

# Impact of oral health conditions on school performance and lost school days by children and adolescents: what are the actual pieces of evidence?

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## Abstract

**Aim:** To investigate evidence of associations between oral health status of children and adolescents and their school performance and lost school days due to dental problems. **Methods:** PubMed electronic database was searched for scientific papers published between 1990 and 2013. Twenty-one papers that attempted to investigate the impact of oral health on school performance and lost school days were retrieved. Brief descriptions of each study's methodology and outcomes were presented and discussed. **Results:** Although the papers reported statistically significant associations between school performance or lost school days and oral health conditions of schoolchildren, all of them were cross-sectional and ecological studies with an observational design, which may not provide full information about causes and effects. In addition, the lack of standardized criteria did not allow comparisons among the studies retrieved in the search. **Conclusions:** Oral diseases appear to impact on lost school days and school performance of children and policy-makers should address this issue when planning health promotion interventions in school settings. However, standardized materials and methodologies as well as longitudinal studies using valid and reliable criteria are needed to confirm the causes or risks of oral health factors in school performance, generating hypotheses for future research and providing important data for determining effective actions in school health programs.

**Keywords:** school performance, absenteeism, oral health.

## Introduction

In 1948, the World Health Organization defined health as being “*a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity*”<sup>1</sup>. Oral health is considered an integral element of general health and well being because it enables individuals to eat, communicate and socialize with others<sup>2</sup>. Moreover, oral health is considered a mirror of general health and the mouth is a portal for infectious organisms to enter the whole organism<sup>2</sup>. Therefore, according to Sheiham<sup>3</sup> “*the compartmentalization involved in viewing the mouth separately from the rest of the body must cease because oral health affects general health*”.

In spite of a range of oral diseases affecting the world's population, dental caries continues to be the most prevalent oral disease in children and adolescents worldwide, leading to pain, poor nutrition and time out of school, interfering in their quality of life<sup>4-6</sup>. Several studies have investigated the effect of chronic diseases<sup>7</sup>, such as asthma<sup>8</sup>, allergic rhinitis<sup>9</sup>, inflammatory demyelination of the central nervous system<sup>10</sup> and diabetes<sup>11</sup> on school performance.

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In relation to oral health, Gift, et al.<sup>12</sup> (1992) showed that in 1989, over 51 million school hours were missed annually by North-American school-aged children as result of visits to dentists or oral problems. Moreover, according to the US General Accounting Offices<sup>13</sup> children with poor oral health are 12 times more likely to have restricted-activity days than those children without oral disease.

Although studies evaluating the impact of oral health conditions on school performance and lost school days are of growing concern to educational and health researchers, there remains an astounding lack of strict scientific inquiry that reviews the studies developed on this topic in order to ascertain the validity of the conclusions.

Considering the importance of this issue in planning health promotion activities in schools, the objectives of this study were to investigate the pieces of evidence and discuss the methods and results of studies that assessed the existence of associations between oral health status of children and adolescents, their school performance and lost school days due to dental problems. This evaluation aimed at providing researchers and decision makers with a more solid background needed to enlighten recommendations and interventions in the school settings.

## Material and methods

The questions addresses by this review were “What evidence is there of an association between oral health and school performance?” and “What are the materials and methods used for studies about oral health and school performance?”

For this purpose, an extensive literature search was carried out using Medline, ISI, Lilacs and Scielo databases.

The intent was to review all full-text papers published in biomedical journals between 1990 and 2013. The search strategy included the key words “*school performance*”, “*oral health*” and “*absenteeism*”.

The studies were screened according to the inclusion criteria: (1) research papers, (2) publications related to oral health, school performance and/or lost school days due to dental problems, (3) English-language papers. Studies conducted and published in other languages were excluded.

Two reviewers selected and reviewed the papers. First, each reviewer independently selected the papers after reading their abstracts and checking their contents. To validate the selection procedure, the reviewers examined the potentially relevant arguments against the inclusion criteria and all discrepancies were discussed until agreement was reached.

## Results

The initial search retrieved 512 studies. One paper was excluded because it was duplicated. The titles and abstracts of the remaining 511 papers were reviewed for a more detailed evaluation. After review and discussion in situations of disagreement, only 17 papers met the inclusion criteria. The reasons for exclusion of the other papers are shown in Figure 1.

In a second round, a secondary search was conducted by investigating the reference list of the gathered literature and four more papers were included in the review due to the importance of the studies and strong relationship with the aim of this review<sup>5,14-16</sup>. Table 1 shows the results of the studies. All papers included in this review were classified as having an observational clinical study design (cross-sectional studies and ecological studies).

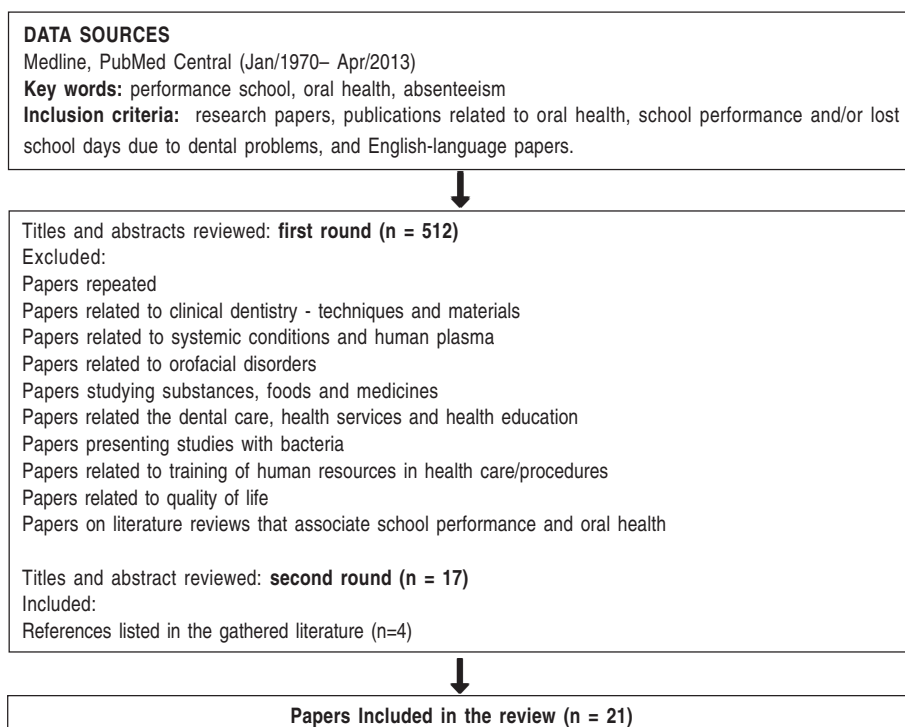


Fig. 1. Diagram of literature search.

Table 1. Results of references appraised

References	Sample	Type of study / Source of data	Objectives	Evaluation tools used for oral health data collection	Evaluation tools used for collection of data about school performance and/or days of school lost	Results
Gift et al./1992/ USA	109603 persons (aged 2 years and older)	Ecological / Interview by telephone	Social consequences (time of work, days in school, reduction of activities) oral health maintenance and treatment of oral problems	National health Interview survey/ oral health supplement	School time lost due oral health problem or dental visit, over the past two weeks	At national level, more than 51 million hours of school lost annually by school-age children due to visits to the dentist or oral problems. These lost hours tend to increase with the children's age, more frequent among girls and persons of less favored socioeconomic and Hispanic background
Petridou et al./1996/ Greece	380 adolescents (12 to 17 years)	Cross-sectional / Questionnaire applied at school	Relative importance of urban and rural lifestyle, and of socioeconomic status among urban residents on the prevalence of caries	DMFT and DMFTS were evaluated, in accordance with WHO criteria, in school environment. Personal interviews were conducted with regard to socioeconomic factors, diet and hygienic habits	One grade, in an ascending 10-grade scale, continuously. It was used as an indicator of multifaceted personal motivation and family supervision	Better school performance is more specifically associated with better dental health. Tooth filling is not significantly related to residence or school performance
Milgrom et al./1998/USA	828 children from 5 to 11 years and their mothers	Cross-sectional / Interviews in the residence	To evaluate the factors associated with the use of the national dental service in children from low income families	The mother completed the questionnaires, and the child was interviewed in the home. Then the mother was interviewed monthly for 6 months about use of dental and medical. Child oral health status was measured by examination performed in the school screening program (0 = no caries, 1 = possible caries, 2 = frank caries, 3 = emergency)	School time lost due oral health problems or dental visit	Poor oral health can increase school absence, further exacerbating school performance problems. Children with these problems have more difficulty at school
Astrom & Okullo/2003/ Uganda	1146 adolescents (13 to 19 years)	Cross-sectional / Questionnaire applied at school	To analyze the interrelationship among ODP scores, sociodemographic characteristics and oral health status	The students completed the questionnaires about sociodemographic characteristics, behaviors, self-assessed oral health and social and psychological factors related to intake of sugared snacks and drinks. A total of 372 students, mean age 16.3 (SD 1.7), completed a short version of the original questionnaire and were examined for dental caries following the WHO diagnostic criteria	Oral Impacts on Daily Performance (OIDP) scale	44% and 30% schoolchildren confirmed difficulties with eating and showing their teeth, respectively. The second more prevalent impact was on difficulties with cleaning their teeth (35%), followed by difficulties with speaking and accomplishing school tasks (34%)
Egri & Gunai /2004/ developing countries	Children from 12 years and older in 44 countries	Ecological / Analysis of epidemiological data	To investigate the association between some educational indicators and dental caries experience	Caries levels amongst 12-year-olds children were obtained from WHO's global oral epidemiology data bank.	Educational factors obtained from Human Development Report.	The increasing percentage of children completing primary level education was associated with a decrease in dental caries.
Gherunpong et al. /2004/ Thailand	1126 children (11 to 12 years)	Cross-sectional / Questionnaire applied at school	To assess the prevalence, characteristics and severity of oral impacts in primary school children	Self-administered questionnaire to obtain demographic information, such as age, sex and occupation of the father and mother, or male and female guardians and oral health behaviors and an oral examination by four calibrated community dentists, mainly based on the WHO guidelines. Orthodontic normative treatment needs were assessed by the Index of Orthodontic Treatment Need (IOTN). Oral hygiene was also assessed using the Simplified-Oral Hygiene Index (OHI-S)	Child Oral Impacts on Daily Performance scale (CHILD-OIDP)	There was very high prevalence of oral impacts on daily performances in this child population. Oral impacts affected children's quality of life mainly as a result of difficulty with eating and smiling, as well as in studying and maintaining social contacts

Table 1. Results of references appraised (cont.)

References	Sample	Type of study / Source of data	Objectives	Evaluation tools used for oral health data collection	Evaluation tools used for collection of data about school performance and/or days of school lost	Results
Muirhead & Marcenes / 2004/UK	1968 children (aged 5 years and older)	Ecologic: government data	To investigate measures of school performance and socioeconomic circumstances could be used as indicators of caries experience	Caries data were obtained from the BASCD Oral Health Survey of 5-year-old children. Material deprivation was measured using the Jarman underprivileged area score (Jarman score) for the school addresses and the percentage of children in each school who received free school meals	School performance data included the results of baseline English, mathematics and literacy tests [more formally known as the Linguistic Awareness of Reading Readiness test of emergent literacy test (LARR)]. School-aggregated baseline scores were obtained from the Local Education Authority, Research and Evaluation Unit	The low school performance (in English and mathematics), free meals provided at school, schoolchildren's addresses were good indicators for need in 5-year-old children.
Jiang et al. / 2005/ China	2662 students (aged 11, 13 and 15 years)	Cross-sectional / Questionnaire applied at school	To assess the associations of oral health variables with socio-economic status and school performance	The structured questionnaire used for data collection was designed by the World Health Organization Global Oral Health Program, Geneva, Switzerland: (1) self-assessment of general health status, (2) self-assessment of oral health status and quality of life, (3) self-reported oral health behavior and lifestyle, (4) oral health knowledge and attitudes, (5) school performance, (6) students' spare time activities, and (7) family status and lifestyle of parents	The structured questionnaire designed by the World Health Organization Global Oral Health Program, Geneva, Switzerland and included performance school (low, moderate, high) among the variables	Oral health and treatment need are associated with gender, age, unhealthy lifestyle, poor school performance and socioeconomic condition
Faitosa et al. / 2005/ Brazil	861 children from 4 years and older and their parents	Cross-sectional / Questionnaire applied at school	To analyze the psychosocial effects of severe caries	The children's oral health was evaluated on the basis of a clinical examination, at the child's school in accordance with the criteria established by the Brazilian Ministry of Health. Validated interview for parents- self-administered questionnaires and <i>Autoquestionnaire Qualité de Vie Enfant Image (AUQEI)</i> for children	School time lost due oral health problems or dental visit	Children with severe caries complained of toothache, had problems with eating certain foods, were absent from school, were ashamed to smile, and stopped playing with other children because of their teeth. Thus severe caries was found to have a negative impact on children's oral health-related quality of life
David et al. / 2006/ India	838 schoolchildren from 12 years and older	Cross-sectional / Questionnaire applied at school	Assess the prevalence and correlates of self-reported state of teeth	Questionnaire and clinical examination. Oral Hygiene Index - Simplified (OHI-S) was used to evaluate the oral hygiene status. Number of fractured anterior teeth was recorded. The criteria established by WHO were used to record dental caries	School performance was assessed by one question: "In your opinion, what does your class teacher think about your school performance compared to that of your classmates?" The variable was categorized as (0) good school performance and (1) poor school performance	23% of the scholars said that the state of their teeth was bad, fact associated with the report of poor school performance, bad breath, difficulty with eating, visits to the dentist, dissatisfaction with the appearance of their teeth and caries experience. Information about oral health can help in the planning of preventive programs with limited resources
Muirhead & Locker / 2006/ Canada	59266 schoolchildren from 8 to 11 years	Ecological / Government sites	Assessed the feasibility and predictive ability of readily available educational indicators as proxy measures of school dental treatment needs	York Region Public Health Unit provided school dental screening data. The percentage of children in each school requiring urgent treatment, such as untreated severe traumatic dental injuries, large visible cavities, acute gingival swelling, infection or reported pain was the outcome measure of interest. Socioeconomic and additional educational data sources were extracted from school address postcodes.	School performance data were obtained from the Ontario's education assessment organization: the Education Quality and Accountability Office (EQAO)	School performance was a significant predictor of children in need of dental treatment, especially of urgency. There is a need for future studies to determine the usefulness of educational indicators in planning oral health programs.



Table 1. Results of references appraised (cont.)

References	Sample	Type of study / Source of data	Objectives	Evaluation tools used for oral health data collection	Evaluation tools used for collection of data about school performance and/or days of school lost	Results
Bernabé et al./2007/Peru	903 children 11 to 12 years	Cross-sectional / Questionnaire applied at school	Determine the prevalence, intensity and extent of Oral Impacts on Daily Performance associated with self-perceived malocclusion	Child version of the Oral Impact of Daily Performances (Child-OIDP).	Child version of the Oral Impact of Daily Performances (Child-OIDP).	Impacts of self-perceived malocclusion primarily affected psychosocial activities such as smiling, emotion and social contact, which were the most frequently and severely impacted. These findings provide further evidence to support the importance of psychological and social components of oral health in children's lives.
Bernabé et al./2007/Peru	805 children from 11 to 12 years	Cross-sectional / Questionnaire applied at school	Determine the prevalence, intensity, and extent of the impacts caused by oral problems, and to compare their intensity and extent according to the type of oral problem.	Child version of the Oral Impact of Daily Performances (Child-OIDP).	Child version of the Oral Impact of Daily Performances (Child-OIDP).	Intensity of the impacts on each performance was assessed, smiling and studying were the most severely impacted everyday activities; (18.8% and 17.0% of the children with impacts reported severe to very severe intensity, respectively).
Petersen et al./2008/China	2662 adolescents aged 11, 13 and 15 years	Cross-sectional / Questionnaire applied at school	Measure the association of general and oral health-related behaviors with living conditions and explore the interrelationships between general and oral health-related behaviors.	The structured questionnaire used for collection of data was designed by the World Health Organization Global Oral Health Program, Geneva, Switzerland – (1) self-assessment of general health status, (2) self-assessment of oral health status and quality of life, (3) self-reported oral health behavior and lifestyles, (4) oral health knowledge and attitudes, (5) school performance, (6) students' spare time activities, and (7) family status and lifestyle of parents.	The structured questionnaire designed by the World Health Organization Global Oral Health Program, Geneva, Switzerland and included performance school (low, moderate, high) among the variables.	The students with low performance at school said they visited the dentist less frequently; consumed large quantities of sugary foods/ drinks, and used tobacco and alcohol, in addition to watching more television and playing on the computer. The relationship between oral health and performance at school emphasizes the need for oral health promotion programs in schools.
Blumenshine et al./2008/USA	3973 school-children's parents from 2 to 19 years	Ecological / Interview by telephone	To examine the sociodemographic and health factors associated with poor school performance and the impact of poor oral health status on school performance, with control of other health and sociodemographic factors.	Data set emanated from the Child Health Assessment and Monitoring Program survey (CHAMP). When a household (parent) was identified by random sampling, he/she was asked if they had children. Those identified as having children were asked to participate in CHAMP and if they agreed, they were called back in 2 weeks to complete the 10- to 15-minute phone CHAMP interview. Child oral health status was reported by the parent.	School performance was derived Impact of Oral Health on School Performance from a question asking the parent "during the past 12 months, how would you describe your child's performance in school" (excellent, above average, average, below average, or poor). School time lost due oral health problems.	A healthy child can be expected to perform better at school and add weight to the adage that "you can't be healthy without good oral health".
Freire et al./2008/Brazil	761 adolescents from 15 years and older	Cross-sectional / Questionnaire applied at school	Relationship between psychosocial factors and oral health test the hypothesis that taller adolescents have lower levels of caries experience.	Data were collected at the schools through self-administered questionnaires and clinical examinations for oral health and anthropometric measures. Questions on the adolescents' oral health-related variables were answered at the schools. Another questionnaire including questions about families' socioeconomic status was handed out to the adolescents to be answered by their mothers at home.	Failure at school examination was used as an indicator of adolescent's school performance. Information was obtained through the question "Have you ever failed an examination at school?", and categories were: no and yes (failed once or more than once).	The hypothesis that taller adolescents have lower levels of caries experience was confirmed in the sample of the present study. Social class and performance at school can be causal factors, and the individual's height is related to both factors.

Table 1. Results of references appraised (cont.)

References	Sample	Type of study / Source of data	Objectives	Evaluation tools used for oral health data collection	Evaluation tools used for collection of data about school performance and/or days of school lost	Results
Pau et al. /2008/ Pakistan	500 students aged 12 years old	Cross-sectional / Questionnaire applied at school	To explore the effect of pain characteristics, associated symptoms, and impact on daily living, with regard to seeking professional care	The adolescents were asked if they went to see a dentist because of their pain, and if they had experienced dental pain in the past month. The data-collection instrument consisted of sections on socio-economic and demographic variables; dental pain screening questionnaire (DePaQ), and Child version of the oral impact on daily performances questionnaire (Child-OIDP).	Child version of the Oral Impact of Daily Performances (Child-OIDP).	The statistically significant results showed that students who reported difficulties with playing, relaxing or sleeping, going to school and speaking or pronouncing clearly, were more likely to visit a dentist because of their pain.
Jürgensen & Petersen/ 2009/Laos	621 school-children from 11 to 13 years	Cross-sectional / Questionnaire applied at school	To study the impact of poor oral health on quality of life; analyze the association between oral health and socio-behavioral factors.	Clinical registration of caries and periodontal status, and scores for dental trauma according to the WHO criteria; structured questionnaire; measurement of anthropometric data.	Absenteeism from school due oral health problem or dental visit.	Absence from school was associated with high caries indexes. Authors suggest the Promotion of Oral Health within the school, to establish changes of habits; and health education to maintain low CPD and reduce interference in the quality of life.
Butani et al. /2009/ California	416 parents of children from 6 to 10 years	Cross-sectional / Questionnaire applied at school	To compare parental perceptions of their children's oral health status and determinants of dental service use	The need factors included were parental perceptions of their children's overall and oral health status, missed school, and workdays.	School time lost due oral health problems or dental visit	The children in special education classrooms were more likely to miss school days for dental visits or problems than those in mainstream classrooms.
Jackson et al./2011/ North Carolina	2183 parents of children from aged younger than 18 years	Ecological / Interview by telephone	To examine school days missed for routine dental care versus dental pain or infection to determine the relationship between children's oral health status and school attendance and performance	Data set emanated from the Child Health Assessment and Monitoring Program survey (CHAMP). When a household (parent) was identified by random sampling, he/she was asked if they had children. Those identified as having children were asked to participate in CHAMP and if they agreed, they were called back in 2 weeks to complete the 10- to 15-minute phone CHAMP interview. Child oral health status was reported by the parent.	School Performance and miss school because of a toothache or routine dental care from a question asking the parent	The poor health status was related with experience of dental pain, miss school and perform poorly in school.
Seirawan et al./2012/Los Angeles	2313 children aged 2 to 16 years	Ecological / Government data	To measure the impact of dental diseases on the academic performance of disadvantaged children.	Two general dentists conducted the clinical oral health examinations for all the children at their respective schools.	The Los Angeles Unified School District (LAUSD) Office DATA and Accountability provide information about student's number of absent days, California Standards Test scores, proficiency levels.	Oral health affects student's performance.

## Oral health status of students

As regards the evaluation of the students' oral health status, the researchers used mainly objective criteria by direct visual inspection of the oral cavity<sup>14-15,17-22</sup> and data from government researches<sup>5,23-24</sup>. Dental caries was the most common oral condition evaluated in the studies, generally following the WHO diagnostic criteria<sup>14-15,17-19,23-24</sup>. Furthermore, other oral conditions were also evaluated, namely oral hygiene, obtained by the Simplified Oral Hygiene Index (OHI-S)<sup>18,20</sup>; dental trauma, obtained by the number of fractured anterior teeth and untreated severe traumatic dental injuries, according to the WHO criteria<sup>15,18,24</sup>; and periodontal disease, obtained by the Community Periodontal Index (CPI)<sup>15</sup>.

## Evaluation of school performance

With regard to data related to school performance in the review studies, they were generally obtained subjectively by questionnaires applied to parents<sup>4,25</sup>. For example, questions such as "in the last 12 months, how would you describe your child's performance in school" (excellent, above average, average, below average, or poor) were used in the study of Blumenshine et al.<sup>4</sup> (2008). Other studies used self-reports of children and adolescents as regards their school performance, ranked as low, moderate or high<sup>21,26-27</sup> or even questions such as "In your opinion, what does your class teacher think about your school performance compared with that of your classmates? (good or poor)"<sup>18</sup>. Other studies, such as Freire et al.<sup>19</sup> (2008) used the question: 'Have you ever failed an examination at school?' and the responses were "no" and "yes" (failed once or more than once).

Instruments developed to assess the quality of life related to oral health (OHRQoL) such as the Oral impact on daily performance (OIDP) and Child Oral Impacts on Daily Performances (Child-OIDP) were also applied to students in some studies as an indirect means of obtaining their school performance<sup>17,20,28-30</sup>.

In only three studies there were objective data about school performance obtained from standardized achievement tests. In the study by Muirhead and Locker<sup>23</sup> (2006), data were obtained from broad governmental educational research databases that used the criteria of the Education Quality and Accountability Office (EQAO) standard tests. Other indexes of academic performance were obtained from the Linguistic Awareness of Reading Readiness test of the emergent literacy test (LARR)<sup>24</sup> and Human Development Report<sup>5</sup>. The criteria used in EQAO were the percentages of grade three and grade six children scoring below the provincial average in reading, writing and mathematics<sup>23</sup>. In the LARR, school performance data included the results of baseline English, mathematics and literacy tests<sup>22</sup>. The study by Seirawan et al.<sup>22</sup> (2012) used The Los Angeles Unified School District (LAUSD) Office DATA and Accountability, which provide information about students' number of absent days, California Standards Test scores, proficiency levels.

## Evaluation of lost school days

Another indirect way used in some of the reviewed studies to evaluate the school performance of schoolchildren was by quantifying the students' lost school days. Generally the studies used questionnaires applied to parents and schoolchildren to obtain these data<sup>4,14-16, 31-32</sup>.

## Results of studies

All the evaluated studies showed associations among clinically detected (normative needs) and/or self-perceived oral health status (subjective needs) with school performance and school days lost by children and adolescents.

## Discussion

To the best of our knowledge, this is the first study to review the quality of evidence related to the impact of oral health conditions on school performance and school days lost by children and adolescents. It was observed that all reviewed studies found statically significant associations between school performance or lost school days and the oral health conditions of schoolchildren. However, due to several limiting methodological factors observed in the studies, the associations observed could be inaccurate, generating weak evidence.

## Designs of the studies

As regard the research design characteristics of the reviewed studies, it was observed that all of them were cross-sectional and ecological observational studies. Observational studies are fast and have lower cost than longitudinal ones, but these studies are unable to show the causality or risk factors related to outcomes<sup>33</sup>.

In spite of this, they can indicate associations that may exist and are therefore useful in generating hypotheses for future research, providing important data to determine effective actions in public health<sup>34</sup>. Thus, it is recommended that longitudinal studies be developed in the future to evaluate the relative risk of the oral conditions impacting on school performance and absence from school due to dental problems, generating stronger evidence.

## Evaluation of oral health conditions

The researchers in the reviewed studies used diverse ways of obtaining clinical data on oral health, by means of objective clinical data or subjective reports.

Most of the studies evaluated the oral needs of participants by normative clinical evaluation, such as caries and periodontal indexes<sup>14-15,17-20,22,24</sup>. Direct inspection of the oral cavity through well-established indexes and criteria, usually collected in a standardized manner by trained personnel, could be considered a reliable and valid method for evaluating oral health conditions.

On the other hand, the analysis of oral health conditions from the perceptions of parents, teachers or students' self-reports, as observed in some studies, might have subjective interpretations that could generate a systematic error arising

from inaccurate measurement of the outcomes of the studied variables<sup>26-29,32</sup>. Thus, it is recommended that oral health indexes be used by calibrated teams of researchers in future studies for more reliable associations.

## Evaluation of school performance

With regard to school performance, no standardized manner of collecting and measuring was observed in the reviewed studies, hindering the replication of studies and comparison of the data. Only three ecological studies used standardized data obtained from a government source for evaluating children's school performance<sup>5,22-24</sup>. Although measures of school performance based on standardized tests have received criticisms due to the largely uncontrolled bias that could interfere in the measurement of intelligence, leading to failure in accurately predicting academic performance, it is likely that a strict standardization of the criteria used in these studies could permit comparisons among them<sup>35</sup>. With this assumption, the national standard achievement tests have commonly been used in studies evaluating associations between chronic diseases and school performance<sup>6,36-37</sup>.

Other studies obtained data about missed school days or school performance from the reports of the schoolchildren's parents or directly from the schoolchildren<sup>4,25</sup>. The acquisition of data related to children's school performance obtained from parents or from schoolchildren must be scrutinized for the probability of information bias, since their perception could be mediated by subjective variables and cannot match the reality, producing data that are not reliable for research purposes.

In addition, instruments such as OIDP and Child-OIDP were used in some studies as an indirect means of evaluating student school performance. These instruments were originally developed to assess the quality of life related to oral health and measure the impact of oral problems on performing the daily life activities of individuals. Considering that school performance is a part of daily activities, this could be considered an indirect criterion used in studies for evaluating this objective. However, they are not specific instruments or criteria for evaluating school performance, which could generate inaccurate measurements or measurement biases.

Mikaeloff et al.<sup>10</sup> (2010) used grade retention as another criterion for evaluating children's school performance. However, the use of grade retention data for this purpose depends on the educational system and criteria adopted in each region or country, and do not allow comparison among studies.

## Associations between oral health, school performance and lost school days

The reviewed studies showed associations between dental problems of children and their school performance. According to Pourat and Nicholson<sup>38</sup> (2012) missed school days due to dental problems may have implications for the school performance of children, since absences from school mean missed opportunities for learning and academic

advancement, and have significant negative social and economic consequences.

It was also observed that the majority of studies investigating the school days lost due to dental problems did not investigate the specific oral problem related to absenteeism, such as pain, dental caries, orofacial trauma or other oral problems. Lack of this information is a limiting study factor because it does not allow determining the specific oral causes associated with poor school performance and prevents comparisons among the studies.

## The influence of other variables on school performance

Analyzing the factors that may interfere with school performance, it is important to control the confounding variables, such as general or systemic health of schoolchildren. Blumenshine et al.<sup>4</sup> (2008) stated that children with poor oral and general health are more likely to have poor school performance. Thus, general health could function as a confounding variable for the relationship between oral health and school performance<sup>4,39</sup>. Other confounding variables were related to socio-environmental conditions of the children, such as low socioeconomic status and low education level of the family, which exert great influence on disturbed schooling, together with the burden of disease<sup>10,40</sup>. This represents a challenge to public health interventions, especially in some populations, such as immigrants and low-income individuals in whom oral problems are more frequent and who cannot afford private treatment<sup>32,38,41</sup>.

Furthermore, other factors must be considered in the association with school performance, as studies have related this variable to perceptions of children's oral health-related quality of life<sup>42-43</sup>. These recent findings provide evidence of the relationship between social determinants, such as quality of life and environment, and school performance and school absenteeism.

From the results of the present review, it was observed a need for developing longitudinal studies to evaluate whether oral health is a risk factor for school absenteeism and school performance, in order to understand the actual influence of oral health conditions on an individual's school performance, using more accurate and reliable data. In addition, the use of multivariate statistics can be an important way to control the confounding factors in these analyses, such as general health, quality of life and socio-environmental conditions.

All the reviewed studies encountered associations between oral conditions and school performance of children and adolescents. However, the lack of longitudinal studies, standardized methodologies for comparisons of results and objective and standardized criteria for data collection on oral conditions, school performance and absenteeism, could make the current evidence on the association of oral conditions with low school performance and absence from school seem inconclusive or weak. The need for developing studies with a longitudinal design using more reliable and valid criteria is emphasized in order to assess the causality or risk of oral health factors impacting on school performance, generating hypotheses for future research and providing



important data for determining effective actions in school health programs.

The outcomes of this study should be interpreted in the context of some limitations. The main objective was to collect important publications about school performance and oral health, though it was not included an appraisal of the quality of the papers selected in the systematic review.

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