
	RT (IC 95%)	p	RT (IC 95%)	p	RT (IC 95%)	P
Gênero						
Feminino	1,00		1,00		1,00	
Masculino	0,90 (0,84-0,97)	0,006	0,92 (0,87-0,98)	0,01	0,84 (0,75-0,95)	0,005
Escola						
Particular	1,00		1,00		1,00	
Pública	2,15 (1,49-3,11)	<0,001	1,82 (1,49-2,23)	<0,001	1,35 (1,04-1,76)	0,02
Nível socioeconômico						
Alto	1,00		1,00		1,00	
Médio-alto	1,23 (1,00-1,52)	0,04	1,28 (1,04-1,58)	0,01	1,18 (1,05-1,32)	0,004
Médio-baixo	1,76 (1,47-2,11)	<0,001	1,86 (1,60-2,18)	<0,001	1,47 (1,28-1,69)	<0,001
Baixo	2,05 (1,64-2,56)	<0,001	2,02 (1,61-2,55)	<0,001	1,61 (1,40-1,85)	<0,001
Escolaridade da mãe						
Ensino superior	1,00		1,00		1,00	
Ensino médio	1,55 (1,27-1,88)	<0,001	1,39 (1,09-1,79)	0,008	1,26 (1,01-1,55)	0,03
Ensino fundamental	2,11 (1,84-2,42)	<0,001	1,96 (1,81-2,14)	<0,001	1,59 (1,29-1,96)	<0,001
Escolaridade do pai						
Ensino superior	1,00		1,00		1,00	
Ensino médio	1,65 (1,40-1,95)	<0,001	1,51 (1,36-1,67)	<0,001	1,28 (1,10-1,50)	0,001
Ensino fundamental	2,15 (1,80-2,55)	<0,001	2,01 (1,73-2,34)	<0,001	1,61 (1,32-1,96)	<0,001
Aglomeração domiciliar						
Baixa	1,00		1,00		1,00	
Média	1,37 (1,27-1,47)	<0,001	1,34 (1,23-1,47)	<0,001	1,16 (1,01-1,33)	0,03
Alta	1,96 (1,71-2,24)	<0,001	1,89 (1,71-2,09)	<0,001	1,50 (1,25-1,81)	<0,001

OMS = Organização Mundial da Saúde; ICDAS = International Caries Detection and Assessment System.
RT = Razão de Taxas; IC = Intervalo de Confiança.

A Tabela 6 apresenta a associação entre perda dentária e as variáveis preditoras estudadas. Em geral, 5,81% dos escolares examinados apresentou pelo menos um dente permanente perdido por cárie. Na análise ajustada, nível socioeconômico, ano escolar, tipo de serviço odontológico, frequência de escovação e sangramento gengival se mantiveram significativamente associados à perda dentária.

Tabela 6. Associação entre perda dentária e as variáveis preditoras (Regressão de Poisson).

		Análise não ajustada			Análise ajustada		
	Prevalência	RP	IC 95%	p	RP	IC 95%	P
Gênero							
Feminino	6,09 (2,97-9,21)[a]	1,00					
Masculino	5,53 (3,17-7,89) [a]	0,90	0,71-1,14	0,42			
Nível socioeconômico							
Alto/Médio-alto	3,07 (0,34-5,79)[a]	1,00			1,00		
Médio-baixo	6,66 (4,47-8,85)[b]	2,17	1,25-3,76	0,006	1,54	0.92-2.56	0.10
Baixo	11,42 (9,20-13,64)[c]	3,71	2,12-6,50	<0,001	2,15	1.40-3.29	<0.001
Escolaridade da mãe							
≤8 anos de estudo	8,94 (6,15-11,73)[a]	1,00					
>8 anos de estudo	2,91 (0,18-5,64)[b]	3,06	1,47-6,37	0,003			
Escolaridade do pai							
≤8 anos de estudo	7,90 (6,17-9,63)[a]	1,00					
>8 anos de estudo	2,71 (0,34-5,09)[b]	2,90	1,75-4,80	<0,001			
Aglomeração domiciliar							
Baixa	2,74 (–0,53-6,01)[a]	1,00					
Média	6,21 (3,65-8,77)[ab]	2,26	0,98-5,19	0,05			
Alta	8,51 (5,59-11,43)[b]	3,10	1,60-6,00	0,001			
Escola							
Particular	1,80 (–1,66-5,26)[a]	1,00					
Pública	6,94 (4,42-9,45) [b]	3,85	0,98-15,08	0,05			
Ano escolar							
Regular (5ª, 6ª or 7ª)	4,77 (2,07-7,47)[a]	1,00			1,00		
Atrasado (4ª ou menos)	10,27 (6,26-14,28)[b]	2,15	1,26-3,66	0,005	1,56	1.15-2.10	0.003
Última visita ao dentista							
≤ 1 ano atrás	5,59 (2,02-9,17)[a]	1,00					
≥ 2 anos atrás	6,93 (3,17-10,69)[a]	1,23	0,74-2,07	0,41			
Nunca foi ao dentista	5,15 (1,53-,877)[a]	0,92	0,44-1,89	0,82			
Tipo de serviço odontológico							
Sistema público	9,58 (7,60-11,56)[a]	1,00			1,00		
Convênio/Particular	3,79 (0,92-6,66) [b]	0,39	0,26-0,59	<0,001	0,61	0.47-0.80	<0.001
Nunca foi ao dentista	5,15 (1,53-,877)[ab]	0,53	0,30-0,93	0,02	0,45	0.26-0.77	0.004
Frequência de escovação							
≤ 1 vez ao dia	9,34 (6,49-12,19)[a]	1,00			1,00		
2 vezes ao dia	5,85 (3,33-8,37)[b]	0,62	0,44-0,87	0,007	0,79	0.68-0.90	0.001
≥3 vezes ao dia	3,54 (0,82-6,27)[c]	0,37	0,23-0,62	<0,001	0,51	0.37-0.70	<0.001
Sangramento gengival							
≤ 45%	3,20 (0,46-5,95)[a]	1,00			1,00		
45% to 60%	6,33 (3,56-9,10)[b]	1,97	1,12-3,46	0,01	1,64	0.98-2.76	0.06
> 60%	8,14 (5,83-10,44)[b]	2,53	1,38-4,65	0,003	1,84	1.13-3.01	0.01
TOTAL	5,81 (3,24-8,37)						

Letras diferentes indicam diferença estatisticamente significativa entre categorias (Teste de Wald).
RP = Razão de Prevalência; IC = Intervalo de Confiança.

As análises referentes à associação entre cárie dentária e estado nutricional estão apresentadas nas Tabelas 7 (prevalência) e 8 (extensão). Independentemente do desfecho utilizado, não foi observada associação significativa entre estado nutricional e cárie dentária, nem mesmo nas análises não ajustadas. Análises adicionais incluindo lesões não cavitadas também não encontraram associação estre as duas condições.

Tabela 7. Associação entre prevalência de cárie e estado nutricional (Regressão de Poisson).

	Prevalência	Análise não ajustada			Análise ajustada		
		RP	IC 95%	p	RP	IC 95%	P
Gênero							
Feminino	57,98 (45,18-70,78)[a]	1,00			1,00		
Masculino	52,56 (44,93-60,18)[a]	0,91	0,84 – 0,98	0,009	0,88	0,84 – 0,93	<0,001
Nível socioeconômico							
Alto	43,13 (30,22-56,03)[a]	1,00			1,00		
Médio-alto	44,51 (39,70-49,33)[b]	1,03	0,85 – 1,25	0,75	1,02	0,85 – 1,22	0,82
Médio-baixo	60,79 (51,70-69,88)[c]	1,41	1,22 – 1,62	<0,001	1,37	1,21 – 1,54	<0,001
Baixo	65,92 (57,41-74,44)[c]	1,53	1,26 – 1,85	<0,001	1,46	1,25 – 1,70	<0,001
Frequência de escovação							
≤ 1 vez ao dia	64,53 (55,74-73,33)[a]	1,00			1,00		
2 vezes ao dia	54,27 (44,50-64,04)[ab]	0,84	0,72 – 0,98	0,025	0,90	0,79 – 1,02	0,10
≥3 vezes ao dia	50,69 (37,24-64,14)[b]	0,78	0,65 – 0,94	0,01	0,83	0,72 – 0,97	0,01
Estado nutricional							
Normal	55,86 (44,77-66,95)[a]	1,00			1,00		
Sobrepeso	54,20 (41,33-67,07)[a]	0,97	0,87 – 1,08	0,59	0,99	0,89 – 1,10	0,88
Obeso	53,89 (44,36-63,41)[a]	0,96	0,82 – 1,14	0,66	1,00	0,87 – 1,16	0,91

Letras diferentes indicam diferença estatisticamente significativa entre categorias (Teste de Wald).
RP = Razão de Prevalência; IC = Intervalo de Confiança.

Tabela 8. Associação entre extensão de cárie e estado nutricional (Regressão de Poisson).

	Extensão	Análise não ajustada			Análise ajustada		
		RT	IC 95%	p	RT	IC 95%	p
Gênero							
Feminino	1,46 (1,11-1,81)[a]	1,00			1,00		
Masculino	1,32 (1,02-1,63)[a]	0,91	0,85 – 0,97	0,006	0,88	0,81 – 0,95	0,002
Nível socioeconômico							
Alto	0,88 (0,54-1,22)[a]	1,00			1,00		
Médio-alto	1,09 (0,83-1,35)[a]	1,24	1,00 – 1,53	0,05	1,22	1,00 – 1,48	0,045
Médio-baixo	1,56 (1,27-1,85)[b]	1,77	1,48 – 2,11	<0,001	1,68	1,42 – 1,99	<0,001
Baixo	1,81 (1,67-1,95)[c]	2,05	1,64 – 2,56	<0,001	1,89	1,57 – 2,28	<0,001
Frequência de escovação							
≤ 1 vez ao dia	1,69 (1,59-1,80)[a]	1,00			1,00		
2 vezes ao dia	1,40 (1,05-1,76)[a]	0,83	0,70 – 0,98	0,03	0,91	0,79 – 1,04	0,20
≥3 vezes ao dia	1,18 (0,78-1,59)[b]	0,70	0,56 – 0,87	0,001	0,76	0,64 – 0,90	0,02
Estado nutricional							
Normal	1,46 (1,11-1,81)[a]	1,00			1,00		
Sobrepeso	1,30 (0,78-1,81)[a]	0,89	0,71 - 1,11	0,30	0,91	0,74 – 1,12	0,38
Obeso	1,19 (0,94-1,45)[a]	0,82	0,66 - 1,00	0,05	0,86	0,72 – 1,04	0,12

Letras diferentes indicam diferença estatisticamente significativa entre categorias (Teste de Wald).
RT = Razão de Taxas; IC = Intervalo de Confiança.

A associação entre qualidade de vida e tratamento de cárie está apresentada na Tabela 9. Foi observado que os escolares com lesões cariosas não tratadas (27,62%, n=422) apresentaram uma pior qualidade de vida quando comparados aos escolares sem necessidade de tratamento, com associação negativa nos domínios sintomas orais e bem estar emocional. Por outro lado, os escolares com lesões cariosas tratadas (10,99%, n=168) apresentaram uma melhor qualidade de vida do que os escolares sem necessidade de tratamento. Esta associação positiva foi observada no CPQ_{11-14} total e nos domínios limitações funcionais e bem estar emocional.

Tabela 9. Associação entre qualidade de vida (escores do CPQ_{11-14}) e tratamento de cárie (Regressão Binomial Negativa).

		Análise não ajustada			Análise ajustada*		
		RT	IC 95%	p	RT	IC 95%	p
CPQ_{11-14} total	Sem necessidade	1,00			1,00		
	Tratado	0,90	0,84-0,97	0,006	0,90	0,85-0,96	0,002
	Não tratado	1,09	1,03-1,15	0,005	1,06	1,00-1,13	0,07
Sintomas orais	Sem necessidade	1,00			1,00		
	Tratado	0,95	0,90-1,01	0,11	0,95	0,90-1,01	0,10
	Não tratado	1,07	1,03-1,12	0,001	1,06	1,02-1,10	0,005
Limitações funcionais	Sem necessidade	1,00			1,00		
	Tratado	0,86	0,75-0,99	0,04	0,86	0,75-0,99	0,04
	Não tratado	1,05	0,94-1,19	0,39	1,03	0,92-1,16	0,59
Bem estar emocional	Sem necessidade	1,00			1,00		
	Tratado	0,92	0,80-1,05	0,20	0,89	0,80-0,99	0,04
	Não tratado	1,13	1,05-1,22	0,001	1,09	1,01-1,20	0,04
Bem estar social	Sem necessidade	1,00			1,00		
	Tratado	0,85	0,69-1,05	0,13	0,87	0,72-1,05	0,15
	Não tratado	1,12	1,01-1,24	0,04	1,06	0,94-1,20	0,34

CPQ_{11-14} = Child Perception Questionnaire; RT = Razão de Taxas, IC = Intervalo de Confiança.
*Estimativas ajustadas para gênero e nível socioeconômico.

Com relação à distribuição intraoral da cárie, observou-se que os escolares com experiência de cárie em dentes anteriores (2,55%, n=39) apresentaram uma pior qualidade de vida do que os escolares livres de cárie. A associação negativa foi observada nos domínios sintomais orais e bem estar social (Tabela 10).

Tabela 10. Associação entre qualidade de vida (escores do $CPQ_{11–14}$) e distribuição intraoral da cárie (Regressão Binomial Negativa).

		Análise não ajustada			Análise ajustada*		
		RT	IC 95%	p	RT	IC 95%	p
CPQ_{11-14} total	Livres de cárie†	1,00			1,00		
	Apenas posterior	1,03	0,97-1,08	0,30	1,01	0,96-1,06	0,80
	Anterior	1,16	1,02-1,31	0,02	1,11	0,99-1,24	0,07
Sintomas orais	Livres de cárie†	1,00			1,00		
	Apenas posterior	1,03	1,00-1,06	0,04	1,02	0,99-1,05	0,14
	Anterior	1,14	1,07-1,21	<0,001	1,11	1,05-1,18	<0,001
Limitações funcionais	Livres de cárie†	1,00			1,00		
	Apenas posterior	0,99	0,88-1,12	0,86	0,97	0,86-1,10	0,67
	Anterior	1,13	0,85-1,50	0,41	1,09	0,83-1,42	0,56
Bem estar emocional	Livres de cárie†	1,00			1,00		
	Apenas posterior	1,07	1,03-1,11	0,001	1,04	0,98-1,11	0,22
	Anterior	1,03	0,76-1,40	0,83	0,98	0,72-1,32	0,87
Bem estar social	Livres de cárie†	1,00			1,00		
	Apenas posterior	1,02	0,94-1,10	0,68	0,98	0,91-1,07	0,70
	Anterior	1,37	1,24-1,53	<0,001	1,30	1,14-1,47	<0,001

CPQ_{11-14} = Child Perception Questionnaire; RT = Razão de Taxas, IC = Intervalo de Confiança.
*Estimativas ajustadas para gênero e nível socioeconômico.
† Esta categoria agrupa os indivíduos livres de cárie e aqueles com pequenas cavidades inativas.

DISCUSSÃO

Trocas minerais ocorrem constantemente sobre as superfícies dentárias, e quando os eventos de perda superam os eventos de redeposição, a doença cárie está estabelecida. As lesões cariosas passam por diferentes estágios, em um gradiente contínuo desde as primeiras trocas bioquímicas a favor da desmineralização até amplas cavidades facilmente detectáveis. A definição de doença, neste caso, assume um importante papel do ponto de vista epidemiológico, uma vez que a ocorrência e distribuição da cárie dentária nas populações dependem do estágio em que a lesão é detectada.

Considerando-se o critério de diagnóstico preconizado pela OMS, quando somente as cavidades cariosas são contabilizadas, a população de escolares estudada apresentou uma baixa experiência de cárie, com um índice CPO-D médio de 1,39. Este valor é menor do que a média nacional de 2,1 e a média da Região Sul de 2,06 (MINISTÉRIO DA SAÚDE, 2011). Quando comparado a dados mundiais, este índice CPO-D é semelhante ao observado em diversos países desenvolvidos (ZABORSKIS *et al*., 2010) e menor do que a média mundial de 1,67 aos 12 anos (dados agrupados de 189 países) (NATAZARAN, 2011).

Quanto mais sensível o critério de diagnóstico, maior a proporção da população considerada portadora da doença. Como observado no presente estudo, a inclusão das lesões não cavitadas resultou em maiores taxas de prevalência de cárie. A detecção das lesões não cavitadas ativas parece importante quando se planeja utilizar os dados epidemiológicos para o desenvolvimento de estratégias de controle e tratamento da doença. É sabido que, em uma certa parcela da população, estas lesões são os únicos sinais clínicos indicativos da presença de doença. Caso elas não sejam diagnosticadas, estes indivíduos serão classificados como livres de cárie e sem necessidade de tratamento. Este foi o caso de cerca de 8% dos escolares incluídos neste estudo. Além da definição da parcela da população necessitando de tratamento, a extensão da doença também é importante para estimar os recursos necessários a serem investidos. A inclusão das lesões não cavitadas brancas foi responsável por um incremento de 40% no índice CPO-D nesta população. Por outro lado, quando, além das lesões brancas, as lesões não cavitadas pigmentadas também foram contabilizadas, as estimativas de cárie aumentaram drasticamente. De acordo com o ICDAS, aproximadamente 80% desta população de escolares de 12 anos apresenta experiência de cárie, o que representa um aumento absoluto de cerca de 25 pontos percentuais em comparação ao critério da OMS. O índice CPO-D de acordo com o ICDAS foi 2,71 vezes maior do que aquele observado utilizando-se o critério da OMS, resultado semelhante ao observado por AGUSTSDOTTIR *et*

al. (2010) em islandeses de mesma idade. A contabilização das lesões não cavitadas pigmentadas na composição do índice CPO deve ser vista com cautela. Sabe-se que a pigmentação de uma lesão não cavitada indica sua paralisação. Dessa forma, a utilidade de se registrar as lesões não cavitadas pigmentadas e incluí-las no índice CPO dos indivíduos é duvidosa, uma vez que estes dados não devem ser utilizados como base para o desenvolvimento de estratégias em saúde. Além disso, a força das associações entre indicadores de risco sócio-demográficos e cárie dentária foi severamente reduzida quando estas lesões foram contabilizadas, conforme já demonstrado em um estudo prévio (MENDES *et al*., 2010).

Quando a doença cárie não é autocontrolada, a intervenção profissional torna-se importante para controlar o desenvolvimento da doença e evitar que ela progrida até causar a perda dentária. Estudos epidemiológicos têm revelado marcante redução da experiência de cárie dentária no mundo nas últimas décadas. Em países desenvolvidos, esta menor prevalência de cárie tem sido acompanhanda pela redução expressiva de perda dentária aos 12 anos, que praticamente inexiste nesta faixa etária. Por este motivo, o componente P do índice CPO-D comumente é omitido, resultando no índice CO-D. No Brasil, embora também se tenha experienciado uma importante redução da prevalência de cárie, uma certa parcela da população ainda perde dentes permanentes precocemente. No presente estudo, 5,81% dos escolares examinados apresentaram pelo menos um molar permanente perdido por cárie. Um estudo chileno recente mostrou uma prevalência de perda dentária de 8,9% aos 12-14 anos (LÓPEZ e BAELUM, 2006), que pode ser considerada semelhante aos nossos resultados tendo em vista a maior idade incluída. Considerando que, aos 12 anos de idade, os primeiros molares permanentes estão em boca há apenas seis anos em média, é possível afirmar que nestes indivíduos, a doença cárie progrediu de maneira especialmente veloz. Visando identificar os grupos mais suscetíveis, diversas variáveis preditoras foram avaliadas e se mostraram significativamente associadas à perda dentária. Conforme já demonstrado consistentemente na literatura (SUSIN *et al*., 2005; LÓPEZ e BAELUM, 2006; BARBATO e PERES, 2009), a prevalência de perda dentária foi maior entre indivíduos de nível socioeconômico mais baixo, o que reflete a forte associação existente entre cárie dentária e nível socioeconômico. Foi observado que os estudantes que repetiram anos na escola apresentaram maior risco de possuir dentes perdidos por cárie do que aqueles que frequentam a série normal para a idade, o que está de acordo com estudos prévios (BLUMENSHINE *et al*., 2008; JACKSON *et al*., 2011). Isto pode estar relacionado ao fato destes estudantes apresentarem pior condição socioeconômica, pais com menor escolaridade e menor

frequência de escovação, características que sabidamente têm associação com cárie dentária. Foi observado que os escolares que nunca foram ao dentista apresentaram menor risco de possuir dentes perdidos por cárie do que os estudantes que utilizam o sistema público de saúde. Os estudantes que nunca foram ao dentista possivelmente sofreram menos dor de dente e foram mais capazes de controlar a progressão da doença cárie. Ademais, isto pode estar relacionado ao tipo de atendimento odontológico oferecido no serviço público, com acesso restrito à atenção especializada para realização de endodontias. Por outro lado, os escolares que frequentam o dentista particular ou utilizam convênios podem ter acesso mais facilitado a tratamentos conservadores que controlam a progressão da doença em estágios anteriores ou ainda a tratamentos especializados, motivo pelo qual eles apresentaram menor risco de perda dentária. Indivíduos que reportaram escovar seus dentes 2 vezes ao dia apresentaram um risco 21% menor de possuir dentes perdidos ao passo que naqueles que reportaram escovar seus dentes 3 vezes ao dia ou mais, o risco foi 49% menor. Como estas estimativas estão ajustadas para o índice de sangramento gengival (que reflete a remoção mecânica do biofilme), esta proteção adicional observada no grupo com maior frequência de escovação pode ser atribuída à maior exposição ao flúor. A ocorrência de perda dentária em idades precoces tende a tornar os indivíduos mais receptivos a novas extrações ao longo da vida (EKLUND e BURT, 1994), o que reforça a necessidade de desenvolver estratégias que visem impedir sua ocorrência em indivíduos tão jovens.

Além das variáveis socioeconômicas e comportamentais já estabelecidas como indicadores de risco para cárie dentária, discute-se ainda a sua associação com estado nutricional. Os resultados disponíveis na literatura são bastante controversos, com apenas dois estudos demonstrando haver uma associação significativa entre as duas condições (GERDIN *et al.*, 2008; HONNE *et al*., 2011). O presente estudo não encontrou associação entre cárie e obesidade, à exemplo de estudos prévios (KOPYCKA-KEDZIERAWSKI *et al*., 2008; TRAMINI *et al*., 2009; JAMELLI *et al.*, 2010). Análises adicionais foram conduzidas incluindo lesões cariosas não cavitadas a fim de investigar se o uso de um critério de diagnóstico mais sensível poderia alterar esta relação, no entanto, nenhuma associação foi encontrada. Embora haja plausibilidade para se investigar a associação entre cárie e obesidade (consumo excessivo de açúcar como um fator de risco comum), os dados epidemiológicos já indicam, por si só, que essas condições parecem não coexistir. Paralelamente à expressiva redução da prevalência de cárie observada no mundo nas últimas décadas, tem se observado o dramático aumento da ocorrência de sobrepeso e obesidade entre crianças em adolescentes, inclusive nos países em desenvolvimento (GUPTA *et al*., 2012). Estatísticas do Ministério da

Saúde demonstram que a prevalência de sobrepeso e obesidade em crianças e adolescentes brasileiros aumentou cerca de 5 vezes nos últimos 30 anos. Em 2008-2009, ao redor de 30% dos indivíduos com 12-13 anos de idade estavam acima do peso (IBGE, 2010).

Embora se discuta sobre a importância e necessidade de incluir lesões cariosas iniciais em estudos epidemiológicos, é sabido que somente lesões cariosas mais avançadas podem vir a ser percebidas pelo indivíduo e afetar sua qualidade de vida. A importância dos indicadores socio-dentais tem sido reconhecida nas últimas décadas, e diversos estudos tem sido conduzidos a fim de avaliar a associação entre cárie dentária e qualidade de vida de crianças e adolescentes. Conforme já demonstrado em estudos anteriores (NURELHUDA *et al.,* 2010; PIOVESAN *et al.,* 2010), a presença de cárie não tratada (cavidades ou restos radiculares) esteve negativamente associada à qualidade de vida relacionada à saúde bucal na população estudada. Esta associação negativa foi observada nos domínios sintomas orais e bem estar emocional. Por outro lado, este estudo demonstrou um efeito positivo na qualidade de vida dos indivíduos que apresentaram cárie dentária tratada (restaurações ou extrações) quando comparado aos escolares livres de cárie. Esta associação foi observada nos domínios limitações funcionais e bem estar emocional. Embora este possa parecer um achado curioso, é concebível que aqueles escolares que já sofreram experiências negativas relacionadas à cárie se sintam melhores após o tratamento do que aqueles que nunca tiveram tais experiências. Foi observado também que os indivíduos que apresentaram experiência de cárie em dentes anteriores sofreram um efeito negativo no convívio social, demonstrado pela associação significativa encontrada no domínio bem estar social. Apesar do número reduzido (n=39), estes escolares relataram evitar sorrir ou dar risadas, receber apelidos por causa dos seus dentes, ou receber perguntas de amigos ou colegas por causa dos seus dentes mais frequentemente do que aqueles escolares que não apresentavam experiência de cárie em dentes anteriores.

As estratégias de controle da cárie dentária desenvolvidas nas últimas décadas apresentaram resultados positivos, o que pode ser constatado pela baixa experiência de cárie observada na população estudada (Artigo I). No entanto, uma parcela importante desta população apresenta dentes permanentes perdidos por cárie (Artigo II), lesões cariosas com necessidade de tratamento (Artigo IV), e sofrem os efeitos negativos da doença (Artigo IV). Estes achados demonstram que, apesar dos avanços significativos alcançados no controle da cárie dentária, estratégias destinadas aos grupos de maior risco devem ser implementadas.

CONCLUSÕES

A partir da realização do presente estudo, foi possível concluir que:

- A experiência de cárie da população estudada pode ser considerada baixa (Artigo I);
- A inclusão de lesões não cavitadas causou um importante impacto nas estimativas de prevalência e extensão de cárie dentária (Artigo I);
- A magnitude das associações entre indicadores de risco sócio-demográficos e cárie dentária foi severamente reduzida quando lesões pigmentadas foram contabilizadas (Artigo I);
- A prevalência de perda dentária foi considerada alta, tendo em vista a idade da população estudada e sua baixa experiência de cárie (Artigo II);
- Indicadores socioeconômicos e comportamentais foram significativamente associados à perda dentária (Artigo II);
- Os escolares com sobrepeso ou obesos não apresentaram maior risco de cárie (Artigo III);
- A presença de cárie tratada esteve positivamente associada à qualidade de vida ao passo que a presença de cárie não tratada ou cárie em dentes anteriores esteve negativamente associada à qualidade de vida relacionada à saúde bucal nos indivíduos estudados (Artigo IV).

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ANEXOS

Impact of different diagnostic criteria on prevalence, extent and risk indicators for dental caries among 12-year-old Brazilian schoolchildren

Impact of different diagnostic criteria on prevalence, extent and risk indicators for dental caries among 12-year-old Brazilian schoolchildren

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Abstract

This study was conducted to compare the prevalence and extent of dental caries according to the WHO, modified WHO, and ICDAS criteria among 12-year-old Brazilian schoolchildren and to assess the impact of these diagnostic criteria on the assessment of socio-demographic risk indicators for dental caries. This cross-sectional survey used a multistage probability sampling strategy to select a representative sample of 12-year-old schoolchildren. After tooth cleaning and drying, a single examiner recorded the presence of noncavitated and cavitated caries lesions. A questionnaire gathered demographic and socioeconomic information. Three different thresholds for caries diagnosis were used: WHO criteria (only cavitated lesions); modified WHO criteria (white and opaque noncavitated and cavitated lesions), and ICDAS (all noncavitated and cavitated lesions). Prevalence ratios (PR), rate ratios (RR) and 95% confidence intervals (95%CI) were estimated (survey Poisson regression analysis). 1,528 of 1,837 eligible schoolchildren participated. Caries prevalence and DMFT increased as the diagnostic criteria became more sensitive (WHO: 55.23%, 1.39; modified WHO: 63.33%, 1.95; ICDAS: 79.82%, 3.78). The use of the WHO criteria decreased caries prevalence and extent mainly in schoolchildren of better socioeconomic background. All socioeconomic variables were significantly associated with dental caries irrespective of the diagnostic criteria ($p<0.05$). The associations between dental caries and socio-demographic variables were not affected by the diagnostic criteria; however, weaker associations were found when noncavitated lesions were included in caries examination. The use of ICDAS should be done with caution since the inclusion of brown lesions resulted in overestimated caries rates that may not reflect the treatment needs in this population.

Introduction

Disease estimates depend on several factors including accuracy, precision and validity of measurements, diagnostic criteria and disease definition. Dental caries, as so many other diseases and conditions, might be detected and defined in a continuum ranging from biochemical changes to lesions obvious even to the untrained eye. In epidemiology, constrains pertaining to time, costs and logistics often impact health survey decisions and this is also true for oral outcomes. The World Health Organization [WHO, 1997] recommends that caries detection should be performed at the cavity level; thus, ignoring the present of incipient lesions. Although this criteria improves examiner reliability and is less time-consuming [Braga et al., 2009], it may underestimate caries experience, mainly in populations with low prevalence of the disease [Amarante et al., 1998; Ismail, 2004]. The notion that patients with incipient caries lesions should not be regarded as ‘‘caries free’’ led to the inclusion of these lesions in epidemiological surveys. Initially, only noncavitated enamel lesions with a chalk-like appearance (white spots) were included in caries examination [Gustafsson et al., 1954; Zickert et al., 1982; Barbachan e Silva and Maltz, 2001; Carvalho et al., 2009]. Recently, the International Caries Detection and Assessment System (ICDAS) proposed the recording of different degrees of enamel caries, including white and brown lesions [Ismail et al., 2007]. However, few studies have assessed the impact of including noncavitated lesions on the epidemiology of caries and, most importantly, its added benefit to risk assessment.

Caries estimates are heavily dependent on the diagnostic criteria [Burt et al., 2008; Pitts, 2008]. While caries extent increases around 15-30% when white and opaque noncavitated lesions are included [Barbachan e Silva and Maltz, 2001; Carvalho et al., 2009], it increases dramatically when ICDAS is used [Agustsdottir et al., 2010; Mendes et al., 2010]. Furthermore, the ability to distinguish risk groups may be affected by diagnostic criteria. Previous studies showed that ICDAS can identify proximal risk factors for dental caries such as soft drink consumption [Burt et al., 2006; Cook et al., 2008], visible plaque and bacterial counts [Joseph et al., 2011]; however, the use of a highly sensitive method seems to hamper the identification of distal risk factors such as socio-demographic characteristics. Educational level was significantly associated with cavitated caries among low-income African-Americans from Detroit (USA), but this association was not observed when ICDAS was used [Ismail et al., 2008]. A previous study has assessed the ability of ICDAS in discriminating socioeconomic factors associated with caries when compared with the standard WHO criteria [Mendes et al., 2010]. Regarding caries prevalence, cavitated scores of ICDAS presented similar discriminatory power compared with WHO criteria; however, the index lost its

discriminatory power when noncavitated lesions (whites and browns) were included. The inclusion of noncavitated caries did not affect the associations between socioeconomic factors and caries extent (DMFT). This study was performed in the primary dentition and used a reduced sample size. Further studies using representative samples are desirable to assess the effect of the inclusion of noncavitated lesions in the assessment of risk indicators for dental caries.

The aims of this study were to compare the prevalence and extent of dental caries according to three different diagnostic criteria (WHO, modified WHO, and ICDAS criteria) among 12-year-old South Brazilian schoolchildren and to assess the impact of these diagnostic criteria on the assessment of socio-demographic risk indicators for dental caries.

Subjects and Methods

The study protocol was approved by the Federal University of Rio Grande do Sul Research Ethics Committee (299/08) and by the Municipal Health Department of Porto Alegre Research Ethics Committee (process nº 001.049155.08.3/register nº 288). All participants and their parents/legal guardians provided written informed consent.

Study design and sample selection

Data pertaining to 1,528 schoolchildren who participated in a cross-sectional survey in Porto Alegre, Southern Brazil was used in the present study. Detailed information regarding the sampling strategy and sample characteristics have been previously published [Alves et al., 2012]. In brief, schoolchildren aged 12 years old who were attending public and private schools were clinically examined between September 2009 and December 2010. A multistage probability sampling strategy was used with the primary sampling unit consisting of 5 geographical areas organized according to the municipal water fluoridation system. Within each area, schools were randomly selected proportional to the number of existing public and private schools (42 schools: 33 public and 9 private). Schoolchildren born in 1997 or 1998 were randomly selected proportional to school size. A total of 1,528 schoolchildren were examined.

Data collection

Clinical examinations were conducted at the schools, with the students in a supine position, using sterile clinical mirrors and periodontal probes. Portable equipments (artificial light, air

compressor and suction) were used to ensure proper conditions for clinical examination regarding humidity control and lighting. Prior to caries examination, schoolchildren received professional tooth brushing and flossing. A single examiner (LSA) performed caries examination, and recorded whether the surfaces were sound, decayed, missing, or filled. Cavitated and noncavitated (white and brown) caries lesions were recorded [Maltz et al., 2003].

A questionnaire was sent to parents/legal guardians of each selected student. This questionnaire gathered information on demographic and socioeconomic characteristics, such as gender, mother's and father's education, socioeconomic status [Standard Brazilian Economic Classification, 2009], number of rooms in the house and number of people living in the house.

Reproducibility

Before the beginning of the study, the examiner performed training and calibration. Assessment of reproducibility during the survey was conducted by means of repeated examinations on 5% of the sample. The minimal time interval between examinations was 2 days. Lowest Cohen's Kappa for caries examination was 0.8 (unweighted).

Data analysis

Caries prevalence was defined as the percentage of schoolchildren having at least one decayed, missing or filled tooth (DMFT=0 or DMFT≥1). Caries extent was defined as the number of decayed, missing and filled teeth (DMFT index). Caries prevalence and caries extent according to WHO criteria (only cavitated caries lesions), modified WHO criteria (active noncavitated lesions and cavitated lesions), and ICDAS (all noncavitated and cavitated caries lesions) were reported as means and 95% confidence intervals (CI).

Absolute differences were calculated for the modified WHO and ICDAS criteria in relation to the standard WHO criteria. Inflation rates were calculated by dividing the estimates obtained with the modified WHO and ICDAS criteria by the ones obtained with the standard WHO criteria. Absolute differences and inflation rates were calculated for caries prevalence and extent. Wald tests for linear and nonlinear hypothesis testing were used to calculate p-values and the significance was set at 5%.

The univariable association between the socio-demographic variables and dental caries using different diagnostic criteria was assessed using survey Poisson regression models.

Prevalence ratios (caries prevalence), rate ratios (caries extent) and their respective 95% CI were estimated and reported.

Data analysis was performed using STATA software (Stata 11.1 for Windows; Stata Corporation, College Station, TX, USA) and estimates of prevalence, extent and association were calculated taking into account the survey design as described previously [Alves et al., 2012].

Results

Caries prevalences using the WHO, modified WHO, and ICDAS criteria according to socio-demographic variables are presented in Table 1 and Figure 1. The inclusion of noncavitated lesions had great impact on caries prevalence estimates. The WHO criteria yielded a caries prevalence of 55.23% which was 8.10 percentage points and 24.59 percentage points smaller than the one found using the modified WHO and ICDAS criteria, respectively. These differences corresponded to an inflation of 14% (inflation rate = 1.14) for the modified WHO and 44% (inflation rate = 1.44) for the ICDAS criteria. Differences in caries prevalence between indices were not homogeneous among schoolchildren. Underestimation of caries prevalence was higher for schoolchildren of better socioeconomic background including those attending private schools, of high socioeconomic status, with University educated parents. The inclusion of white spot lesions promoted no significant impact on caries prevalence of schoolchildren of low socioeconomic status.

The impact of including noncavitated lesions was also evident on caries extent (Table 2). According to the WHO criteria, on average 1.39 teeth were affected by caries; this estimate was in contrast to a caries extent of 1.95 and 3.78 teeth when using the modified WHO and ICDAS criteria, respectively. When considering caries extent according to ICDAS, cavitated lesions corresponded to 36.8% (1.39), white noncavitated lesions to 14.8% (0.56), and brown noncavitated lesions to 48.4% (1.83) (Figure 2). These estimates indicate that whereas the DMF-T according to the modified WHO criteria was approximately 40% (inflation rate = 1.40) larger than the original WHO criteria, the ICDAS estimates were 2.71 fold higher. Caries extent was underestimated mainly in schoolchildren of better socioeconomic conditions.

Significant associations between caries prevalence and school type, socioeconomic status, mother's and father's education, and crowding were consistently observed for all diagnostic criteria (Table 3). However, the strength of these associations decreased steadily as

the diagnostic criteria became more sensitive. Gender was the only variable that lost its significant association with caries prevalence when ICDAS was used.

All socio-demographic variables were significantly associated with DMFT irrespective of the diagnostic criteria used (Table 4). Compared to the standard WHO criteria, a slight decrease in the association strength was observed for the modified WHO criteria, whereas, a considerable decrease was observed for ICDAS.

Discussion

We investigated the effect of three different diagnostic criteria (WHO, modified WHO, and ICDAS criteria) on the prevalence and extent of dental caries using data derived from a survey of 12-year-old South Brazilian schoolchildren. The impact of these diagnostic criteria on the association strength between socio-demographic risk indicators and dental caries was also assessed. Compared to the standard WHO criteria, a steady increase in caries prevalence and extent estimates was observed when the modified WHO and ICDAS criteria were used. On the contrary, a marked decrease in the association strength among caries prevalence and extent and important risk indicators was observed when noncavitated lesions were included, mainly when ICDAS criteria was used.

The decreasing occurrence of caries in several populations has raised concerns about the appropriateness of the original WHO criteria since it focuses on the detection of cavitated lesions. The early detection of noncavitated caries requires cleaning and drying of the tooth surface as well as good illumination [Assaf et al., 2004], which increases the complexity and time of the examination [Braga et al., 2009]. Intra- and inter-examiner reproducibility are also affected by the inclusion of incipient lesions [Braga et al., 2009], resulting in longer training and calibration sessions. Thus, it is imperative to assess the impact of noncavitated lesions on caries epidemiology before adopting more cumbersome examination strategies in oral epidemiological surveys.

The inclusion of white and opaque noncavitated lesions (modified WHO criteria) resulted in a prevalence rate 14% higher than the one found when caries detection was performed at the cavity level. Approximately 8% of the sample presented white spot lesions as the unique signs of the disease, and they were classified as caries free according to the WHO criteria. The impact of white lesions was more pronounced on caries extent estimates, once these lesions were responsible for in increment of 40% in the DMF-T index when compared with the standard WHO criteria. The diagnosis of white and opaque noncavitated lesions may be important for planning dental care strategies, since these lesions are

progressing, indicating ongoing disease and therefore the need for treatment. According to the literature, 35% of white spot lesions will maintain its clinical appearance indicative of active disease or will progress to cavities or fillings over a period of 3 years [Nyvad et al., 2003]. This finding evidences the need for the early detection of such lesions in order to allow the adoption of conservative approaches. When ICDAS was used, caries prevalence was 44% higher compared with the WHO criteria. Regarding caries extent, the DMFT index was 2.71 fold higher than the one found by the WHO criteria, resulting in an absolute difference of 2.39 teeth. It is important to clarify that the main difference between the modified WHO criteria and ICDAS is the recording of brown lesions. According to the current knowledge regarding caries activity, brown lesions are classified as inactive and they may be considered just as scars of past disease episodes [Maltz et al., 2006]. Dental surfaces are continuously being submitted to the de-remineralization process. When this process is unbalanced, and demineralization events exceed remineralization events, a caries lesion is established. It is important to point out that a brown spot is a self-controlled demineralization process that does not need any treatment. Therefore, the value of this additional data on brown lesions is questionable, since it does not define the portion of the population requiring treatment.

When noncavitated lesions were disregarded, the underestimation of caries estimates was higher among schoolchildren of better socioeconomic conditions. This is a conceivable finding since individuals living in more affluent conditions are less affected by the disease, and show a lower rate of caries progression, being more likely to present noncavitated caries as the unique signs of the disease. Thus, in this subpopulation, the detection of incipient lesions promotes a greater impact than the one observed in schoolchildren living in underprivileged conditions, who present a higher proportion of cavities. It is important to point out that Brazil is a developing country and the majority of the population belongs to mid-low and low socioeconomic strata (approximately 67% in this sample). It is expected that the inclusion of noncavitated lesions would promote a greater impact on caries estimates among developed countries, with a greater proportion of individuals living in high and mid-high socioeconomic condition, and lower rates of caries prevalence and progression.

A previous study compared the ability of WHO and ICDAS criteria to discriminate groups susceptible to caries [Mendes et al., 2010]. Regarding caries prevalence, it was shown that the discriminatory power decreased when both noncavitated and cavitated scores of ICDAS were included in caries assessment. Most of the children exhibited noncavitated caries lesions, and, according to the authors, a little room for showing any discrimination between the explanatory factors could be expected. Variables such as age, number of brothers and

sisters and family income lost their significance when the score 1 of ICDAS was used as the cutoff. This lower discriminatory power observed in prevalence analyses was not observed in extent analyses. It is clear in the literature that the dichotomization of quantitative variables promotes negative consequences, such as loss of information about individual differences and reduction of effect size and statistical power [MacCallum et al., 2002]. When caries prevalence is the outcome, DMFT is dichotomized into DMFT=0 and DMFT≥1, and it may compromise the identification of risk indicators for dental caries in reduced samples. The results of the present study do not corroborate this previous finding, since the inclusion of noncavitated caries has not altered the variables with which caries was associated. We could speculate that the disagreement between our results and those by Mendes et al. [2010] could be attributed to issues related to sample size and statistical power.

Socio-demographic factors have been consistently associated with caries experience in Brazilian population [Antunes et al., 2006; Peres et al., 2007; Piovesan et al., 2010], which is in agreement with our findings. All socio-demographic variables included in the present study were significantly associated with caries prevalence and extent irrespective of the diagnostic criteria, except gender. Although the inclusion of noncavitated caries has not altered the significance of the associations, their magnitudes were modified. Regarding prevalence analysis, the inclusion of white noncavitated lesions reduced the strength of the associations, which was further reduced with the inclusion of brown lesions. In regards to extent analysis, another pattern can be observed. When only white and opaque noncavitated lesions were added in caries examination (modified WHO criteria), the associations were similar to the ones found with the standard WHO criteria. On the other hand, when all noncavitated caries were included, whites and browns, the magnitude of the associations are markedly reduced in comparison with the WHO criteria. This difference can be attributed to the natural history of dental caries. As stated previously, dental surfaces are continuously being submitted to the de-remineralization process. Teeth under eruption are more prone to biofilm accumulation, and thus to demineralization [Dirks, 1966; Carvalho et al., 1989; Maltz et al., 2003]. When these teeth achieve the occlusal plane, and local conditions are favorable, the rebalancing of the de-remineralization process occurs and a brown lesion is established. However, in individuals at higher risk for dental caries, such as those of underprivileged socioeconomic backgrounds, local conditions are commonly unfavorable and the lesion might progress. If we record both situations in caries examination, the ability to distinguish groups at different risks for the disease may be compromised.

The results of the present study showed that the inclusion of noncavitated lesions promoted an important impact on caries estimates, mainly among schoolchildren of better socioeconomic conditions. The use of ICDAS should be done with caution since the inclusion of brown lesions resulted in overestimated caries rates that may not reflect the treatment needs in this population. The associations between dental caries and socio-demographic variables were not affected by the diagnostic criteria; however, weaker associations were found when noncavitated lesions were included in caries examination.

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Table 1

Table 1. Caries prevalence according to independent variables using WHO, modified WHO, and ICDAS criteria, absolute differences and inflation rates comparing the methods. Mean (95% confidence interval).

Variable (n)	WHO	Modified WHO	ICDAS	Absolute Differences		Inflation rate	
				Modified WHO - WHO	ICDAS - WHO	Modified WHO/WHO	ICDAS/WHO
Gender							
Female (758)	57.98 (45.18-70.78)	66.34 (56.16-76.52)	81.82 (73.19-90.44)	8.35** (4.53-12.18)	23.83** (13.34-34.32)	1.14*** (1.05-1.23)	1.41*** (1.15-1.66)
Male (770)	52.56 (44.93-60.18)	60.42 (53.05-67.78)	77.88 (72.64-83.12)	7.85** (4.63-11.07)	25.32*** (22.62-28.02)	1.14*** (1.07-1.22)	1.48*** (1.36-1.60)
School							
Private (261)	37.46 (22.54-52.38)	48.02 (37.88-58.15)	66.85 (56.04-77.66)	10.55** (5.54-15.56)	29.39*** (24.03-34.74)	1.28** (0.99-1.57)	1.78** (1.26- 2.30)
Public (1,267)	60.24 (50.53-69.95)	67.65 (60.11-75.20)	83.48 (80.38-86.58)	7.41** (4.46-10.36)	23.23*** (15.53-30.93)	1.12*** (1.05-1.18)	1.38*** (1.19-1.57)
Socioeconomic status							
High (141)	43.13 (30.22-56.03)	52.10 (40.51-63.70)	71.11 (54.65-87.57)	8.97*** (6.75-11.20)	27.98*** (18.49-37.47)	1.20*** (1.10-1.31)	1.64*** (1.36-1.93)
Mid-high (358)	44.51 (39.70-49.33)	54.32 (49.16-59.48)	72.21 (67.81-76.60)	9. 80** (5.30-14.30)	27.69*** (25.47-29.91)	1.22*** (1.10-1.33)	1.62*** (1.52-1.72)
Mid-low (871)	60.79 (51.70-69.88)	68.31 (59.83-76.80)	84.17 (79.99-88.36)	7.52** (5.24-9.80)	23.38*** (17.57-29.19)	1.12*** (1.07-1.17)	1.38*** (1.23-1.53)
Low (158)	65.92 (57.41-74.44)	71.83 (68.58-75.09)	85.22 (81.27-89.17)	5.91 (–1.62-13.44)	19.29** (8.7-29.89)	1.08*** (0.96-1.21)	1.29*** (1.09-1.48)
Mother's education†							
University (216)	40.47 (26.96-53.98)	52.56 (46.07-59.04)	69.82 (58.81-80.82)	12.08* (4.69-19.48)	29.34*** (21.52-37.17)	1.29*** (1.01-1.57)	1.72*** (1.33-2.11)
High school (516)	51.38 (45.30-57.45)	58.30 (51.01-65.58)	77.16 (74.06-80.25)	6.92***(5.50-8.33)	25.77*** (21.38-30.17)	1.13*** (1.11-1.15)	1.50*** (1.36-1.64)
Elementary school (789)	63.33 (53.54-73.12)	70.97 (63.28-78.65)	85.56 (83.04-88.08)	7.63** (4.90-10.36)	22.23*** (14.67-29.79)	1.12*** (1.06-1.18)	1.35*** (1.17-1.52)
Father's education†							
University (203)	36.24 (30.15-42.32)	47.16 (45.31-49.02)	66.33 (55.60-77.06)	10.92* (4.36-17.49)	30.09*** (20.49-39.69)	1.30** (1.02-1.57)	1.83*** (1.45-2.20)
High school (436)	53.04 (46.85-59.23)	60.36 (54.49-66.23)	76.76 (73.04-80.48)	7.32** (5.05-9.59)	23.72*** (20.66-26.77)	1.13*** (1.08-1.18)	1.44*** (1.34-1.55)
Elementary school (788)	62.84 (54.59-71.09)	70.31 (62.82-77.81)	85.67 (81.99-89.34)	7.47***(6.54-8.40)	22.82*** (16.75-28.89)	1.11*** (1.08-1.14)	1.36*** (1.22-1.50)
Crowding†							
Low (351)	45.52 (36.93-54.11)	55.03 (49.23-60.84)	71.32 (63.40-79.25)	9.51** (4.57-14.45)	25.80*** (22.11-29.48)	1.20*** (1.06-1.34)	1.56*** (1.40-1.72)
Medium (826)	54.63 (45.61-63.64)	62.71 (55.43-69.99)	80.41 (75.29-85.53)	8.08** (4.92-11.24)	25.78*** (21.15-30.41)	1.14*** (1.07-1.22)	1.47*** (1.31-1.63)
High (350)	68.58 (61.28-75.88)	75.07 (68.99-81.15)	88.80 (85.17-92.44)	6.48*** (4.40-8.56)	20.22** (9.31-31.12)	1.09*** (1.05-1.13)	1.29*** (1.10-1.48)
Total (1,528)	55.23 (45.26-65.19)	63.33 (55.20-71.46)	79.82 (73.89-85.75)	8.10** (5.60-10.60)	24.59*** (18.70-30.48)	1.14*** (1.07-1.21)	1.44*** (1.26-1.62)

WHO = World Health Organization; ICDAS = International Caries Diagnosis and Assessment System.
* p<0.05; ** p<0.01; *** p<0.001 (Wald test).

Table 2

Table 2. Caries extent according to independent variables using WHO, modified WHO, and ICDAS criteria, absolute difference and inflation rates comparing the methods. Mean (95% confidence interval).

Variable	WHO	Modified WHO	ICDAS	Absolute Differences		Inflation rate	
				Modified WHO - WHO	ICDAS - WHO	Modified WHO/WHO	ICDAS/WHO
Gender							
Female	1.46 (1.11-1.81)	2.03 (1.60-2.45)	4.10 (3.09-5.10)	0.56*** (0.45-0.68)	2.63*** (1.71-3.56)	1.38*** (1.30-1.47)	2.80*** (2.05-3.55)
Male	1.32 (1.02-1.63)	1.88 (1.57-2.19)	3.47 (3.09-3.86)	0.55*** (0.50-0.60)	2.15*** (1.84-2.45)	1.41*** (1.31-1.52)	2.62*** (2.14-3.09)
School							
Private	0.73 (0.36-1.10)	1.18 (0.81-1.55)	2.95 (1.63-4.28)	0.45*** (0.37-0.52)	2.22** (1.23-3.21)	1.61** (1.21-2.02)	4.03*** (3.15-4.90)
Public	1.58 (1.30-1.85)	2.17 (1.89-2.44)	4.01 (3.56-4.46)	0.59*** (0.49-0.69)	2.43*** (1.90-2.96)	1.37*** (1.27-1.47)	2.54*** (2.01-3.07)
Socioeconomic status							
High	0.88 (0.54-1.22)	1.19 (0.78-1.59)	2.77 (1.90-3.65)	0.30*** (0.23-0.38)	1.89** (1.12-2.66)	1.34*** (1.28-1.41)	3.14*** (2.02-4.26)
Mid-high	1.09 (0.83-1.35)	1.53 (1.34-1.72)	3.28 (2.63-3.94)	0.43*** (0.34-0.53)	2.19*** (1.58-2.79)	1.40*** (1.23-1.57)	3.00*** (2.26-3.73)
Mid-low	1.56 (1.27-1.85)	2.22 (1.89-2.56)	4.09 (3.48-4.71)	0.66*** (0.52-0.80)	2.53*** (1.95-3.11)	1.42*** (1.31-1.53)	2.62*** (2.11-3.12)
Low	1.81 (1.67-1.95)	2.41 (2.32-2.50)	4.47 (3.34-5.61)	0.60*** (0.44-0.75)	2.66** (1.50-3.82)	1.33*** (1.22-1.43)	2.46*** (1.79-3.14)
Mother's education							
University	0.80 (0.60-1.01)	1.22 (0.96-1.47)	2.74 (1.80-3.68)	0.41** (0.23-0.58)	1.93** (1.12-2.74)	1.51*** (1.25-1.77)	3.40*** (2.55-4.24)
High school	1.25 (1.00-1.50)	1.70 (1.34-2.07)	3.46 (2.79-4.12)	0.45** (0.27-0.63)	2.20*** (1.73-2.68)	1.36*** (1.23-1.49)	2.76*** (2.46-3.05)
Elementary school	1.70 (1.37-2.04)	2.40 (2.07-2.73)	4.38 (3.91-4.85)	0.69*** (0.61-0.77)	2.68*** (1.96-3.39)	1.40*** (1.31-1.50)	2.57*** (1.87-3.26)
Father's education							
University	0.77 (0.61-0.93)	1.15 (1.03-1.28)	2.68 (1.93-3.43)	0.38** (0.22-0.55)	1.91*** (1.29-2.53)	1.50** (1.14-1.86)	3.48*** (2.87-4.10)
High school	1.27 (1.06-1.49)	1.72 (1.48-2.01)	3.45 (2.85-4.05)	0.47*** (0.36-0.58)	2.17*** (1.69-2.66)	1.37*** (1.27-1.46)	2.70*** (2.32-3.08)
Elementary school	1.65 (1.32-1.99)	2.33 (1.95-2.71)	4.33 (3.62-5.03)	0.67*** (0.61-0.74)	2.67*** (1.91-3.43)	1.40*** (1.34-1.47)	2.61*** (1.95-3.26)
Crowding							
Low	0.99 (0.76-1.22)	1.42 (1.15-1.69)	3.16 (2.26-4.07)	0.42*** (0.32-0.53)	2.17*** (1.40-2.94)	1.43*** (1.29-1.57)	3.18*** (2.51-3.86)
Medium	1.36 (1.09-1.63)	1.91 (1.60-2.23)	3.68 (3.07-4.29)	0.55** (0.39-0.71)	2.32*** (1.78-2.85)	1.40*** (1.26-1.54)	2.70*** (2.20-3.19)
High	1.95 (1.70-2.19)	2.69 (2.48-2.90)	4.78 (3.93-5.63)	0.74*** (0.62-0.86)	2.83*** (1.83-3.83)	1.38*** (1.28-1.47)	2.45*** (1.80-3.10)
Total	1.39 (1.07-1.71)	1.95 (1.59-2.31)	3.78 (3.11-4.45)	0.56** (0.48-0.64)	2.39*** (1.77-3.00)	1.40*** (1.31-1.49)	2.71*** (2.10-3.32)

WHO = World Health Organization; ICDAS = International Caries Diagnosis and Assessment System.
* p<0.05; ** p<0.01; *** p<0.001 (Wald test).

Table 3

Table 3. Association between caries prevalence and independent variables using WHO, modified WHO, and ICDAS criteria.

Variable	WHO		Modified WHO		ICDAS	
	PR (95% CI)	p	PR (95% CI)	p	PR (95% CI)	p
Gender						
Female	1.00		1.00		1.00	
Male	0.90 (0.84-0.97)	0.009	0.91 (0.84-0.98)	0.01	0.95 (0.88-1.01)	0.15
School						
Private	1.00		1.00		1.00	
Public	1.60 (1.17-2.20)	0.003	1.40 (1.19-1.66)	<0.001	1.24 (1.13-1.37)	<0.001
Socioeconomic status						
High	1.00		1.00		1.00	
Mid-high	1.03 (0.84-1.25)	0.75	1.04 (0.85-1.26)	0.67	1.01 (0.86-1.19)	0.85
Mid-low	1.40 (1.22-1.62)	<0.001	1.31 (1.19-1.43)	<0.001	1.18 (1.02-1.36)	0.01
Low	1.52 (1.26-1.84)	<0.001	1.37 (1.19-1.59)	<0.001	1.19 (1.03-1.38)	0.01
Mother's education						
University	1.00		1.00		1.00	
High school	1.26 (1.00-1.61)	0.05	1.10 (1.00-1.22)	0.04	1.10 (1.01-1.20)	0.02
Elementary school	1.56 (1.26-1.93)	<0.001	1.35 (1.23-1.47)	<0.001	1.22 (1.10-1.36)	<0.001
Father's education						
University	1.00		1.00		1.00	
High school	1.43 (1.32-1.62)	<0.001	1.27 (1.19-1.36)	<0.001	1.15 (1.02-1.31)	0.02
Elementary school	1.76 (1.55-1.93)	<0.001	1.49 (1.37-1.61)	<0.001	1.29 (1.16-1.43)	<0.001
Crowding						
Low	1.00		1.00		1.00	
Medium	1.20 (1.09-1.31)	<0.001	1.13 (1.11-1.16)	<0.001	1.12 (1.06-1.19)	<0.001
High	1.50 (1.31-1.72)	<0.001	1.36 (1.30-1.42)	<0.001	1.24 (1.15-1.34)	<0.001

WHO = World Health Organization; ICDAS = International Caries Diagnosis and Assessment System.
PR = Prevalence Ratio; CI = Confidence Interval.

Table 4

Table 4. Association between caries extent and independent variables using WHO, modified WHO, and ICDAS criteria.

Variable	WHO		Modified WHO		ICDAS	
	RR (95% CI)	p	RR (95% CI)	p	RR (95% CI)	p
Gender						
Female	1.00		1.00		1.00	
Male	0.90 (0.84-0.97)	0.006	0.92 (0.87-0.98)	0.01	0.84 (0.75-0.95)	0.005
School						
Private	1.00		1.00		1.00	
Public	2.15 (1.49-3.11)	<0.001	1.82 (1.49-2.23)	<0.001	1.35 (1.04-1.76)	0.02
Socioeconomic status						
High	1.00		1.00		1.00	
Mid-high	1.23 (1.00-1.52)	0.04	1.28 (1.04-1.58)	0.01	1.18 (1.05-1.32)	0.004
Mid-low	1.76 (1.47-2.11)	<0.001	1.86 (1.60-2.18)	<0.001	1.47 (1.28-1.69)	<0.001
Low	2.05 (1.64-2.56)	<0.001	2.02 (1.61-2.55)	<0.001	1.61 (1.40-1.85)	<0.001
Mother's education						
University	1.00		1.00		1.00	
High school	1.55 (1.27-1.88)	<0.001	1.39 (1.09-1.79)	0.008	1.26 (1.01-1.55)	0.03
Elementary school	2.11 (1.84-2.42)	<0.001	1.96 (1.81-2.14)	<0.001	1.59 (1.29-1.96)	<0.001
Father's education						
University	1.00		1.00		1.00	
High school	1.65 (1.40-1.95)	<0.001	1.51 (1.36-1.67)	<0.001	1.28 (1.10-1.50)	0.001
Elementary school	2.15 (1.80-2.55)	<0.001	2.01 (1.73-2.34)	<0.001	1.61 (1.32-1.96)	<0.001
Crowding						
Low	1.00		1.00		1.00	
Medium	1.37 (1.27-1.47)	<0.001	1.34 (1.23-1.47)	<0.001	1.16 (1.01-1.33)	0.03
High	1.96 (1.71-2.24)	<0.001	1.89 (1.71-2.09)	<0.001	1.50 (1.25-1.81)	<0.001

WHO = World Health Organization; ICDAS = International Caries Diagnosis and Assessment System.
RR = Rate Ratio; CI = Confidence Interval.

Figure 1

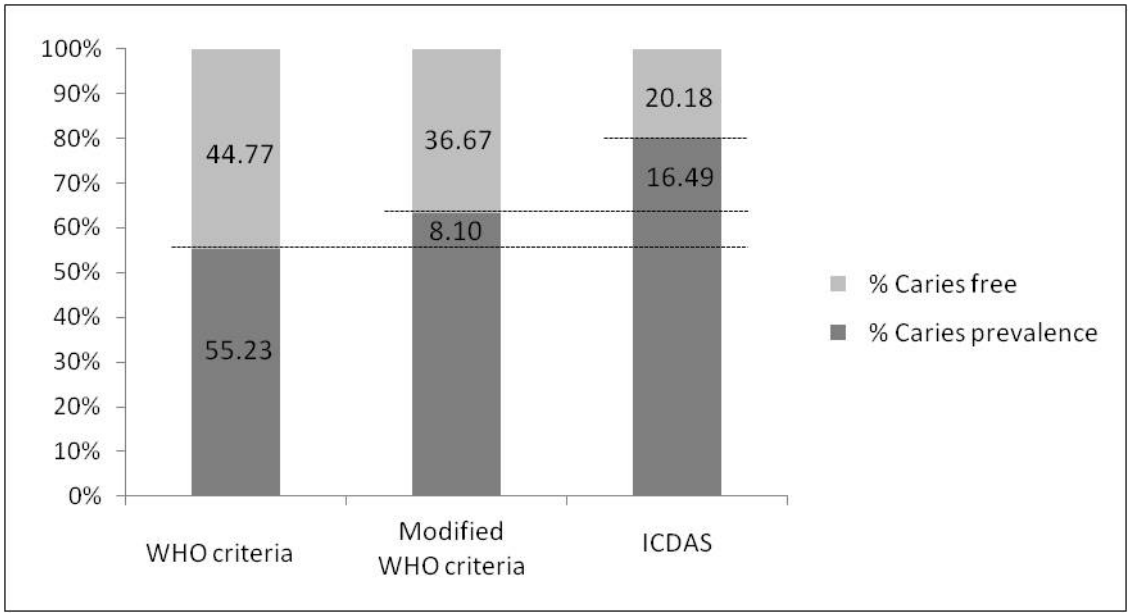

Figure 1. Caries prevalence and the proportion of caries free individuals according to different diagnostic criteria.

Figure 2

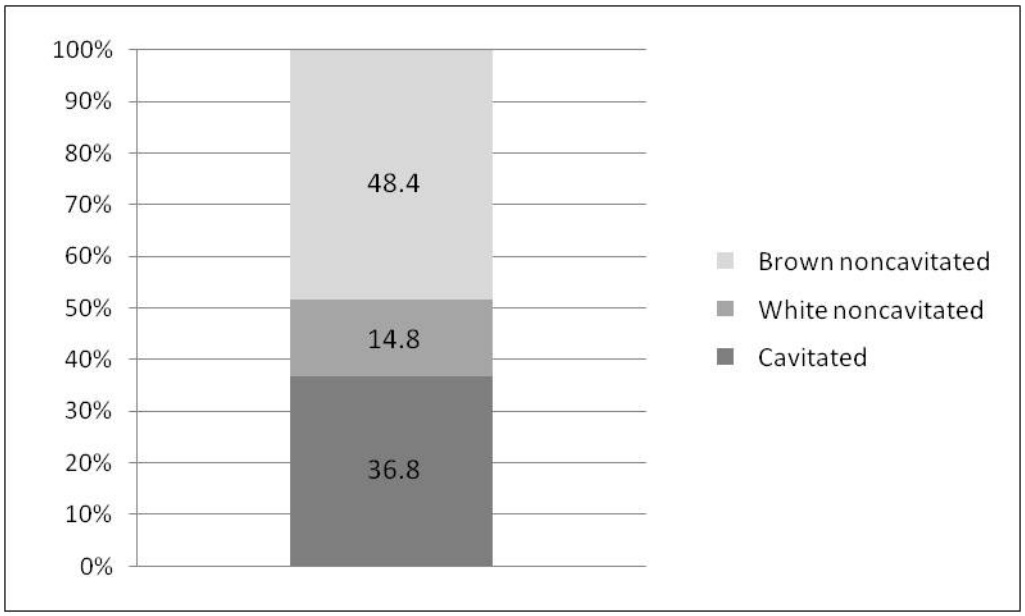

Figure 2. Proportional contribution of cavitated, white and brown noncavitated caries lesions to the DMF-T index (100% correspond to the mean DMF-T according to ICDAS).

Tooth loss due to dental caries among 12-year-old schoolchildren from South Brazil

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Abstract

Objective: To assess the prevalence and risk indicators for tooth loss due to dental caries among 12-year-old schoolchildren from South Brazil. *Methods*: This cross-sectional survey used a multistage probability sampling strategy to select a representative sample of 12-year-old schoolchildren attending public and private schools. Clinical examinations registered the Gingival Bleeding Index and dental caries. A questionnaire collected information on socioeconomic characteristics, access to dental services, and brushing frequency. Survey Poisson regression models were used to assess the association between tooth loss and predictor variables. *Results*: 1,528 schoolchildren were examined (response rate of 83.17%). Caries prevalence was 55.23% (95%CI=45.26-65.19), with a mean DMFT of 1.39. The overall prevalence of tooth loss in this population was 5.81% (95%CI=3.24-8.37). After adjusting for other cofactors, schoolchildren with low socioeconomic status (PR=2.15, 95%CI=1.40-3.29), who repeated years in school (PR=1.56, 95%CI=1.15-2.10), and those presenting >60% of sites with gingival bleeding (PR=1.84, 95%CI=1.13-3.01) were more likely to present at least one missing tooth. In contrast, schoolchildren reporting a brushing frequency of 2 times/day (PR=0.79, 95%CI=0.68-0.90) and ≥3 times/day (PR=0.51, 95%CI=0.34-0.620.37-0.70) were less likely to present missing teeth as well as those accessing dental services by insurance or in private clinics (PR=0.61, 95%CI=0.47-0.80) or those that had never visited a dentist (PR=0.45, 95%CI=0.26-0.77). *Conclusion*: This study showed a high prevalence of tooth loss among 12-year-old South Brazilian schoolchildren, considering the reduced period of time at risk and the low caries prevalence observed in this population.

Introduction

Tooth loss is a clinically relevant endpoint in Dentistry that negatively affects the quality of life of affected individuals (1). It has been shown in the literature that early tooth loss can favor more receptive attitudes towards tooth extraction, thus promoting an accelerated pattern of tooth loss in adulthood (2). Studies on the prevalence and risk indicators for tooth loss among children and adolescents could help the development of strategies to control and manage dental caries in earlier stages.

Twelve years has been chosen as the global monitoring age for caries for international comparisons and monitoring of disease trends (3); however, little is known on the prevalence of tooth loss in this age group. López and Baelum (4) investigating gender differences in tooth loss among Chilean adolescents found a prevalence of 8.9% among high school students aged 12-14 years. Studies including older adolescents have reported prevalence rates ranging from 16.1% to 40.9% in different populations aged 14-19 years (5-8). It is clear that the occurrence of tooth loss tends to increase linearly with aging, reinforcing the need for the identification of susceptible groups.

Few studies have assessed risk factors/indicators for tooth loss among children and adolescents. Socioeconomic indicators such as income, parents' educational level and socioeconomic status have been consistently associated with tooth loss, with individuals living in deprived conditions been more likely to present lost teeth (4, 6, 8, 9). The association between gender and tooth loss remains unclear, since some studies have shown such relationship (4, 8), but others have not (5, 9). Dental visiting pattern is another variable controversially associated with tooth loss. While some authors showed that episodic dental visitors are at higher risk for presenting missing teeth than did routine visitors (7, 9), others showed that students who visited a dentist rarely or never were less likely to have lost teeth than did those who visited a dentist in the last year (4). There is only one population-based survey assessing the risk indicators for tooth loss among Brazilian adolescents (8). Using secondary data from a National Oral Health Survey, it was observed that adolescents (15-19 years) living in localities with non-fluoridated water supply were 40% more likely to have tooth loss compared with those living in areas with fluoridated water supply. It would be interesting to investigate the occurrence of tooth loss in a low caries experience population with access to water fluoridation. Therefore, the aim of this study was to assess the prevalence and risk indicators for tooth loss due to dental caries in a representative sample of 12-year-old schoolchildren from South Brazil.

Subjects and Methods

This cross-sectional survey was conducted in Porto Alegre, southern Brazil, from September 2009 to December 2010. The target population was schoolchildren aged 12 years old who were attending public and private schools.

Sample

Sample size was calculated to estimate the prevalence of dental caries in this population and used the following parameters: prevalence of 60% (10), precision level of ±3%, 95% confidence intervals, and a design effect of 1.3. Thus, a sample size of 1,331 was considered necessary, to which was added a non-response error of 40%, resulting in a sample of 1,837 individuals. This sample size was sufficient to estimate a prevalence of tooth loss of 10% (4) using the same parameters.

A multistage probability sampling strategy was used. The primary sampling unit consisted of five geographical areas organized according to the municipal water fluoridation system. Within each area, the schools were randomly selected proportional to the number of existing public and private schools (42 schools: 33 public and 9 private). Schoolchildren born in 1997 or 1998 were then randomly selected proportional to school size. The sampling strategy and the study sample are shown in Figure 1.

Data collection

Clinical examinations were conducted at the schools, with the students in a supine position, using artificial light, air compressor and suction. Sterile clinical mirror and periodontal probe were also used. A trained examiner (NDT) recorded the Gingival Bleeding Index (11). After tooth cleaning and drying, another examiner (LSA) recorded dental caries (3), including the presence of missing teeth or root tips. Before the beginning of the study, the examiner performed training and calibration to evaluate dental caries. Assessment of reproducibility during the survey was conducted by means of repeated examinations on 5% of the sample. The minimal time interval between examinations was 2 days. Lowest Cohen's Kappa for caries examination was 0.8 (unweighted).

A questionnaire was sent to parents/legal guardians to gather information on gender, socioeconomic status (12), parents' educational level, number of rooms in the house, number of people living in the house, access to dental services, and brushing

frequency. Information on the school year that the student was attending was also recorded.

Non-response analysis

Of the 337 and 1,500 schoolchildren who were selected from private and public schools, 76 and 233 did not participate, yielding response rates of 77.44% and 84.46%, respectively. Telephone contact was established with 176 parents/legal guardians of the non-respondents. Of those children, 26% reported no interest due to previous access to dental care, 27% of schoolchildren refused to participate, 24% did not return the informed consent or questionnaire, and 4% showed concern about biosecurity or refused to answer socioeconomic questions. Nineteen percent of students were not available at school during the normal survey schedule.

A random sample of non-respondents was selected and information for 80 schoolchildren was obtained. After comparing participants and non-respondents with regards to demographics, socioeconomic status and family related data, small discrepancies were observed. A weighted variable based on information provided by the Primary Education School Census of 2010 (13) was used in the statistical analysis to minimize potential non-response bias.

Data analysis

The primary outcome of this study was tooth loss prevalence, defined as the percentage of schoolchildren having at least one missing tooth or root tip.

Socioeconomic status was categorized using cutoff points proposed by the standard Brazilian economic classification into low (≤13 points), mid-low (≥14 to ≤22 points), mid-high (≥23 to ≤28 points) and high (≥29 points) socioeconomic status (12). Due to the reduced number of individuals presenting missing teeth in the high socioeconomic status category, mid-high and high categories were combined. Household crowding was calculated as the number of persons per room, and it was categorized into low (≤0.6 persons/room), medium (>0.6 to ≤1 persons/room) and high crowding (>1 person/room), according to data distribution. Gingival bleeding was categorized according to tertiles.

Data analysis was performed using STATA software (Stata 11.1 for Windows; Stata Corporation, College Station, TX, USA), taking into account the survey design. Given the discrepancy in some of the demographic and socioeconomic features among

the study participants and subjects who did not participate, a weight variable was used in the statistical analysis to adjust for the potential bias in the population estimates (14). The sample weight was adjusted for the probability of selection and population distribution according to gender, school type and city area. Probability of selection was calculated by dividing the population size by the number of individuals sampled in each area. This procedure also permitted achieving the expansion weight. The distribution of the population (poststratification) was calculated using the Primary Education School Census (13). The sample and the population were divided into various subgroups according to gender, school type and city area. The final sample weight variable was calculated by multiplying the base weight with the poststratification adjustment.

Tooth loss prevalence was reported as means and 95% confidence intervals (95% CI). Pairwise comparisons of crude estimates were carried out using the Wald test. The association between tooth loss and predictor variables was assessed using survey Poisson regression models. The preliminary analysis was carried out using unadjusted models and variables showing associations with $p<0.25$ were selected for the adjusted ones. Confounding and effect modifications were assessed. Variables were considered confounders if a change of 30% or more in other variables in the model was observed. Effect modification was assessed by including interaction terms in the adjusted models. Prevalence ratios and their respective 95% CI were estimated and reported.

Ethical considerations

This study was approved by the Federal University of Rio Grande do Sul Research Ethics Committee (299/08) and by the Municipal Health Department of Porto Alegre Research Ethics Committee (001.049155.08.3/288). All participants and their parents/legal guardians provided written informed consent.

Results

A total of 1,528 schoolchildren were examined, yielding a response rate of 83.17%. Caries prevalence was 55.23% (95% CI=45.26-65.19), with a mean DMFT of 1.39. Ninety six students presented missing teeth due to dental caries or root tips. The overall prevalence of tooth loss in this population was 5.81% (95% CI=3.24-8.37). On average, the examined schoolchildren presented 0.08 (95% CI=0.04-0.12) missing teeth due to caries. Among those who presented missing teeth, a mean number of 1.46

(95% CI=1.19-1.74) teeth were lost. All missing teeth due to dental caries were first permanent molars. Table 1 summarizes the frequency distribution of sample and the prevalence of tooth loss according to predictor variables. Preliminary analysis showed that the prevalence of tooth loss differed between categories of all predictor variables, except gender and last dental visit.

Association between tooth loss and predictor variables is shown in Table 2. In the unadjusted analysis, all variables were significantly associated with the occurrence of tooth loss, except gender and last dental visit. After adjusting for other cofactors, schoolchildren with low socioeconomic status (PR=2.15, 95% CI=1.40-3.29), attending 4th grade or earlier (PR=1.56, 95% CI=1.15-2.10), and those presenting >60% of sites with gingival bleeding (PR=1.84, 95% CI=1.13-3.01) were more likely to present at least one missing tooth. In contrast, schoolchildren reporting a brushing frequency of 2 times/day (PR=0.79, 95% CI=0.68-0.90) and ≥3 times/day (PR=0.51, 95% CI=0.34-0.620.37-0.70) were less likely to present missing teeth as well as those accessing dental services by insurance or in private clinics (PR=0.61, 95% CI=0.47-0.80) or those that had never visited a dentist (PR=0.45, 95% CI=0.26-0.77).

Discussion

This study was carried out to assess the prevalence and risk indicators for early tooth loss among a 12-year-old population living in a fluoridated area in South Brazil. Despite the low caries experience observed, 5.81% of the examined schoolchildren presented missing teeth or root tips. Several predictors were significantly associated with the occurrence of tooth loss, including socioeconomic, school-related and clinical variables. To the best of our knowledge, this is the first study to assess the prevalence and risk indicators for tooth loss due to dental caries among Brazilian 12-year-olds.

Dental caries in children and adolescents has been extensively studied over the last decades, and a significant decrease in caries experience has been observed worldwide, including in Latin America (15, 16). Similarly, the proportion of the M component of the DMFT index has also decreased. In Brazil, the M component corresponded to 17.24% of the DMFT among 12 year-olds in 1980 (17), decreasing to 13.18% in 1986, 9.42% in 1996, and 6.47% in 2003 (18). Recently, a National Oral Health Survey (19) showed that 5.8% of the DMFT was composed by missing teeth, which is in agreement with our findings (0.08/1.39). We observed a prevalence of tooth loss of 5.81% among 12-year-olds López and Baulum (4) found a prevalence of tooth

loss of 8.9% among 12-14-year-old Chilean adolescents, which can be considered similar to our findings taking into account the inclusion of older individuals. This prevalence rates can be regarded as high considering the reduced time at risk for dental caries. Although a high prevalence of tooth loss has been observed in developing countries such as Brazil and Chile, developed countries have shown low rates or absence of tooth loss in this age group. For example, national data from Sweden usually report the DF-T index among 12-year-olds due to the absence of missing teeth in that population (20).

Several characteristics have been used as proxies to capture the effect of children and adolescents' socioeconomic status on oral health, including school type (public or private), parents' educational level, income, socioeconomic status and housing conditions. We have used a comprehensive set of variables to assess the relationship between socioeconomic background and tooth loss, and all variables showed significant associations in the unadjusted analyses. After adjusting for other cofactors, schoolchildren with low socioeconomic status were 2.15 times as likely as those with high/mid-high socioeconomic status to present missing teeth. This finding is in agreement with previous studies assessing the relationship between socioeconomic conditions and tooth loss (4, 6, 8, 9).

School-related variables have received attention from the dental literature in the last years (8, 21-24). Studies have shown that school performance and school attendance may be influenced by student's oral health. Children with poorer oral health status have been cited as more likely to experience dental pain, miss school, and perform poorly in school (21, 22). In the present study, we found that schoolchildren attending 4th grade or earlier were 56% more likely to present missing teeth than did students attending the regular school years for age. Unlike previous studies suggesting that a poor oral health may cause a poor school performance, our hypothesis to explain this finding is based on the family background of these children. Schoolchildren who repeated years in school are more socioeconomic deprived, have parents with lower schooling, live in a higher crowding condition and have poorer oral hygiene habits than did schoolchildren attending the regular school year (unpublished data), and these habits and behaviors are associated with dental caries and tooth loss. In this sense, a poor school performance and a poor oral health may coexist and may share common risk factors, but no causal relationship between them would be expected. Barbato and Peres (8) have also found a significant, though weaker, association between education gap and

tooth loss, with Brazilian adolescents presenting education gap being 14% more likely to present lost teeth.

In the present study, 21.6% of the examined schoolchildren had never visited a dentist. The prevalence of tooth loss (root tips) in this subgroup was similar to the one found among students accessing the Public Health System; however, they were 55% less likely to present missing teeth than did their counterparts accessing the Public Health System. The rationale for this lower risk among schoolchildren who had never visited a dentist may be that they were less affected by dental pain and were more able to control caries progression. This higher risk observed among schoolchildren using the Brazilian Public Health System may be related to the type of dental treatments offered in this service. When dental pain occurs and an endodontic treatment is required, the patient should be referred to the secondary care level. Statistics from the Brazilian Ministry of Health show that specialized dental services corresponded to no more than 3.5 percent of all dental procedures in 2004 (25). Due to this limited access to secondary care in the Public Health System, teeth with deep caries lesions needing endodontic treatment may be commonly indicated for extraction. Furthermore, we observed that students accessing dental services by insurances or in private clinics were at lower risk for tooth loss, which probably is related to the wider access to conservative treatment in this type of service. López and Baelum (4) have discussed that a similar situation appears to exist in Chile, where the dental public health-care system ensures everybody access to free emergency dental treatment including extractions while access to conservative restorative procedures is more difficult.

Traditionally, studies assessing the relationship between dental caries and tooth brushing categorize brushing frequency into < once a day, once a day or > than once a day (4, 26), thus suggesting that a frequency of 2, 3 or more exerts the same effect on caries experience. A recent National Health Survey of Schoolchildren showed that almost 75% of Brazilian students attending the 8^{th} grade reported a tooth brushing frequency of three times a day or more (27). Based on this common practice, we decided to discriminate schoolchildren who used to brush teeth 2 and 3 times a day, and increasing protection estimates against tooth loss was observed. Schoolchildren reporting a brushing frequency of twice a day were 21% less likely to present missing teeth, with this protection factor increasing to 49% in students reporting a brushing frequency of 3 times a day or more. These significant associations were found even after the adjustment for other factors, including gingival bleeding (that reflects the

mechanical effect of brushing on biofilm removal). Based on this multivariate analysis, adjusting the estimates for gingival bleeding, it is possible to speculate that the beneficial effect of brushing frequency on tooth loss is associated with fluoride exposure. A previous in situ study has also shown that a brushing frequency of 3 times/day with fluoridated dentifrice decreased mineral loss when compared with a frequency of 2 times/day (28).

In conclusion, this study showed a high prevalence of tooth loss among 12-year-old South Brazilian schoolchildren, considering the reduced period of time at risk and the low caries prevalence observed in this population. The risk indicators identified in the present study may be addressed in public strategies to control the occurrence of tooth loss in this and similar populations.

Acknowledgements

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Figure 1

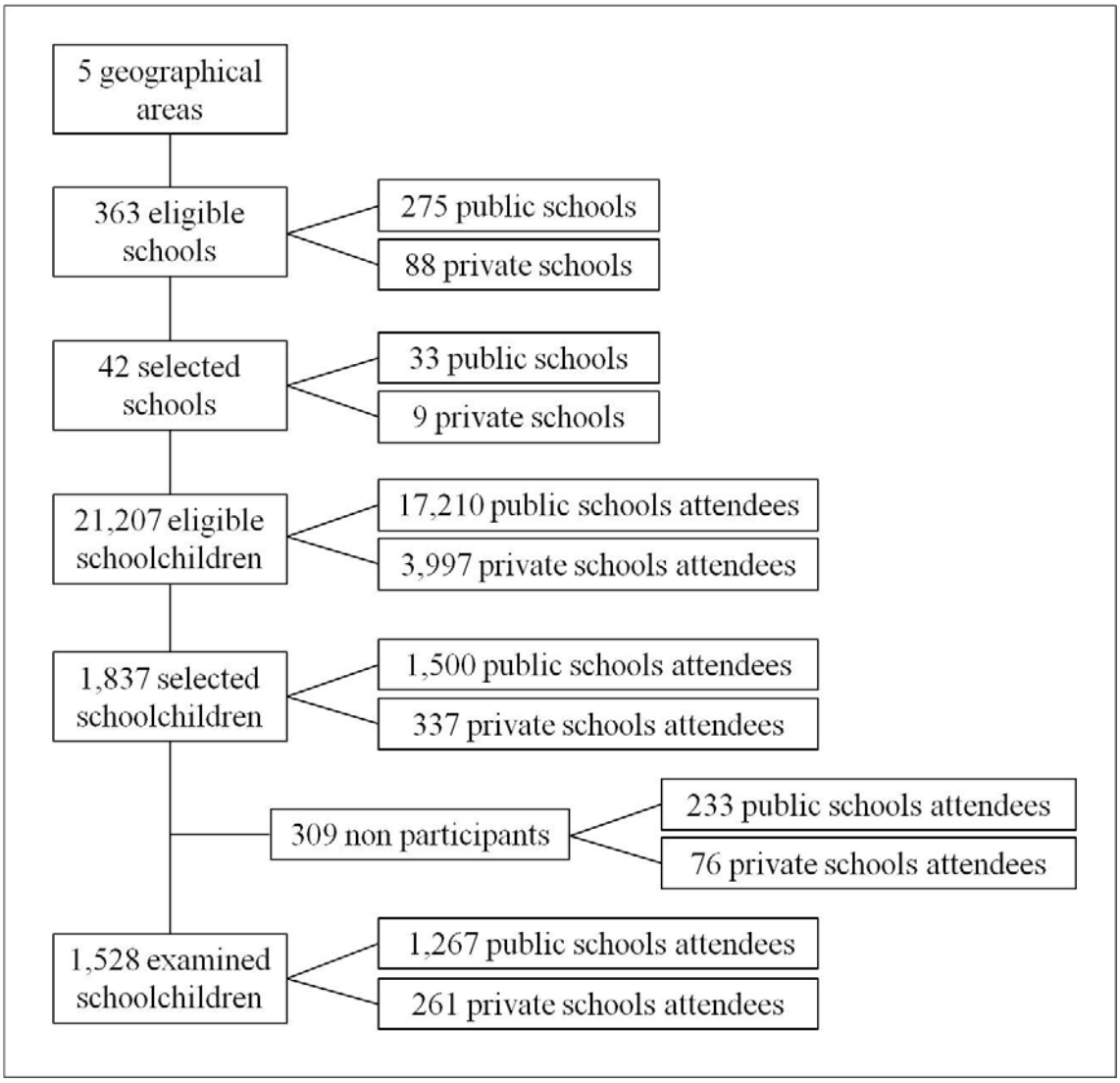

Figure 1. Sampling strategy and study sample.

Table 1

Table 1. Sample distribution and tooth loss prevalence by predictor variables. Mean (95% confidence interval).

	n (%)	Prevalence	
Gender			
Female	758 (49.7)	6.09	(2.97-9.21)[a]
Male	770 (50.3)	5.53	(3.17-7.89)[a]
Socioeconomic status			
High/Mid-high	499 (32.6)	3.07	(0.34-5.79)[a]
Mid-low	871 (57.0)	6.66	(4.47-8.85)[b]
Low	158 (10.4)	11.42	(9.20-13.64)[c]
Mother's level of education*			
≤8 years	789 (51.9)	8.94	(6.15-11.73)[a]
>8 years	732 (48.1)	2.91	(0.18-5.64)[b]
Father's level of education*			
≤8 years	788 (55.2)	7.90	(6.17-9.63)[a]
>8 years	639 (44.8)	2.71	(0.34-5.09)[b]
Crowding*			
Low	351 (23.0)	2.74	(–0.53-6.01)[a]
Medium	826 (54.1)	6.21	(3.65-8.77)[ab]
High	350 (22.9)	8.51	(5.59-11.43)[b]
School			
Private	261 (17.1)	1.80	(–1.66-5.26)[a]
Public	1,267 (82.9)	6.94	(4.42-9.45)[b]
School year			
Regular (5^{th}, 6^{th} or 7^{th})	1,219 (79.8)	4.77	(2.07-7.47)[a]
Late (4^{th} or earlier)	309 (20.2)	10.27	(6.26-14.28)[b]
Last dental visit			
≤ 1 year ago	844 (55.24)	5.59	(2.02-9.17)[a]
≥ 2 years ago	354 (23.17)	6.93	(3.17-10.69)[a]
Never visited a dentist	330 (21.6)	5.15	(1.53-.877)[a]
Type of dental services			
Public health system	487 (31.9)	9.58	(7.60-11.56)[a]
Insurance/Private	711 (46.5)	3.79	(0.92-6.66)[b]
Never visited a dentist	330 (21.6)	5.15	(1.53-.877)[ab]
Brushing frequency			
≤ 1 time/day	341 (22.3)	9.34	(6.49-12.19)[a]
2 times/day	677 (44.3)	5.85	(3.33-8.37)[b]
≥3 times/day	510 (33.4)	3.54	(0.82-6.27)[c]
Gingival bleeding			
≤ 45%	507 (33.3)	3.20	(0.46-5.95)[a]
45% to 60%	516 (33.8)	6.33	(3.56-9.10)[b]
> 60%	502 (32.9)	8.14	(5.83-10.44)[b]
Total	1,528 (100.0)	5.81	(3.24-8.37)

* Figures do not totalize 1,528 due to missing data.

Different letters indicate a statistically significant difference between categories using Wald test ($p<0.05$).

Table 2

Table 2. Association between tooth loss and predictor variables (unadjusted and adjusted Poisson regression analyses).

	Unadjusted			Adjusted		
	PR	95% CI	p	PR	95% CI	p
Gender						
Female	1.00					
Male	0.90	0.71-1.14	0.42			
Socioeconomic status						
High/Mid-high	1.00			1.00		
Mid-low	2.17	1.25-3.76	0.006	1.54	0.92-2.56	0.10
Low	3.71	2.12-6.50	<0.001	2.15	1.40-3.29	<0.001
Mother's level of education						
≤8 years	1.00					
>8 years	3.06	1.47-6.37	0.003			
Father's level of education						
≤8 years	1.00					
>8 years	2.90	1.75-4.80	<0.001			
Crowding						
Low	1.00					
Medium	2.26	0.98-5.19	0.05			
High	3.10	1.60-6.00	0.001			
School						
Private	1.00					
Public	3.85	0.98-15.08	0.05			
School year						
Regular (5^{th}, 6^{th} or 7^{th})	1.00			1.00		
Late (4^{th} or earlier)	2.15	1.26-3.66	0.005	1.56	1.15-2.10	0.003
Last dental visit						
≤ 1 year ago	1.00					
≥ 2 years ago	1.23	0.74-2.07	0.41			
Never visited a dentist	0.92	0.44-1.89	0.82			
Type of dental services						
Public health system	1.00			1.00		
Insurance/Private	0.39	0.26-0.59	<0.001	0.61	0.47-0.80	<0.001
Never visited a dentist	0.53	0.30-0.93	0.02	0.45	0.26-0.77	0.004
Brushing frequency						
≤ 1 time/day	1.00			1.00		
2 times/day	0.62	0.44-0.87	0.007	0.79	0.68-0.90	0.001
≥3 times/day	0.37	0.23-0.62	<0.001	0.51	0.37-0.70	<0.001
Gingival bleeding						
≤ 45%	1.00			1.00		
45% to 60%	1.97	1.12-3.46	0.01	1.64	0.98-2.76	0.06
> 60%	2.53	1.38-4.65	0.003	1.84	1.13-3.01	0.01

PR = Prevalence ratio; CI = Confidence interval.

ARTIGO III

Overweight and obesity are not associated with dental caries among 12-year-old South Brazilian schoolchildren

Overweight and obesity are not associated with dental caries among 12-year-old South Brazilian schoolchildren

Running head: Association between overweight/obesity and caries

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Abstract

Objectives: To assess the association between weight status and dental caries among 12-year-old Brazilian schoolchildren. *Methods*: This cross-sectional study was performed in Porto Alegre using a multistage probability sampling strategy to draw a representative sample of schoolchildren attending public and private schools. Data on demographics, socioeconomic status, oral hygiene habits, anthropometrics and dental caries were collected. Overweight and obesity were defined according to WHO categories for BMI (body mass index)-for-age Z-scores. Survey Poisson regression models were used to assess the association between weight status and dental caries. Estimates were adjusted for gender, socioeconomic status and brushing frequency. Prevalence ratios (PR), rate ratios (RR) and 95% confidence intervals (95% CI) were reported. *Results*: 1,528 out of 1,837 eligible schoolchildren were examined. Prevalence of overweight and obesity were 22.15% (95% CI = 20.59-23.72) and 13.61% (95% CI = 11.44-15.78), respectively. Caries experience was observed in 55.23% (95% CI = 45.26-65.19) of children. Schoolchildren presented, on average, 1.39 (95% CI = 1.07-1.71) decayed, missing or filled teeth. No significant differences in caries experience or extent were observed among BMI groups. After adjusting for important co-factors, weight status was not associated with caries prevalence (overweight: PR = 0.99, 95% CI = 0.89-1.10; obese: PR = 1.00, 95% CI = 0.87-1.16) or caries extent (overweight: RR = 0.91, 95% CI = 0.74-1.12; obese: RR = 0.86, 95% CI = 0.72 – 1.04). *Conclusions*: Our findings indicate that overweight and obese adolescents should not be regarded as at higher risk for dental caries in this population.

Introduction

Overweight/obesity, defined as abnormal or excessive fat accumulation, is a major risk factor for several chronic diseases including diabetes (1), cardiovascular diseases (2) and cancer (3). Once considered a problem limited to adults in high income countries, excessive body weight has risen significantly among children and young adults in developing countries (4). Recent data from Brazil showed a 5-fold increase in the prevalence of overweight and obesity among children and adolescents in the last 30 years. In 2008-2009, 31.2% of adolescents aged 12-13 years were considered overweight or obese (5). Behavioral (6) and dietary (7) changes are clearly associated with the global obesity epidemic observed in the last decades.

Oral diseases including caries, periodontitis, oral cancer and temporomandibular disorders are related to diet, oral hygiene, smoking, alcohol, diabetes and stress. As these risk factors are common to a number of other chronic diseases and conditions, adopting an approach aimed at key risk factors is more rational than a disease-specific strategy (8). Excessive sugar consumption is a well-known risk factor for adult obesity (9, 10) and dental caries (11), thus it is plausible to speculate that overweight/obese children are at higher risk of developing caries. In this regard, strategies aimed at promoting better eating habits could have a positive impact on both conditions.

Epidemiological studies investigating the relationship between dental caries and overweight/obesity in adolescents have found conflicting results. Two recent studies including French (12) and Brazilian (13) schoolchildren did not find an association between caries and obesity. In contrast, a cohort study conducted in Sweden (14) and a cross-sectional survey performed with Indian adolescents (15) observed a significant association with obese children presenting a greater caries experience than normal weight ones. Conversely, conflicting results were observed when data derived from the Third and Forth National Health and Nutrition Examination Surveys (NHANES III – 1988-1994; NHANES IV – 1999-2002) were analyzed (16). When analyzing data collected for the NHANES III, overweight was significantly associated with reduced rates of caries in individuals aged 12-18 years. In contrast, no association between caries and weight status was observed for the NHANES IV data. Inconclusive results were also observed in a systematic review including studies published between 1984 and 2004 (17).

Considering the inconsistent results observed in the literature and the need for further evidence derived from well-designed studies (17), the aim of this study was to

assess the association between weight status and dental caries among 12-year-old Brazilian schoolchildren.

Materials and Methods

This study used a cross-sectional design and was performed in Porto Alegre, southern Brazil, from September 2009 to December 2010. The target population was schoolchildren aged 12 years old who were attending public and private schools. The study protocol was approved by the Federal University of Rio Grande do Sul Research Ethics Committee (299/08) and by the Municipal Health Department of Porto Alegre Research Ethics Committee (process nº 001.049155.08.3/register nº 288). All participants and their parents/legal guardians provided written informed consent.

Sampling strategy and sample size calculation

A multistage probability sampling strategy was used. The primary sampling unit consisted of 5 geographical areas organized according to the municipal water fluoridation system. Within each area, the schools were randomly selected proportional to the number of private and public schools (42 schools: 33 public and 9 private). Schoolchildren born in 1997 or 1998 were then randomly selected proportional to school size.

A sample size of 1,331 was calculated to be necessary to estimate a caries prevalence of 60% (18) with a precision level of ±3% for the 95% confidence interval and to assume a design effect of 1.3. A non-response error of 40% was added, and a final sample size of 1,837 was estimated.

Data collection

Clinical examination was conducted at the schools, with the students in a supine position, using portable equipments (artificial light, air compressor and suction), clinical mirror and probe. The instruments were properly packed and sterilized. After tooth cleaning and drying, a single examiner recorded the number of decayed, missing or filled teeth (DMFT index) according to WHO criteria (cavity level) (19). The presence of incipient caries lesions (early stage of caries development before cavity formation) was also recorded(11). Calibration was performed before the beginning of the study and its maintenance was assessed during the survey by means of repeated examinations

conducted on 5% of the sample. The lowest Cohen's kappa value observed was 0.80 (unweighted).

Anthropometric data were gathered to allow the calculation of body mass index (BMI) (weight (kg) / height $(m)^2$). Participants were weighed using a 150kg digital scale, and two readings were made. A third assessment was taken if a difference >0.3 kg was observed between measurements. The mean of the two closest measurements was used to calculate BMI. Height was measured to the nearest full centimeter using inelastic metric tape attached to a flat wall with no footer. The measurements were taken by a single researcher (NDT) with the students wearing light clothing and no shoes.

A questionnaire directed to parents/legal guardians collected information on schoolchildren's oral hygiene habits and socioeconomic status (using the standard Brazilian economic classification, which takes into account the educational level of the head of the family and the purchase power of the family) (20).

Non-response analysis

Of the 337 and 1,500 schoolchildren who were selected from private and public schools, 76 and 233 did not participate, yielding response rates of 77.44% and 84.46%, respectively. Telephone contact was established with 176 parents/legal guardians of the non-respondents. Of those children, 26% reported no interest due to previous access to dental care, 27% of schoolchildren refused to participate, 24% did not return the informed consent or questionnaire, and 4% showed concern about biosecurity or refused to answer socioeconomic questions. Nineteen percent of students were not available at school during the normal survey schedule.

A random sample of non-respondents was selected and information for 80 schoolchildren was obtained. After comparing participants and non-respondents with regards to demographics, socioeconomic status and family related data, small discrepancies were observed. A weighted variable based on information provided by the Primary Education School Census of 2010 (23) was used in the statistical analysis to minimize potential non-response bias.

Data analysis

Caries prevalence was defined as the percentage of schoolchildren having at least one decayed, missing or filled tooth (DMFT=0 or DMFT≥1). Caries extent was defined as the number of decayed, missing and filled teeth (DMFT index).

BMI-for-age Z-scores were calculated using specific software (AnthroPlus, WHO, Geneva, Switzerland). BMI-for-age Z-score is a measure of the standard deviation (SD) away from standardized mean BMI. It is considered one of the most appropriate measures of weight in children and adolescents because it accounts for the wide, natural variation in growth. Using cutoffs recommended by WHO (21), the sample was categorized as follows: normal weight (BMI-for-age Z-score ≤ +1SD), overweight (BMI-for-age Z-score > +1SD to ≤ +2SD) and obese (BMI-for-age Z-score > +2SD). Weight status was considered the main predictor variable.

Socioeconomic status was categorized using cutoff points proposed by the standard Brazilian economic classification into low (≤13 points), mid-low (≥14 to ≤22 points), mid-high (≥23 to ≤28 points) and high (≥29 points) socioeconomic status. Parents answered a question on schoolchildren's brushing frequency, which was categorized into ≤ 1 time/day, 2 times/day or ≥3 times/day.

Data analysis was performed using STATA software (Stata 11.1 for Windows; Stata Corporation, College Station, TX, USA) taking into account the survey design. Given the discrepancy in some of the demographic and socioeconomic features among the study participants and subjects who did not participate, a weight variable was used in the statistical analysis to adjust for the potential bias in the population estimates (22). The sample weight was adjusted for the probability of selection and population distribution according to gender, school type and city area. Probability of selection was calculated by dividing the population size by the number of individuals sampled in each area. This procedure also permitted achieving the expansion weight. The distribution of the population (poststratification) was calculated using the Primary Education School Census (23). The sample and the population were divided into various subgroups according to gender, school type and city area. The final sample weight variable was calculated by multiplying the base weight with the poststratification adjustment.

Preliminary analysis was carried out using Wald tests adjusted for multiple comparisons. The association between the predictor variables and dental caries was assessed using a survey Poisson regression model. Unadjusted and adjusted prevalence ratios (caries prevalence), rate ratios (caries extent) and their respective 95% confidence

intervals were estimated and reported. Confounding and effect modifications were assessed. Socioeconomic status, gender and brushing frequency were used as controlling variables due to their possible association with dental caries. A secondary analysis designed to assess the impact of incipient caries on the association estimates was also conducted.

Results

A total of 1,528 schoolchildren were examined, yielding an overall response rate of 83.17%. Sample distribution, caries prevalence and extent by predictor variables are shown in Table 1. Caries prevalence was 55.23% (95% CI=45.26-65.19) and, on average, schoolchildren presented 1.39 (95% CI=1.07-1.71) decayed, missing or filled teeth. The overall prevalence of excessive body weight was 35.77% (95% CI=34.16-37.38), being 22.15% (95% CI=20.59-23.72) overweight and 13.61% (95% CI=11.44-15.78) obese individuals. No significant differences between genders were observed in caries experience. Children of higher socioeconomic status and brushing more often showed significantly lower prevalence and extent of DMFT. No significant differences in caries experience were found among categories of weight status.

The association among caries prevalence and extent, and predictor variables is shown in Tables 2 and 3. Caries prevalence was not significantly associated with overweight and obesity (Table 2). Similarly, weight status was not significantly associated with the number of teeth with caries experience (Table 3). A secondary analysis was conducted to assess the impact of incipient caries lesions on the estimates. Adding incipient caries lesions to the outcome variable did not reveal any significant association between weight status and dental caries (data not shown). Gender, socioeconomic status and tooth brushing frequency were significantly associated with caries prevalence and extent irrespective of adjustment for the other co-factors.

Discussion

The present study was carried out to assess the association between weight status and caries among South Brazilian schoolchildren. After adjusting for gender, socioeconomic status and tooth brushing frequency, no association was found between obesity and caries in this population. To our knowledge, this was the first study to assess the association between obesity and incipient and cavitated dental caries in permanent dentition using a large population-based sample of Brazilian schoolchildren.

Obesity is a major public health concern due to its global distribution and severe consequences. Excessive body weight is a complex metabolic condition with behavioral, environmental and genetic components. The association between obesity and caries has been investigated under the hypothesis that excessive sugar intake might cause both conditions. Whereas it is clear that dental caries is a sugar-dependent disease, the association between sugar intake and obesity is controversial in the literature. A large prospective study including over 120,000 adults followed-up to 20 years showed that sugar-sweetened beverages, sweets and desserts were significantly associated with weight gain after adjusting for important co-factors (9). This result corroborates the findings of a recent meta-analysis including 88 studies that indicated that soft drink consumption was significantly associated with body weight (10). However, the effect size of soft drink consumption on body weight was approximately 3.5 times larger for adults than children. A recent meta-analysis found a negligible association between sugar-sweetened beverages and BMI in children and adolescents with a high chance of publication bias favoring studies with positive results (24). Based on these findings, it seems reasonable to ascertain that whereas the association between sugar consumption and obesity has been demonstrated in adults, it is not well established in children and adolescents.

The present study found no association between weight status and tooth decay, which is in agreement with previous studies (12, 13, 16). Jamelli et al. (13) using a case-control design did not find an association between obesity and caries in a sample of schoolchildren from a public school in Northeast Brazil. Ecological analysis further corroborates these findings, showing that Brazilian regions with higher prevalence of overweight/obesity are least affected by dental caries. In 2008-2009, the prevalence of overweight/obesity among adolescents was approximately 30% in South Brazil and 20% in North Brazil (5) whereas the mean DFMT was 2 and 3.2 (25), respectively. Similarly, no significant association between caries and weight was observed among children and adolescents in the USA using data from the NHANES IV (16). A cross-sectional study conducted in France also failed to show any significant associations in 12-year-old children (12).

The lack of association between obesity and dental decay observed herein could be explained by the fact that the weight excess observed in this schoolchildren population might not be the result of a high consumption of cariogenic carbohydrates. This reasoning would be consistent with the studies showing weak or no association

between sugar intake and obesity in children and adolescents (24). The Southern Brazilian population presents typical dietary habits, with a high consumption of protein, especially meat, milk and eggs. Since these foods have a significant fat content, it can explain, at least in part, the high prevalence of obesity observed in this region. Furthermore, this population presents a more affluent socioeconomic condition when compared to other areas in Brazil (26), which might be related to better hygiene habits, higher access to fluoridated products and, consequently, low rates of caries (25).

Whereas the association between obesity and caries extent did not reach statistical significance (RR=0.86, 95% CI=0.72-1.04, p=0.12), the upper limit of the confidence interval for obese children was close to 1 indicating that a larger sample size could potentially reach statistical significance. Assuming that a larger study sample would provide enough power to show a significant association, the strength of the association would still be modest questioning its epidemiologically/clinically relevance. Additionally, an apparent inverse relationship could be observed in the adjusted model with RR point estimates decreasing from 0.91 (95% CI=0.74-1.12) for overweight to 0.86 (95% CI=0.72-1.04) for obese children. Although both estimates were not statistically significant, we conducted additional joint hypothesis (p=0.29) and linear trend tests (p=0.14) which confirmed that no significant differences could be observed. A recent publication reporting findings from two NHANES (1988-1994 and 1999-2002) (16) found an inverse association between overweight and caries for individuals aged 12-18 years using the NHANES 1988-1994 data (OR = 0.5, 95% CI =0.3-0.9). However, this association could not be substantiated when data from the NHANES 1999-2002 was analyzed (OR = 1.0, 95% CI = 0.8-1.4). Collectively, previous studies (12, 13) and our findings indicate that childhood obesity does not increase the likelihood of caries; further studies are needed to better explore if a negative association actually exists.

In contrast to our findings, two studies conducted in adolescents have shown a positive association between weight status and caries (14, 15). Using epidemiological data collected by local governmental agencies in Östergötland, Sweden, Gerdin et al. (14) assessed the association between BMI and caries in a cohort of 2,303 Swedish children. Obese children had significantly higher DFT than non-obese. After adjusting for gender and socioeconomic status, BMI at 4, 5, 7 and 10 years of age was significantly associated with DFT at age 12. However, the strength of the association was weak with regression coefficients ranging between 0.024 to 0.05 for the various

BMI estimates. The study conducted by Honne et al. (15) included 13- to 15-year-old Indian schoolchildren and showed that overweight/obese individuals had 3.7 times higher chance of having 5 or more teeth with caries experience than normal-weight children. The direct comparison of our study with these studies should be done with caution given differences in population characteristics, obesity and caries distribution.

It is well established that BMI can be affected by demographics and pubertal maturation among children and adolescents (27). Growth spurts occur throughout childhood and adolescence changing body fat accumulation and distribution. Moreover, pubertal timing, which usually happens earlier in girls than boys, has been associated with rapid changes in weight gain (27). We tried to limit the impact of age on our study by including only 12 years old schoolchildren instead of using the usual school year approach for sampling. The influence of gender on BMI was accounted for by using AnthroPlus, a growth assessment tool that takes gender differences into account. From a statistical point of view, limited differences were observed in the association between caries and BMI when the estimates were adjusted for gender. In addition to the multivariable analysis, we performed a stratified analysis for boys and girls and tested for gender-BMI statistical interactions with no indications that gender was affecting our estimates of association. Nevertheless, it is important to acknowledge that maturity might still have affected our results since it was not directly assessed and adjusted for in the analysis.

It has been suggested in the dental literature that studies including non-cavitated caries lesions are needed to confirm the non-significant association between weight status and caries experience (12). The DMFT index used in this and other studies does not assess the presence of incipient caries lesions, and this could underestimate caries experience and ultimately affect the results. In the present study, incipient caries lesions were assessed in addition to the traditional DMFT and its inclusion in a secondary analysis did not affect our results ruling out any diagnostic bias. Participation bias is a phenomenon that frequently affects estimates on epidemiological studies. The sampling strategy adopted herein included both private and public schools increasing external validity and yielded a high participation rate of 83.17%. Contrary to other studies, students were selected by age instead of school year, which improves sample representativeness regarding dental caries. In this population, schoolchildren attending 4th grade or earlier were more affected by caries than those students attending the regular school year for this age (unpublished data), and the selection of individuals by

grade could have influenced the results. Furthermore, discrepancies observed between the sample and target population were solved by the use of appropriate methodology. A limitation of this study is the lack of data on dietary habits since the pathway to explain a possible association between obesity and caries is based on sugar consumption.

In conclusion, the present study found no association between dental caries and weight status among South Brazilian schoolchildren. Our findings indicate that overweight and obese adolescents should not be regarded as at higher risk for dental caries in this population.

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Table 1

Table 1. Sample distribution, caries prevalence and extent by predictor variables.

		Caries prevalence		Caries extent	
	n (%)	Mean	95% CI	Mean	95% CI
Gender					
Female	758 (49.61)	57.98[a]	45.18 – 70.78	1.46[a]	1.11 – 1.81
Male	770 (50.39)	52.56[a]	44.93 – 60.18	1.32[a]	1.02 – 1.63
Socioeconomic status					
High	141 (9.23)	43.13[a]	30.22 – 56.03	0.88[a]	0.54 – 1.22
Mid-high	358 (23.43)	44.51[b]	39.70 – 49.33	1.09[a]	0.83 – 1.35
Mid-low	871 (57.00)	60.79[c]	51.70 – 69.88	1.56[b]	1.27 – 1.85
Low	158 (10.34)	65.92[c]	57.41 – 74.44	1.81[c]	1.67 – 1.95
Tooth brushing					
≤ 1 time/day	341 (22.31)	64.53[a]	55.74 – 73.33	1.69[a]	1.59 – 1.80
2 times/day	677 (44.31)	54.27[ab]	44.50 – 64.04	1.40[a]	1.05 – 1.76
≥3 times/day	510 (33.38)	50.69[b]	37.24 – 64.14	1.18[b]	0.78 – 1.59
Weight status					
Normal	986 (64.53)	55.86[a]	44.77 – 66.95	1.46[a]	1.11 – 1.81
Overweight	335 (21.92)	54.20[a]	41.33 – 67.07	1.30[a]	0.78 – 1.81
Obese	207 (13.55)	53.89[a]	44.36 – 63.41	1.19[a]	0.94 – 1.45
TOTAL	1,528 (100.00)	55.23	45.26 – 65.19	1.39	1.07 – 1.71

CI = confidence interval.

Different letters indicate a statistically significant difference between categories using Wald test ($p<0.05$).

Table 2

Table 2. Association between caries prevalence and predictor variables (unadjusted and adjusted Poisson regression analysis).

	Unadjusted			Adjusted		
	PR	95% CI	p	PR	95% CI	P
Gender						
Female	1.00			1.00		
Male	0.91	0.84 – 0.98	0.009	0.88	0.84 – 0.93	<0.001
Socioeconomic status						
High	1.00			1.00		
Mid-high	1.03	0.85 – 1.25	0.75	1.02	0.85 – 1.22	0.82
Mid-low	1.41	1.22 – 1.62	<0.001	1.37	1.21 – 1.54	<0.001
Low	1.53	1.26 – 1.85	<0.001	1.46	1.25 – 1.70	<0.001
Tooth brushing						
≤ 1 time/day	1.00			1.00		
2 times/day	0.84	0.72 – 0.98	0.025	0.90	0.79 – 1.02	0.10
≥3 times/day	0.78	0.65 – 0.94	0.01	0.83	0.72 – 0.97	0.01
Weight status						
Normal	1.00			1.00		
Overweight	0.97	0.87 – 1.08	0.59	0.99	0.89 – 1.10	0.88
Obese	0.96	0.82 – 1.14	0.66	1.00	0.87 – 1.16	0.91

PR = prevalence ratio; CI = confidence interval.

Table 3

Table 3. Association between caries extent and predictor variables (unadjusted and adjusted Poisson regression analysis).

	Unadjusted			Adjusted		
	RR	95% CI	p	RR	95% CI	P
Gender						
Female	1.00			1.00		
Male	0.91	0.85 – 0.97	0.006	0.88	0.81 – 0.95	0.002
Socioeconomic status						
High	1.00			1.00		
Mid-high	1.24	1.00 – 1.53	0.05	1.22	1.00 – 1.48	0.045
Mid-low	1.77	1.48 – 2.11	<0.001	1.68	1.42 – 1.99	<0.001
Low	2.05	1.64 – 2.56	<0.001	1.89	1.57 – 2.28	<0.001
Tooth brushing						
≤ 1 time/day	1.00			1.00		
2 times/day	0.83	0.70 – 0.98	0.03	0.91	0.79 – 1.04	0.20
≥3 times/day	0.70	0.56 – 0.87	0.001	0.76	0.64 – 0.90	0.02
Weight status						
Normal	1.00			1.00		
Overweight	0.89	0.71 - 1.11	0.30	0.91	0.74 – 1.12	0.38
Obese	0.82	0.66 - 1.00	0.05	0.86	0.72 – 1.04	0.12

RR = rate ratio; CI = confidence interval.

Association among quality of life, dental caries treatment and intraoral distribution in 12-year-old South Brazilian schoolchildren

Association among quality of life, dental caries treatment and intraoral distribution in 12-year-old South Brazilian schoolchildren

Running head: Dental caries and quality of life in schoolchildren

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Abstract

Objectives: To assess the association between dental caries treatment, intraoral distribution, and oral health-related quality of life (OHRQoL) of 12-year-old South Brazilian schoolchildren. *Methods:* This cross-sectional survey used a multistage probability sampling strategy to select a representative sample of schoolchildren from Porto Alegre, southern Brazil. Data was collected from September 2009 to December 2010, and 1,528 of 1,837 eligible schoolchildren attending public and private schools participated. Clinical examination was conducted to assess dental caries experience (DMFT). OHRQoL was assessed by a self-reported 16-item Child Perception Questionnaire (CPQ_{11-14}). Parents/legal guardians answered questions on socioeconomic status. Survey negative binomial regression models were used to assess the association between CPQ_{11-14} scores and caries treatment status (treated/untreated) and intraoral distribution (anterior/posterior). Estimates were controlled for gender and socioeconomic status. *Results:* Compared to schoolchildren without treatment needs, individuals with treated caries presented an improved OHRQoL (overall $CPQ_{11–14}$, adjusted RR=0.90, 95%CI=0.85-0.96; functional limitations, adjusted RR=0.86, 95%CI=0.75-0.99; emotional well-being, adjusted RR=0.89, 95%CI=0.80-0.99) whereas those with untreated caries presented a poorer OHRQoL (oral symptoms, adjusted RR=1.06, 95%CI=1.02-1.10; emotional wellbeing, adjusted RR=1.09, 95%CI=1.01-1.20). Individuals with caries in anterior teeth experienced greater negative impact on oral symptoms (adjusted RR=1.11, 95%CI=1.05-1.18) and social wellbeing (adjusted RR=1.30; 95%CI=1.14-1.47) domains than caries free students. *Conclusions:* Treated caries was positively associated with OHRQoL; untreated caries and caries affecting anterior teeth were negatively associated with OHRQoL of 12-year-old Brazilian schoolchildren.

Introduction

Oral health has been traditionally defined by the presence of oral diseases and disorders derived from clinical findings and dental indices. Recently, a shift towards the study of the negative effects of caries, periodontal disease and trauma on individuals' wellbeing has become mainstream in oral epidemiology and clinical oral research (1). Oral health-related quality of life (OHRQoL) is a multidimensional construct that refers to the extent to which an individual's daily living is disrupted by oral problems (2). The value of measures of OHRQoL in supplementing clinical data has been recognized in the last decade (3) and several instruments have been validated to different populations and languages.

A significant decrease in dental caries has been observed worldwide among children in the last 50 years (4, 5). In spite of these advances, caries prevalence remains high in children of several developing countries and among underprivileged children in developed countries. Advanced caries lesions may cause discomfort, pain, functional impairment and poor aesthetics with recent studies showing that dental caries may have a negative impact on OHRQoL of children and adolescents (6-11). However, data analysis of epidemiological studies investigating this association has been inconsistent with some studies combining caries treated and untreated individuals in the same category (6-8, 11), whereas others have combined caries free and caries treated individuals (9, 10). To the best of our knowledge, no study has assessed the impact of treated and untreated dental caries on OHRQoL.

The detrimental effect of dental caries on OHRQoL observed in recent epidemiological studies (6-11) is likely related to caries affecting molars – the most commonly affected teeth in children and adolescents. Studies have shown that malocclusion (12), trauma (13) and severe fluorosis (8) affecting anterior teeth may have a negative impact on schoolchildren's OHRQoL; however the specific impact of caries affecting anterior teeth on quality of life has not been explored in the dental literature. We hypothesized that individuals having caries in anterior teeth may present aesthetic impairment, which could be associated with difficulty in socializing.

The aim of this study was to assess the association between dental caries and OHRQoL of 12-year-old Brazilian schoolchildren in regards to treatment status (treated/untreated) and intraoral distribution (anterior/posterior).

Materials and Methods

Study design and sample

This cross-sectional survey was conducted in Porto Alegre, southern Brazil, from September 2009 to December 2010, and included schoolchildren aged 12 years old who were attending public and private schools.

A multistage probability sampling strategy was used. The primary sampling unit consisted of five geographical areas organized according to the municipal water fluoridation system. Within each area, the schools were randomly selected proportional to the number of existing public and private schools (42 schools: 33 public and 9 private). Schoolchildren born in 1997 or 1998 were then randomly selected proportional to school size.

Sample size was calculated to estimate the prevalence of dental caries in this population and used the following parameters: prevalence of 60% (14), precision level of ±3%, 95% confidence intervals, and a design effect of 1.3. Thus, a sample size of 1,331 was considered necessary, to which was added a non-response error of 40%, resulting in a sample of 1,837 individuals.

Data collection

Clinical examinations were conducted at the schools, with the students in a supine position, using portable equipments (artificial light, air compressor and suction). Sterile clinical mirror and periodontal probe were also used. Prior to caries examination, schoolchildren were submitted to professional tooth brushing and flossing. Cotton rolls were used to control moisture and dental caries experience was recorded by a single examiner (LSA) using the DMFT index (15) including caries activity assessment (16).

The self-reported 16-item Child Perception Questionnaire (CPQ_{11-14}) was used to measure schoolchildren's OHRQoL (17). The cross-culturally adapted version to the Brazilian Portuguese language was used (18). Children were asked how often, in the past 3 months, they had experienced oral problems classified into four domains: oral symptoms, functional limitations, emotional wellbeing and social wellbeing. Each item had 5 answer alternatives: "never"=0; "once/twice"=1; "sometimes"=2; "often"=3; and "every day/almost every day"=4. The overall and domain-specific $CPQ_{11–14}$ scores were computed by summing all item scores. The overall score can vary from 0 to 64 and each domain-specific score ranges from 0 to 16. Higher values denote a poorer OHRQoL.

Another questionnaire containing questions on demographic and socioeconomic characteristics was sent to parents/legal guardians to gather information on gender and socioeconomic status (using the standard Brazilian economic classification, which takes into account the educational level of the head of the family and the purchase power of the family) (19).

Reproducibility

Before the beginning of the study, the examiner performed training and calibration for the used indexes. During the survey, data collection was repeated on 5% of the sample to assess intra-examiner reproducibility. The minimal time interval between examinations was 2 days. Cohen's unweighted Kappa for DMFT was 0.8.

Test-retest reliability

The test-retest reliability of CPQ_{11-14} during the study was assessed by repeating the questionnaire after three days or more on 5% of the sample. The Intraclass Correlation Coefficient for CPQ_{11-14} scores was 0.7.

Data analyses

The primary outcome of the study was OHRQoL (overall and domain-specific CPQ_{11-14} scores).

To assess the association between dental caries treatment status and OHRQoL, the sample were categorized as follows: (1) no treatment needs - schoolchildren without treatment needs comprising caries free students and those with minor inactive cavities; (2) treated - schoolchildren with treated caries comprising students with missing and/or filled teeth but no cavities, recurrent decay or root tips; and (3) untreated - schoolchildren with untreated caries including students with at least one tooth with carious cavity, recurrent decay or root tip. To assess the association between caries intraoral distribution and OHRQoL, individuals were classified as follows: (1) caries free students (schoolchildren presenting only minor inactive cavities were included in this category); (2) schoolchildren with treated/untreated caries only in posterior teeth; and (3) schoolchildren with treated/untreated caries in at least one anterior tooth. Individuals without treatment needs and caries free students were used as the reference category in all analyses.

Data analysis was performed using STATA software (Stata 11.1 for Windows; Stata Corporation, College Station, TX, USA), taking into account the survey design. Given the discrepancy in some of the demographic and socioeconomic features among the study participants and subjects who did not participate, a weight variable was used in the statistical analysis to adjust for the potential bias in the population estimates (20). The sample weight was adjusted for the probability of selection and population distribution according to gender, school type and city area. Probability of selection was calculated by dividing the population size by the number of individuals sampled in each area. This procedure also permitted achieving the expansion weight. The distribution of the population (poststratification) was calculated using the Primary Education School Census (21). The sample and the population were divided into various subgroups according to gender, school type and city area. The final sample weight variable was calculated by multiplying the base weight with the poststratification adjustment.

Overall and domain-specific CPQ_{11-14} mean scores and 95% confidence intervals were reported. Wald tests adjusted for multiple comparisons were used to compare CPQ_{11-14} scores among caries categories. The distribution of the outcome variables was evaluated using histograms and by calculating the mean to variance ratio. Graphs were used to plot the observed proportions along with the poisson and negative binomial probabilities. Likelihood tests were used to compare poisson and negative binomial regression models. Since evidence of overdispersion was observed, the association between the predictor variables (treatment status and intraoral distribution) and the outcomes (overall and domain-specific CPQ_{11-14} scores) was assessed using survey negative binomial regression models and robust variance estimation. Unadjusted and adjusted rate ratios (RR) were estimated by exponentiation of the regression coefficient ($\beta = \log(\mu_{x+1} / \mu_x)$. Point estimates and 95% confidence intervals (95%CI) were calculated and reported. In the context of this study, the RR can be interpreted as the factor by which caries treatment and caries intraoral distribution changes the expected CPQ_{11-14}. Gender and socioeconomic status were used as controlling variables. Socioeconomic status used cutoff points proposed by the standard Brazilian economic classification, and households were categorized into low (≤13 points), mid-low (≥14 to ≤22 points), mid-high (≥23 to ≤28 points) and high (≥29 points) socioeconomic status, taking into consideration data distribution.

Ethical considerations

This study was approved by the Federal University of Rio Grande do Sul Research Ethics Committee (299/08) and by the Municipal Health Department of Porto Alegre Research Ethics Committee (001.049155.08.3/288). All participants and their parents/legal guardians provided written informed consent.

Results

A total of 1,528 schoolchildren were examined (17.08% private schools attendees and 82.92% public schools attendees), yielding a response rate of 83.17%. Table 1 summarizes the frequency distribution of sample by demographic, socioeconomic status and clinical characteristics.

Mean overall and domain-specific $CPQ_{11–14}$ scores according to treatment status and intraoral distribution are shown in Table 2. Statistically significant differences of $CPQ_{11–14}$ scores were observed among categories of treatment status in all domains except social wellbeing. Regarding intraoral distribution, $CPQ_{11–14}$ scores were significantly different among categories in oral symptoms, emotional and social wellbeing domains.

Association between $CPQ_{11–14}$ scores and treatment status is shown in Table 3. Compared to schoolchildren without treatment needs, individuals with treated caries presented an improved OHRQoL as indicated by a 10% decrease in the overall $CPQ_{11–14}$ mean scores (adjusted RR=0.90, 95%CI=0.85-0.96), a 14% decrease in the functional limitations mean scores (adjusted RR=0.86, 95%CI=0.75-0.99) and a 11% decrease in emotional well-being mean scores (adjusted RR=0.89, 95%CI=0.80-0.99) after adjusting for gender and socioeconomic status. In contrast, schoolchildren with untreated caries had poorer OHRQoL as indicated by a 6% increase in the oral symptoms mean scores (adjusted RR=1.06, 95%CI=1.00-1.10) and 9% increase in the emotional wellbeing mean scores (adjusted RR=1.09, 95%CI=1.01-1.20) after adjusting for other factors.

Caries intraoral distribution was significantly associated with $CPQ_{11–14}$ scores indicating that caries affecting anterior teeth was negatively associated with OHRQoL (Table 4). Individuals with caries in anterior teeth experienced a higher average $CPQ_{11–14}$ score than caries free students. This negative association was related to oral symptoms (adjusted RR=1.11, 95%CI=1.05-1.18) and social wellbeing (adjusted RR=1.30; 95%CI=1.14-1.47) domains.

Discussion

This study assessed the association among dental caries treatment, its intraoral distribution and OHRQoL in a representative sample of 12-year-old South Brazilian schoolchildren. Our main findings were that treated caries were positively associated with OHRQoL, whereas untreated caries and caries affecting anterior teeth were negatively associated with OHRQoL. This is the first study to assess the relationship between caries and OHRQoL in regards to treatment status (treated/untreated) and intraoral distribution (anterior/posterior).

The present study found a significant association between untreated caries and poorer OHRQoL. Schoolchildren with cavities and/or root tips experienced a higher average $CPQ_{11–14}$ score than students without treatment needs (oral symptoms and emotional wellbeing domains). This association is in agreement with previous studies using similar methodology and sample characteristics (9, 10). In a study conducted in South Brazil, Piovesan et al. (9) showed that the presence of a carious cavity was associated with a poorer quality of life. Nurelhuda et al. (10), using another questionnaire to measure OHRQoL (Child-Oral Impact on Daily Performance (OIDP)), found that schoolchildren presenting decayed teeth were twice as likely to report some oral impact on daily activities as those not presenting decayed teeth. The impact of untreated caries on OHRQoL found in our study is a plausible finding since cavitated caries may cause oral symptoms such as dental pain/discomfort, bad breath and food impaction. It may also cause emotional involvement with children feeling upset, irritable/frustrated or concerned with their teeth. Direct comparisons with other studies (6-8, 11) are unwarranted since these studies have not distinguished between treated and untreated caries lesions in their statistical analysis.

Our results showed that schoolchildren presenting treated caries showed an improved OHRQoL when compared to students without treatment needs, and that this positive impact was related to functional limitations and emotional well-being. Although this may seem like an unexpected finding, it is conceivable that children who have suffered functional impairment during eating and drinking or some emotional involvement due to dental caries may experience an improvement on their quality of life after receiving dental caries treatment. On the other hand, students who have never suffered negative oral experiences due to caries may have stable or unchanged perceived oral health. Comparison with previous cross-sectional studies is difficult since individuals with treated caries were combined with caries free individuals (9, 10) or

with individuals presenting untreated caries (6-8, 11), greatly limiting our ability to distinguish the effect of treating caries on OHRQoL. The impact of caries treatment on OHRQoL (Child-OIDP inventory) has been investigated in an interventional study with Tanzanian schoolchildren (22). Changes in the quality of life of this population were assessed after atraumatic restorations (ART), extractions and oral health education. Consistent with our results, a significant improvement on the quality of life was observed after 6-months of follow-up. Another study evaluated changes in parent-reported oral health-related quality of life of children with early childhood caries (23). The authors concluded that dental interventions had a significant positive impact on oral health and physical, mental, and social functioning. Collectively, these results seem to indicate that caries treatment is positively associated with quality of life.

Children's concern about their aesthetic appearance becomes significant when they approach adolescence (24) and the present results may provide some additional indirect evidence of this phenomenon. When compared to caries free individuals, students with caries in anterior teeth presented an average CPQ_{11-14} score 30% higher in social wellbeing domain indicating self-image dissatisfaction. As expected, students with caries only in posterior teeth did not suffer a negative impact on this domain. Among the 39 schoolchildren with caries in anterior teeth, 8 had treated caries and 31 had untreated caries. Thus, due to sample size constraints, we could not compare schoolchildren with treated and untreated anterior caries to assess if dental caries treatment would reduce the negative impact of anterior caries on OHRQoL. Irrespective of treatment status, schoolchildren with anterior caries avoided smiling, were more frequently questioned about their mouth or teeth, and were teased by other children more often than caries free individuals. We have also found an association between caries in anterior teeth and oral symptoms. Since students presenting caries in anterior teeth were those with the highest burden of disease in this population, it is conceivable that posterior teeth affected by caries could explain, at least in part, this association between anterior caries and oral symptoms.

Unlike other studies that included only public school attendees (6, 9, 11), the present survey included schoolchildren from private and public schools. Only minor discrepancies between the sample and the target population were observed and appropriate methodology was used to minimize any participation bias. In contrast to other studies that selected participants according to school year (6, 7, 11), in our study schoolchildren were selected by age irrespective of school year. Caries prevalence in

this population of 12 year-old Brazilian schoolchildren was higher among those attending 4th grade or earlier than among students attending the regular school year for this age (unpublished data), and the selection of individuals by grade could have influenced the results. Previous studies have shown that socio-demographic characteristics (9, 25) may influence self-perception and OHRQoL. In order to reduce confounding, estimates of association were calculated using multivariable analysis adjusting for gender and socioeconomic status.

In conclusion, the present findings showed that schoolchildren with treated caries presented an improved OHRQoL related to functional limitations and emotional well-being. In contrast, untreated caries was negatively associated with OHRQoL related to oral symptoms and emotional wellbeing; and caries affecting anterior teeth was negatively associated with OHRQoL in regards to oral symptoms and social wellbeing. Collectively, these findings highlight the need for better management of caries at the individual and population levels, especially when considering the high prevalence of untreated caries in this (26) and similar populations.

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Table 1

Table 1. Sample distribution according to socio-demographic and clinical characteristics.

Variable	n	%
Gender		
Male	770	50.39
Female	758	49.61
Socioeconomic status		
High	141	9.23
Mid-high	358	23.43
Mid-low	871	57.00
Low	158	10.34
Caries treatment status		
No treatment needs	938	61.39
Treated	168	10.99
Untreated	422	27.62
Caries intraoral distribution		
Caries-free[†]	938	61.39
Only posterior teeth	551	36.06
Anterior teeth	39	2.55
Total	1,528	100.00

[†]This category combines caries free students and those presenting only minor inactive cavities.

Table 2

Table 2. Overall and domain-specific mean $CPQ_{11–14}$ scores according to treatment status and intraoral distribution.

	CPQ_{11-14} Mean (95% CI)	OS Mean (95% CI)	FL Mean (95% CI)	EWB Mean (95% CI)	SWB Mean (95% CI)
Treatment status					
No treatment needs	12.30[a] (10.88-13.72)	4.13[ab] (3.68-4.57)	3.03[ab] (2.60-3.45)	2.81[a] (2.42-3.20)	2.32[a] (1.95-2.69)
Treated	11.11[b] (09.56-12.67)	3.93[b] (3.27-4.59)	2.61[a] (2.30-2.92)	2.57[ab] (2.01-3.14)	1.98[a] (1.46-2.50)
Untreated	13.40[c] (12.21-14.59)	4.42[c] (4.17-4.66)	3.19[b] (2.70-3.68)	3.18[b] (2.64-3.72)	2.59[a] (2.18-3.01)
Intraoral distribution					
Caries-free[†]	12.30[a] (10.88-13.72)	4.13[a] (3.68-4.57)	3.03[a] (2.60-3.45)	2.81[a] (2.42-3.20)	2.32[a] (1.95-2.69)
Only posterior teeth	12.62[a] (11.63-13.62)	4.25[ab] (3.88-4.61)	2.99[a] (2.68-3.30)	3.01[b] (2.61-3.41)	2.36[ab] (2.08-2.64)
Anterior teeth	14.25[a] (10.71-17.78)	4.69[b] (4.15-5.23)	3.41[a] (1.69-5.12)	2.91[ab] (1.46-4.36)	3.19[c] (2.59-3.79)
Total	12.46 (11.21-13.72)	4.18 (3.78-4.59)	3.03 (2.71-3.35)	2.88 (2.48-3.29)	2.35 (2.03-2.67)

CPQ_{11-14} = overall scores of Child Perception Questionnaire; OS = oral symptoms; FL = functional limitation; EWB = emotional wellbeing; SWB = social wellbeing; 95% CI = 95% Confidence interval.

Different letters indicate a statistically significant difference between categories (Wald test).

[†]This category combines caries free students and those presenting only minor inactive cavities.

Table 3

Table 3. Association between $CPQ_{11–14}$ scores and treatment status (unadjusted and adjusted negative binomial regression analyses).

		Unadjusted			Adjusted*		
		RR	95% CI	p	RR	95% CI	p
Overall CPQ_{11-14}	No treatment needs	1.00			1.00		
	Treated	0.90	0.84-0.97	0.006	0.90	0.85-0.96	0.002
	Untreated	1.09	1.03-1.15	0.005	1.06	1.00-1.13	0.07
Oral symptoms	No treatment needs	1.00			1.00		
	Treated	0.95	0.90-1.01	0.11	0.95	0.90-1.01	0.10
	Untreated	1.07	1.03-1.12	0.001	1.06	1.02-1.10	0.005
Functional limitations	No treatment needs	1.00			1.00		
	Treated	0.86	0.75-0.99	0.04	0.86	0.75-0.99	0.04
	Untreated	1.05	0.94-1.19	0.39	1.03	0.92-1.16	0.59
Emotional wellbeing	No treatment needs	1.00			1.00		
	Treated	0.92	0.80-1.05	0.20	0.89	0.80-0.99	0.04
	Untreated	1.13	1.05-1.22	0.001	1.09	1.01-1.20	0.04
Social wellbeing	No treatment needs	1.00			1.00		
	Treated	0.85	0.69-1.05	0.13	0.87	0.72-1.05	0.15
	Untreated	1.12	1.01-1.24	0.04	1.06	0.94-1.20	0.34

CPQ_{11-14} = overall scores of Child Perception Questionnaire; RR = Rate Ratio, 95% CI = 95% Confidence Interval.
*Estimates are adjusted for gender and socioeconomic status.

Table 4

Table 4. Association between $CPQ_{11–14}$ scores and caries intraoral distribution (unadjusted and adjusted negative binomial regression analyses).

		Unadjusted			Adjusted*		
		RR	95% CI	p	RR	95% CI	p
Overall CPQ_{11-14}	Caries-free†	1.00			1.00		
	Only posterior teeth	1.03	0.97-1.08	0.30	1.01	0.96-1.06	0.80
	Anterior teeth	1.16	1.02-1.31	0.02	1.11	0.99-1.24	0.07
Oral symptoms	Caries-free†	1.00			1.00		
	Only posterior teeth	1.03	1.00-1.06	0.04	1.02	0.99-1.05	0.14
	Anterior teeth	1.14	1.07-1.21	<0.001	1.11	1.05-1.18	<0.001
Functional limitations	Caries-free†	1.00			1.00		
	Only posterior teeth	0.99	0.88-1.12	0.86	0.97	0.86-1.10	0.67
	Anterior teeth	1.13	0.85-1.50	0.41	1.09	0.83-1.42	0.56
Emotional wellbeing	Caries-free†	1.00			1.00		
	Only posterior teeth	1.07	1.03-1.11	0.001	1.04	0.98-1.11	0.22
	Anterior teeth	1.03	0.76-1.40	0.83	0.98	0.72-1.32	0.87
Social wellbeing	Caries-free†	1.00			1.00		
	Only posterior teeth	1.02	0.94-1.10	0.68	0.98	0.91-1.07	0.70
	Anterior teeth	1.37	1.24-1.53	<0.001	1.30	1.14-1.47	<0.001

CPQ_{11-14} = overall scores of Child Perception Questionnaire; RR = Rate Ratio; 95% CI = 95% Confidence Interval.
*Estimates are adjusted for gender and socioeconomic status.
†This category combines caries free students and those presenting only minor inactive cavities.