

## Prevalence of dental trauma in Brazilian children and adolescents: a systematic review and meta-analysis

Prevalência de lesões dentárias traumáticas em crianças e adolescentes brasileiros: uma revisão sistemática e metanálise

Prevalencia de lesiones dentales traumáticas en niños brasileños y adolescentes: una revisión sistemática y metaanálisis

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### Abstract

*This study aimed to investigate the prevalence of dental trauma in Brazilian children and adolescents. A systematic review was conducted considering eight databases: MEDLINE (via PubMed), LILACS, BBO, Scopus, Embase, Web of Science, Open Access Theses and Dissertations, and OpenThesis. Only prevalence studies that used a probabilistic sampling method were included, without restriction on year or language of publication. The JBI critical appraisal tools for prevalence studies were used to assess the individual risk of bias. The individual studies were combined in the meta-analysis using the random-effects model. The heterogeneity between the studies was analyzed by Cochran's Q and the I-square statistics. A meta-regression analysis was performed to evaluate the sources of heterogeneity. The GRADE approach assessed the certainty of evidence across included studies. The search resulted in 2,069 records, of which 36 were included in the study. The eligible studies were published from 2000 to 2021, with a total sample of 40,194 children and adolescents. Most studies (75%) had a low risk of bias. In permanent teeth, the prevalence of dental trauma was 21% (95%CI: 16.0; 26.0) and in deciduous teeth; 35% (95%CI: 26.0; 44.0). The prevalence of dental trauma among boys was higher than among girls for both dentitions. Based on a low certainty, the prevalence of traumatic dental injuries in Brazilian children and adolescents is higher than that found worldwide both in deciduous and permanent teeth. Also, the prevalence of dental trauma among boys is higher than among girls.*

*Tooth Injuries; Child; Adolescent; Systematic Review*

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## Introduction

The International Association of Dental Traumatology (IADT) defines dental trauma as an external impact on dental tissue and may present itself clinically as an injury to hard (enamel fracture, enamel fracture and dentin with or without pulp exposure, root fracture, and alveolar fracture) or supportive (concussion, subluxation, intrusive, extrusive, or lateral dislocation, and avulsion) tissues of the teeth <sup>1</sup>. The dental trauma is a worldwide public health problem and can be considered the fifth most common group of injuries in the world <sup>2</sup>. Children and adolescents are the most affected by dental trauma, with an estimated average prevalence of 18% among 12-years-old <sup>3,4</sup>. The consequences of dental trauma in this age group can be presented in different ways, such as a decreased quality of life <sup>5</sup>, tooth loss <sup>6</sup>, pulp necrosis followed by root resorption <sup>7</sup>, or interruption of root formation <sup>8</sup>; and additionally, emotional stress for both child and parents <sup>9</sup>.

In Brazil, an epidemiological survey performed in 2010 with adolescents aged 12 year found that the prevalence of pediatric dental trauma was 21.5% <sup>10</sup>. However, the survey did not include children in primary dentition, who also have a high prevalence of pediatric dental trauma <sup>3</sup>. This study was carried out in 2010, and it has not been updated since then. Recently, Aldrigui et al. <sup>4</sup> published a systematic review and meta-analysis assessing the prevalence of pediatric dental trauma in Latin America and the Caribbean. However, this systematic review has only included a few Brazilian studies, and yet no subgroup analysis for the population was performed. Furthermore, the bibliographic search was carried out in 2011; and since then, several Brazilian studies have been published.

Moreover, Brazil is a large country, in which its prevalence rates of pediatric dental trauma may vary according to each region <sup>11,12,13,14,15</sup>. This inconsistency may be a result of socioeconomic, behavioral, and phenotypic differences, but also of the lack of information on the epidemiology of dental trauma in certain sparsely populated areas. Thus, knowing the epidemiological profile of pediatric dental trauma in Brazil and its regions might help to understand the proportion and impact of these injuries on the population as well as helping to identify areas that need to implement more urgent preventive measures.

Thus, although most epidemiological pediatric dental trauma studies in the literature have been conducted in Brazil <sup>3</sup>, no meta-analysis has determined the prevalence of pediatric dental trauma in the population. Then, this systematic review aimed to answer the following guiding question: "What is the prevalence of dental trauma in children and adolescents in Brazil?"

## Methods

### Protocol and registration

A protocol was registered at the International Prospective Register of Systematic Reviews (PROSPERO) database, under the number CRD42018111212. This systematic review was reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) <sup>16</sup> and was conducted according to the Joanna Briggs Institute (JBI) manual <sup>17</sup>.

The original protocol (published in October 2018) was designed to investigate the prevalence and risk factors associated with dental trauma in Brazilian children and adolescents; however, due to a large number of variables, the authors chose to continue the review focusing only on epidemiological prevalence data – this decision was made before the study selection process. Then, a new update in October 2019 was carried out to include this change and adaptations of tools for assessing the risk of bias and meta-analysis models that would be used.

### Eligibility criteria

The inclusion and exclusion criteria were based on the CoCoPop mnemonic (Condition, Context, and Population) <sup>17</sup>.

### **Inclusion criteria**

- **Condition**

Diagnosis of pediatric dental trauma in the anterior teeth (maxillary or mandibular) by Andreasen's or O'Brien's criteria. Both criteria considered only the clinical appearance of the dental trauma, as crown color change, fracture involving enamel, fracture involving enamel and dentin, fracture involving enamel, dentin, and pulp, absence and restoration due to trauma.

- **Context**

Studies performed in Brazil.

- **Population**

Brazilian children and adolescents aged 0-19 years, regardless of sex, ethnicity, or other sociodemographic factors. The 19-year-old threshold was established according to the classification of the World Health Organization (WHO) for "adolescent" <sup>18</sup>.

- **Study design**

We considered only prevalence studies that used a probabilistic sampling method (simple or complex) or that included all target populations.

### **Exclusion criteria**

The following studies were excluded: (1) studies performed in emergency and traumatology services, where pediatric dental trauma frequency could be artificially higher; (2) studies including participants presenting a cleft lip and/or palate as well as other craniofacial deformities or any syndrome; (3) studies with overlapping results; in this case, we considered the most recent study with the best methodological quality.

### **Sources of information and search**

Embase, MEDLINE (via PubMed), Scopus, Web of Science, LILACS, and BBO databases were used as primary study sources. OpenGrey and Open Access Theses and Dissertations were used to partially capture the "gray literature". All steps were performed to minimize selection and publication biases.

The MeSH (Medical Subject Headings), DeCS (Health Sciences Descriptors), and Emtree (Embase Subject Headings) resources were used to select appropriate search descriptors. The Boolean operators "AND" and "OR" were used to enhance the research strategy through several combinations (Supplementary Material. Box S1. [http://cadernos.enp.fiocruz.br/static//arquivo/suppl-e00015920\\_9970.pdf](http://cadernos.enp.fiocruz.br/static//arquivo/suppl-e00015920_9970.pdf)). The bibliographic search was performed in January, 2019, and updated on February 2nd, 2021. The search strategy included the following descriptors: "tooth injuries", "tooth avulsion", "maxillofacial injuries", "Brazil". Also, the following DeCS descriptors: "traumatismos dentários" [Portuguese], "avulsão dentária" [Portuguese], "Brasil" [Portuguese]. The search strategy was adapted for each database, respecting their rules of syntax.

The results obtained were exported to the EndNote Web software (<https://endnote.com/>), in which duplicates were considered only once.

### **Study selection**

Study selection was performed in three phases. In the first phase, as a calibration exercise, two reviewers discussed the eligibility criteria and applied them to a sample of 20% of the studies retrieved after the initial search to determine inter-rater agreement. After achieving a proper level of agreement

(kappa  $\geq$  0.81), two reviewers (W.A.V. and R.F.A.) performed a methodical analysis of all the titles of the studies, independently. The reviewers were not blind to the names of authors and journals. In the second phase, the reviewers (W.A.V. and R.F.A.) read the abstracts independently for the initial application of the exclusion criteria. Studies containing titles that met the objectives of the study but did not have abstracts available were fully read in phase three.

In the third phase, preliminary eligible studies had their full texts evaluated to verify whether they fulfilled the eligibility criteria. When both reviewers disagreed, a third reviewer (A.J.S.) was consulted to make a final decision. Excluded studies were registered in a separate database listing the reasons for exclusion.

### **Data collection**

After the selection, the studies were analyzed and two reviewers (W.A.V. and R.F.A.) extracted information regarding the identification of the study (author, year, city, state, and region where the research was conducted, funding sources), sample characteristics (number of patients, distribution by sex, age range, and sample collection location), characteristics of data collection (evaluation period, trauma diagnosis criteria), and main results (overall prevalence and prevalence by gender). If prevalence were not directly provided, they were calculated. In case of missing data, we contacted the corresponding author by e-mail.

A calibration exercise was performed with both reviewers (W.A.V. and R.F.A.) in order to ensure consistency among reviewers, in which information was extracted jointly from an eligible study. Any disagreement between the reviewers was solved through discussions, and when both reviewers disagreed, a third one (A.J.S.) was consulted to make a final decision.

### **Risk of bias in individual studies**

Two authors (W.A.V. and R.F.A.) assessed the risk of bias and individual quality of the studies selected, independently, using the JBI critical appraisal tools for use in JBI systematic reviews<sup>17</sup> for prevalence studies. As a calibration purpose, the authors analyzed an eligible study jointly, with the presence of a third reviewer (A.J.S.) in charge of solving divergences in case of doubts.

This tool is composed of nine questions, as follows: (1) "Was the sample frame appropriate to address the target population?", (2) "Were the study participants sampled appropriately?", (3) "Was the sample size adequate?", (4) "Were the study subjects and the setting described in detail?", (5) "Was the data analysis conducted with sufficient coverage of the identified sample?", (6) "Were valid methods used for the identification of the condition?", (7) "Was the condition measured in a standard, reliable way for all participants?", (8) "Was there appropriate statistical analysis?" and (9) "Was the response rate adequate, and if not, was the low response rate managed appropriately?".

Each question could be answered as: "yes" – if the study did not present bias regarding the domain evaluated by the question; or "no" – if the study presented bias regarding the domain evaluated by the question; or "unclear" – if the study did not provide sufficient information to evaluate the bias in the question; or (4) "not applicable" – if the question was not suitable for the study.

The individual bias of the study was categorized according to the sum of positive answers to the questions corresponding to the assessment tool. The risk of bias was considered high when the study obtained less than 4 of "yes" answers, moderate when the study obtained 5 to 7 of "yes" answers, and low when the study reached 8 or 9 of "yes" scores<sup>19,20,21</sup>.

### **Summary measures and syntheses of results**

To give equal weights to the different populations investigated, only one study per age in each municipality was included in the meta-analysis. For this purpose, we selected the most recent study with the best methodology for each municipality. Studies conducted in the same municipality but evaluating different age groups of children or adolescents were included in the meta-analysis.

The analyses were conducted considering the type of teeth (permanent or deciduous) evaluated in the studies. The individual studies were combined in the meta-analysis using the random-effects

model proposed by Dersimonian-Laird and Freeman-Tukey double arcsine transformation. The heterogeneity between the studies was analyzed by Cochran's Q statistics and its magnitude was estimated by the I-square ( $I^2$ ) statistics. For each analysis, the data were grouped into subgroups considering two variables: (1) the regions of Brazil and (2) the gender of the sample.

The causes of heterogeneity were assessed by meta-regression, evaluating the effect of the following variables: year of publication, average age of the sample, population size, Human Development Index (HDI), and trauma diagnostic criteria. The data regarding the HDI and population size of each city were collected from the online system of the Brazilian Institute of Geography and Statistics (IBGE. <https://cidades.ibge.gov.br/>).

The existence of the small-study effect was also assessed by visual inspection of the funnel graph and the Egger test. All analyses were performed in the R program version 4.0 (<https://www.r-project.org/>).

### **Certainty of evidence collection**

Certainty of the identified evidence was assessed with the Grading of Recommendation, Assessment, Development, and Evaluation (GRADE) tool<sup>22</sup> with adaptations proposed by Iorio et al.<sup>23</sup>. For meta-analysis of prevalence, the best evidence is obtained through cross-sectional studies or baseline examination from cohort studies. Thus, evidence derived from these types of studies initiates the assessment as having "high certainty of evidence," and can be downgraded by the risk of bias, inconsistency, indirectness, imprecision, and publication bias. Finally, the level of certainty among the identified evidence can be characterized as high, moderate, low, or very low<sup>22</sup>.

## **Results**

### **Study selection**

During the first phase of the study selection, 2,069 results were found distributed in eight electronic databases, including the gray literature. After removing the duplicates, 1,182 results remained for the analysis of titles and abstracts. After applying the eligibility criteria to the titles and abstracts, 126 results were eligible for the full-text analysis. After reading the full-text, 90 studies were excluded (Supplementary Material. Box S2. [http://cadernos.enp.fiocruz.br/static//arquivo/supple00015920\\_9970.pdf](http://cadernos.enp.fiocruz.br/static//arquivo/supple00015920_9970.pdf)). Thus, 36 studies<sup>14,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58</sup> were selected for the qualitative analysis (Figure 1).

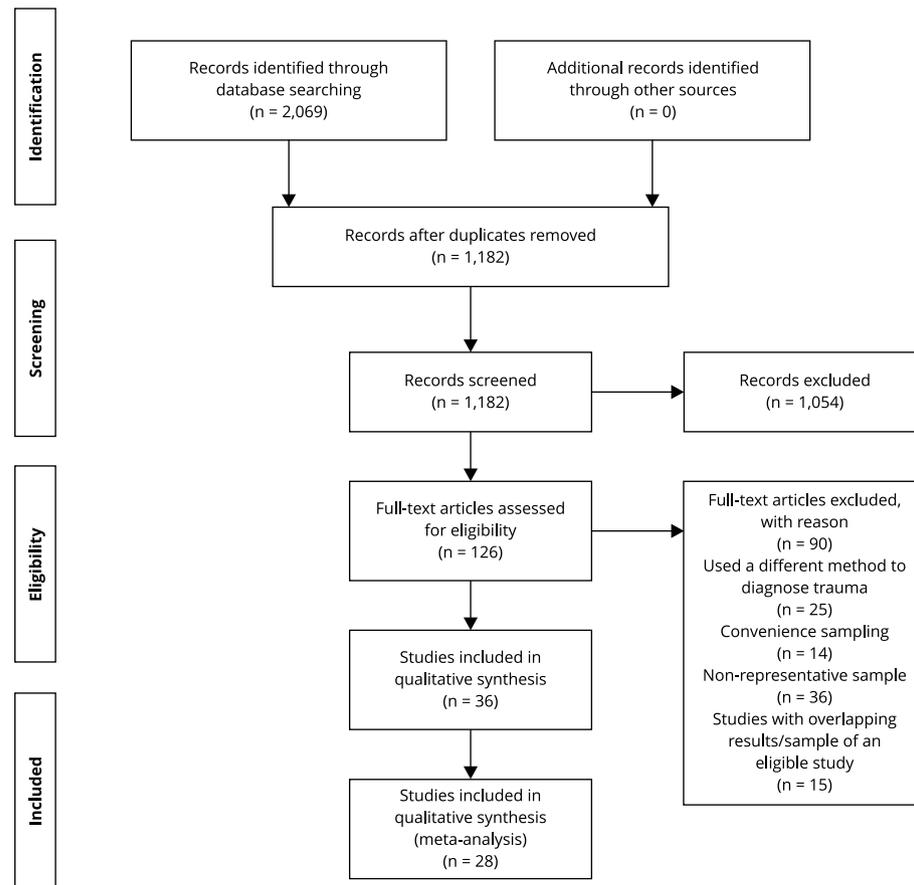
### **Characteristics of eligible studies**

The studies were published between 2000 and 2021, and most studies were conducted in the Southern (16 studies)<sup>42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57</sup> and Southeastern (13 studies)<sup>14,30,31,32,33,34,35,36,37,38,39,40,41</sup> regions, and one study was conducted in all regions<sup>58</sup>. The total sample consisted of 40,194 children and adolescents aged from 1 to 19 years. Fifteen studies<sup>25,26,27,31,33,34,35,38,40,41,48,51,52,55,56</sup> evaluated the prevalence of pediatric dental trauma in deciduous teeth and 21 studies<sup>14,24,28,29,30,32,36,37,39,42,43,44,45,46,47,49,50,53,54,57,58</sup> evaluated the prevalence of pediatric dental trauma in permanent teeth.

Four studies included all target populations in the study, one study used a stratified multi-phase cluster sampling method, and the other studies used a single, two, or three-phase random sampling method (Table 1). The assessment of the prevalence of dental trauma was conducted through clinical examination mostly in public and private schools along with health centers on national child vaccination days. The most used diagnostic criterion among studies was Andreasen's, used by 55% of the studies, followed by the criterion established by O'Brien, used by 45% of the studies. The number of examiners in each study varied from 1 to 18. Four of the studies<sup>33,41,48,49</sup> did not make it clear how many examiners have performed the clinical evaluations.

**Figure 1**

Flowchart of the process of literature search and selection, adapted from the PRISMA statement.



### **Risk of bias in individual studies**

Among the 36 studies included, none were scored 4 or less, nine studies (25%) scored 4 to 7, and the others (75%) scored 8 or 9. The main shortcomings were related to the lack of details of the sampling method (19.4% of the studies) and the use of an unappropriated statistical analysis (63.9% of the studies) (Supplementary Material. Table S1. [http://cadernos.ensp.fiocruz.br/static//arquivo/suppl-e00015920\\_9970.pdf](http://cadernos.ensp.fiocruz.br/static//arquivo/suppl-e00015920_9970.pdf)).

For question 2, those studies that encompassed the entire population were classified as “yes”. The studies that used a random sampling method and showed all detailed information – the precision of the final prevalence estimation which incorporates the clustering effect and details of randomization – were classified as “yes”, while those that presented incomplete information were classified as “unclear”.

Regarding the method of assessing the prevalence of dental trauma (question 7), studies that did not describe the number of operators and whether calibration was performed (kappa test and calibration method) were classified as “no”. In contrast, the studies that described the number of operators and stated that calibration was performed, but without details about the kappa test and calibration method, were classified as “unclear”.

**Table 1**

Main characteristics of the eligible studies.

Region/ Study (year of publi- cation)	City (State)	Sampling method	Represen- tativity	Sample analyzed (n)	Setting	Number of raters	Dental trauma diagnostic classifi- cation criteria	Year of data colle- ction	Prevalence of dental trauma	Funding source
<b>Northeast</b>										
Soriano et al. <sup>24</sup> (2009)	Recife (PE)	Single- phase random sampling *	12 years-old school children living in the whole city	1,046 (520♀ 526♂)	Public and private schools	1	Andreasen	2002	10.5% (110/1,046)	+
Siqueira et al. <sup>25</sup> (2013)	Campina Grande (PB)	Two-phase random sampling **	3-5 years-old preschool children living in the whole city	814 (392♀ 422♂)	Public and private schools	3	Andreasen	2012	34.5% (281/814)	CAPES, FAPEMIG and CNPq
Gomes et al. <sup>26</sup> (2014)	Campina Grande (PB)	Two-phase random sampling **	3-5 years-old preschool children living in the whole city	843 (405♀ 434♂)	Public and private schools	3	Andreasen	+	34.1% (286/843)	CAPES, FAPEMIG and CNPq
Neves et al. <sup>27</sup> (2017)	Campina Grande (PB)	Two-phase random sampling **	5 years-old preschool children living in the whole city	769 (366♀ 403♂)	Public and private schools	2	Andreasen	2015	54.3% (407/769)	CAPES, FAPEMIG and CNPq
Carvalho et al. <sup>28</sup> (2020)	Recife (PE)	Two-phase random sampling **	15-19 years- old school adolescents living in the whole city	1,485 (823♀ 662♂)	Public and private schools	1	Andreasen	2009	17.8% (264/1,485)	CAPES
<b>Central-West</b>										
Freire et al. <sup>29</sup> (2014)	Goiania (GO)	Two-phase random sampling **	12 years-old school children living in the whole city	2,075 (1,053♀ 1,022♂)	Public and private schools	6	O'Brien	2010	17.2% (358/2,075)	FAPEG
<b>Southeastern</b>										
Cortes et al. <sup>30</sup> (2001)	Belo Horizonte (MG)	Two-phase random sampling ***	9-14 years-old school children living in the whole city	3,702 (1,973♀ 1,729♂)	Public and private schools	1	O'Brien	+	12.1% (448/3,702)	CNPq
Dutra et al. <sup>31</sup> (2010)	Matozinhos (MG)	Single- phase random sampling #	1-4 years-old preschool children living in the whole city	407 (202♀ 205♂)	National Child Vaccination Day	5	Andreasen	2008	45.9% (187/407)	+
Jorge et al. <sup>32</sup> (2012)	Belo Horizonte (MG)	Two-phase random sampling ##	15-19 years old school adolescents living in the whole city	891 (539♀ 352♂)	Public and private schools	2	Andreasen	2009	24.7% (220/891)	+

(continues)

Table 1 (continued)

Region/ Study (year of publi- cation)	City (State)	Sampling method	Represent- tativity	Sample analyzed (n)	Setting	Number of raters	Dental trauma diagnostic classifi- cation criteria	Year of data colle- ction	Prevalence of dental trauma	Funding source
Bonini et al. <sup>33</sup> (2012)	Amparo (SP)	Single- phase random sam- pling ###	3-4 years old preschool children living in the city	376 (191♀ 185♂)	National Child Vaccination Day	11	Andreasen	+	27.7% (104/376)	+
Ramos-Jorge et al. <sup>34</sup> (2013)	Belo Horizonte (MG)	Single- phase random sampling #	1-3 years old preschool children living in the whole city	519 (249♀ 270♂)	National Child Vaccination Day	18	Andreasen	+	41.2% (214/519)	+
Castro et al. <sup>35</sup> (2013)	Casa Branca (SP)	All target population was included	0-6 years old preschool children living in the whole city	61 (29♀ 32♂)	+	1	Andreasen	2011- 2012	1.6 (1/61)	+
Bendo et al. <sup>36</sup> (2014)	Belo Horizonte (MG)	Three-phase random sampling <sup>§</sup>	11-14 years old school children living in the whole city	1,122 (667♀ 455♂)	Public and private schools	3	Andreasen	2009	14.8% (166/1,122)	CAPES and FAPEMIG
Oliveira Filho et al. <sup>37</sup> (2014)	Diamantina (MG)	Single- phase random sampling <sup>§§</sup>	14-19 years old school adolescents living in the whole city	687 (389♀ 298♂)	Public and private schools	1	Andreasen	2010	26.6% (183/687)	+
Viegas et al. <sup>38</sup> (2014)	Belo Horizonte (MG)	Two-phase random sampling <sup>**</sup>	5 years old preschool children living in the whole city	1,632 (795♀ 837♂)	Public and private schools	1	Andreasen	2009	49.4% (806/1,632)	CAPES, CNPq and FAPEMIG
Ramos-Jorge et al. <sup>39</sup> (2014)	Diamantina (MG)	Two-phase random sampling <sup>**</sup>	11-14 years old school children living in the whole city	668 (394♀ 274♂)	Public and private schools	2	O'Brien	2012	34.3% (229/668)	CAPES and FAPEMIG
Corrêa-Faria et al. <sup>40</sup> (2015)	Diamantina (MG)	Single- phase systematic sampling <sup>§§§</sup>	1-5 years old preschool children living in the whole city	301 (145♀ 156♂)	National Child Vaccination Day	10	Andreasen	+	33.9% (102/301)	CNPq and FAPEMIG
Tello et al. <sup>41</sup> (2016)	Diadema (SP)	Single- phase random sampling <sup>†</sup>	1-4 years-old preschool children living in the whole city	2002: 779 2004: 925 2006: 1,014 2008: 1,198 2010: 1,258 2012: 1,215	National Child Vaccination Day	+	Andreasen	2002, 2004, 2006, 2008, 2010, 2012	2002: 10.9% (85/779) 2004: 15.8% (146/925) 2006: 17.2% (174/1,014) 2008: 17.1% (205/1,198) 2010: 19.4% (244/1,258) 2012: 20.1% (244/1,215)	FAPESP, CNPq and CAPES

(continues)

Table 1 (continued)

Region/ Study (year of publi- cation)	City (State)	Sampling method	Represen- tativity	Sample analyzed (n)	Setting	Number of raters	Dental trauma diagnostic classifi- cation criteria	Year of data colle- ction	Prevalence of dental trauma	Funding source
Freire-Maia et al. <sup>14</sup> (2018)	Belo Horizonte (MG)	Three-phase random sampling ††	8-10 years-old school children living in the whole city	1,201 (536♀ 665♂)	Public and private schools	2	Andreasen	2010	14.1% (169/1,201)	+
<b>South</b>										
Marcenes et al. <sup>42</sup> (2000)	Jaraguá do Sul (SC)	Two-phase random sampling †††	12 years-old school children living in the whole city	476 (225♀ 251♂)	Public and private schools	1	O'Brien	1998	15.3% (73/476)	+
Marcenes et al. <sup>43</sup> (2001)	Blumenau (SC)	Two-phase random sampling †††	12 years-old school children living in the whole city	652 (329♀ 323♂)	Public and private schools	1	O'Brien	1998	58.6% (382/652)	+
Nicolau et al. <sup>44</sup> (2003)	Cianorte (PR)	All target population was included	All 13 years-old children living in the whole city	652 (328♀ 324♂)	Public and private schools	1	O'Brien	1999	20.4% (133/652)	CAPES
Traebert et al. <sup>45</sup> (2004)	Biguaçu (SC)	All target population was included	11-13 years-old children living in the whole city	2,260 (1,087♀ 1,173♂)	Public and private schools	1	O'Brien	2001	10.7% (242/2,260)	+
Trabert et al. <sup>46</sup> (2006)	Herval D'Oeste (SC)	All target population was included	12 years-old children living in the whole city	260 (135♀ 125♂)	Public and private schools	1	O'Brien	2000	17.3% (45/260)	+
Traebert et al. <sup>47</sup> (2008)	Tubarão (SC)	Two-phase random sampling **	7-8 years-old school children living in the whole city	385 (194♀ 191♂)	Public and private schools	3	O'Brien	2003	9.6% (37/385)	+
Kramer et al. <sup>48</sup> (2009)	Canela (RS)	Single-phase random sampling †	0-5 years-old preschool children living in the whole city	1,095 (544♀ 515♂)	National Child Vaccination Day	+	Andreasen	2004	23.6% (258/1,095)	+
Carvalho et al. <sup>49</sup> (2010)	Curitiba (PR)	Two-phase random sampling ††	12-15 years-old children living in the whole city	1,581 (832♀ 749♂)	Public and private schools	+	O'Brien	2005 - 2008	37.1% (587/1,581)	CNPq
Traebert et al. <sup>50</sup> (2010)	Palhoça (SC)	Two-phase random sampling ††	12 years-old children living in the whole city	405 (194♀ 211♂)	Public and private schools	7	O'Brien	2003	23.5% (95/405)	+
Wendt et al. <sup>51</sup> (2010)	Pelotas (RS)	Two-phase random sampling †††	1-5 years-old preschool children living in the whole city	571 (278♀ 293♂)	Public and private schools	3	Andreasen	2009	36.6% (209/571)	CNPq
Goettems et al. <sup>52</sup> (2012)	Pelotas (RS)	Two-phase random sampling †††	2-5 years-old preschool children living in the whole city	501 (242♀ 259♂)	Public and private schools	3	Andreasen	2007	39.5% (198/501)	+

(continues)

Table 1 (continued)

Region/ Study (year of publi- cation)	City (State)	Sampling method	Represen- tativity	Sample analyzed (n)	Setting	Number of raters	Dental trauma diagnosti- c classifi- cation criteria	Year of data colle- ction	Prevalence of dental trauma	Funding source
Damé- Teixeira et al. <sup>53</sup> (2013)	Porto Alegre (RS)	Two-phase random sampling &	12 years-old children living in the whole city	1,528 (758♀ 770♂)	Public and private schools	1	O'Brien	2010	34.8% (531/1,528)	CAPES
Goettems et al. <sup>54</sup> (2014)	Pelotas (RS)	Two-phase random sam- pling ###	8-12 years-old children living in the whole city	1,210 (636♀ 574♂)	Public and private schools	6	O'Brien	2010	12.6% (153/1,210)	CNPq
Guedes et al. <sup>55</sup> (2014)	Santa Maria (RS)	Two-phase random sampling &&	1-5 preschool children living in the whole city	478 (246♀ 232♂)	National Child Vaccination Day	15	O'Brien	+	14.1% (66/478)	FAPESP
Agostini et al. <sup>56</sup> (2016)	Santa Maria (RS)	Two-phase random sampling &&	1-5 preschool children living in the whole city	2008: 455 (210♀ 245♂) 2010: 639 (318♀ 321♂) 2013: 556 (263♀ 283♂)	National Child Vaccination Day	15 (per year)	O'Brien	2008, 2010 and 2013	2008: 31.5% (139/441) 2010: 13.0% (83/639) 2013: 22.5% (123/546)	CAPES and CNPq
Comim et al. <sup>57</sup> (2021)	Santa Maria (RS)	Single- phase random sampling *	15-19 years-old children living in the whole city	1,197 (684♀ 513♂)	Public and private schools	2	O'Brien	2018	17.0% (203/1,197)	CAPES
<b>All regions</b>										
Bomfim et al. <sup>58</sup> (2017)	All Brazilian states	Stratified multi-phase cluster sam- pling &&&	12 years old children of whole country	7,240 (3,642♀ 3,598♂)	Home	10 per capital and 2 to 6 per coun- tryside muni- cipalities	Andreasen	2010	23.9% (1735/7,240)	+

♀: female; ♂: male; +: not cited by author; CAPES: Brazilian Graduate Studies Coordinating Board; CNPq: Brazilian National Research Council; FAPESP: Goiás State Research Foundation; FAPEMIG: Minas Gerais State Research Foundation; FAPESP: São Paulo State Research Foundation; GO: Goiás; MG: Minas Gerais; PB: Paraíba; PE: Pernambuco; PR: Paraná; SC: Santa Catarina; SP: São Paulo; RS: Rio Grande do Sul.

\* Schoolchildren from all public and private schools were randomly selected using a list provided by the local education authorities;

\*\* Preschools/schools were randomly selected from each health district in the first phase and children were randomly selected from each preschool/school in the second phase. Sample distribution was proportional to the total population enrolled in private and public preschools in each administrative district of the city;

\*\*\* First, the schools were grouped into sampling units of approximately the same size, according to their location, and were chosen by a systematic sampling technique. Then, a second-stage sampling frame including all school classes of the selected sampling units (grouped schools) was created. A total of 114 classes, 19 for each age, was selected using a systematic sampling technique. All the children attending class on the day the researcher visited the school were invited to participate;

# One municipal health clinics from each region of the city were randomly selected. All children present in the selected health clinic were invited to participate;

## The authors only cited that a stratified cluster sampling method was performed;

### Participants were randomly selected using a systematic sampling procedure, in all 11 health centers of the city. The sample was stratified according to the number of children who had attended each health center in the previous year;

(continues)

**Table 1 (continued)**

- § The sample of schoolchildren was selected in three stages: (1) a sample was randomly selected proportionally to the distribution of the number of schoolchildren in each administrative district of the city; (2) the number of schoolchildren in public and private schools within each administrative district was then used for the estimation of a representative sample; and (3) classes were randomly chosen at each selected school;
- §§ Students in the ninth year of secondary school education and in high school participated in the study. Each class was coded and submitted to randomization using an automated statistics program, thereby ensuring proportionality by grade;
- §§§ Randomization was performed using systematic sampling. Accordingly, the children were arranged in a line, with the first child examined, the second not examined, the third child examined, and so on;
- † All municipal health centers (one of each district of the city) were included. Then, each fifth child in the queue was invited to participate. If parents did not agree to participate, the next child in the queue was selected;
- †† The sample was stratified according to the nine administrative districts. The first stage was the randomization of public and private schools in each administrative district of the city. In the second and third stages, classes and children were randomly chosen from the selected schools (proportionally to the total number of children enrolled in the schools);
- ††† The first-stage units comprised all private and public primary schools in the city. As the number of children differed from school to school, an equal probability scheme was adopted by sampling with probability proportional to size of schools. All children enrolled in the selected schools were invited to participate in the survey;
- ‡ The health centers were randomly selected, and all children were invited to participate;
- ‡‡ First, the schools were grouped into sampling units of approximately the same size and were chosen by a systematic sampling technique. Then, the school children of the selected schools were randomly selected;
- ‡‡‡ The sampling strategy was stratified by type of school: private or public. In each stratum, schools were randomly sampled in a simple way within each stratum. All enrolled children from the selected schools within the age group studied were initially eligible for the study;
- & The sampling strategy was stratified by type of school: private or public. In each stratum, schools were randomly sampled in a simple way within each stratum. Schoolchildren were then randomly selected proportional to the number of schoolchildren in each school;
- && 15 health centers that are equally distributed in the five administrative regions of the city were randomly selected. During the survey, every fifth child in the queue for vaccination was invited to participate. If parents did not agree to participate, then the parents of the next child were invited;
- &&& The sample of the SB Brasil Project was obtained using a stratified multistage cluster sampling method. Primary sampling units were census tracts for state capitals and the Federal District. Cities were the primary sampling units for interior municipalities. Households within the census tracts for the state capitals and the Federal District and households for the interior municipalities were selected in the second sampling stage.

## **Synthesis of results, meta-analysis, and regression**

### **• Prevalence in deciduous teeth**

For this outcome, nine studies <sup>27,31,33,38,40,41,48,52,56</sup> were included in the meta-analysis. Overall, 6,841 children aged between 1 and 6 years were analyzed, and the prevalence of dental trauma in this population was 35% (95%CI: 26.0; 44.0; I<sup>2</sup> = 98%). Regarding the results of the subgroup analysis by region, the Northeast presented the higher prevalence of dental trauma (53%; 95%CI: 49.0; 56.0) (Figure 2a). Considering the subgroup by sex, the prevalence of dental trauma in boys (40%; 95%CI: 29.0; 51.0) was higher than in girls (34%; 95%CI: 24.0; 44.0) (Figure 2b), but without significant difference between the subgroups.

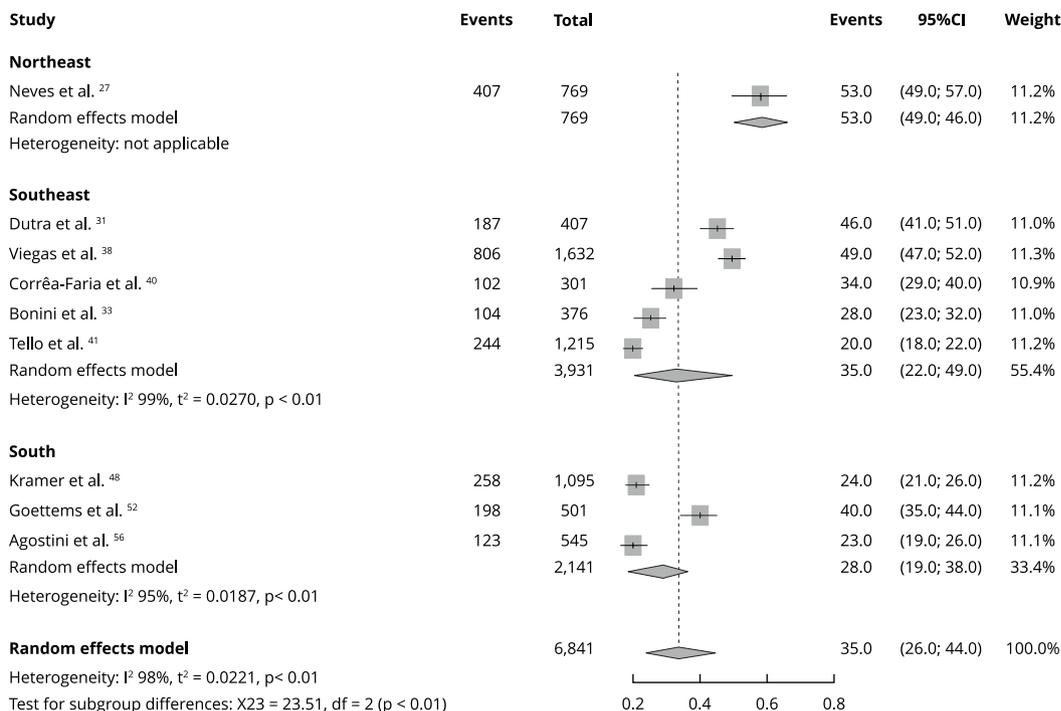
Among the variables studied in the meta-regression analysis, we observed that the average age of the sample contributed significantly ( $p < 0.0001$ ) to explain 82.7% of the variability. The increase of the average age in 1 year causes an increase of 0.12 in the prevalence of trauma in the deciduous teeth (Figure 3). The other variables studied in the meta-regression did not contribute significantly to the variability between the prevalence: HDI ( $p = 0.6421$ ); sampling method ( $p = 0.3360$ ), and population size ( $p = 0.2416$ ).

Visual inspection of the funnel plot did not reveal asymmetry in the distribution of studies. The Egger test confirmed this finding ( $p = 0.8676$ ).

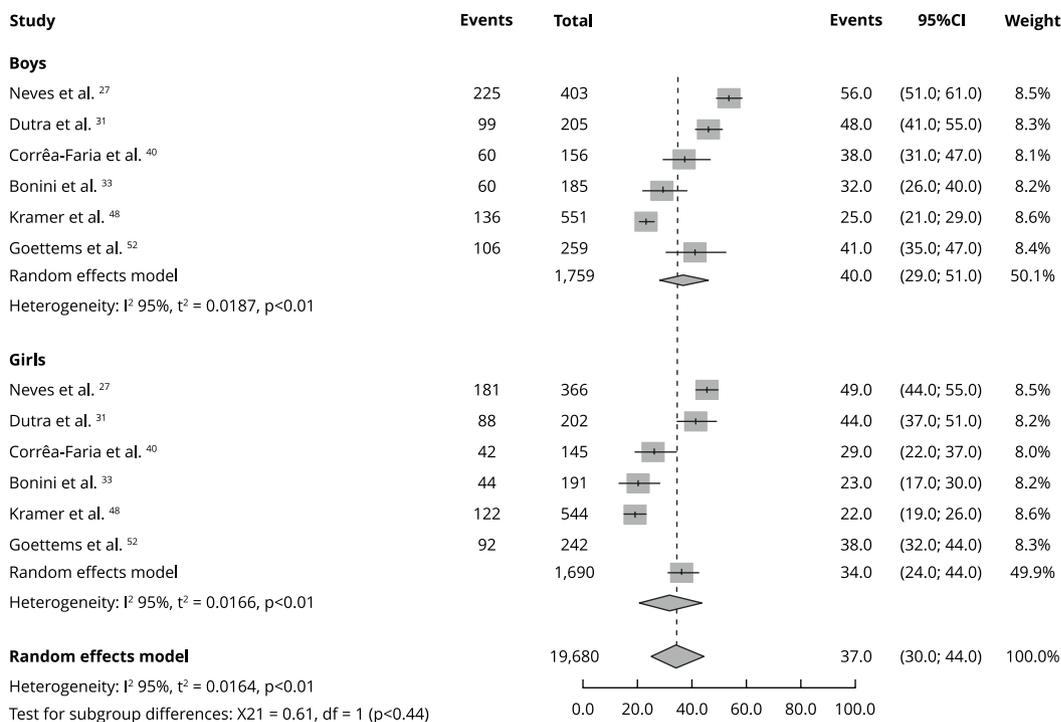
**Figure 2**

Subgroup analyses of the prevalence of dental trauma in deciduous teeth.

2a) Brazilian regions

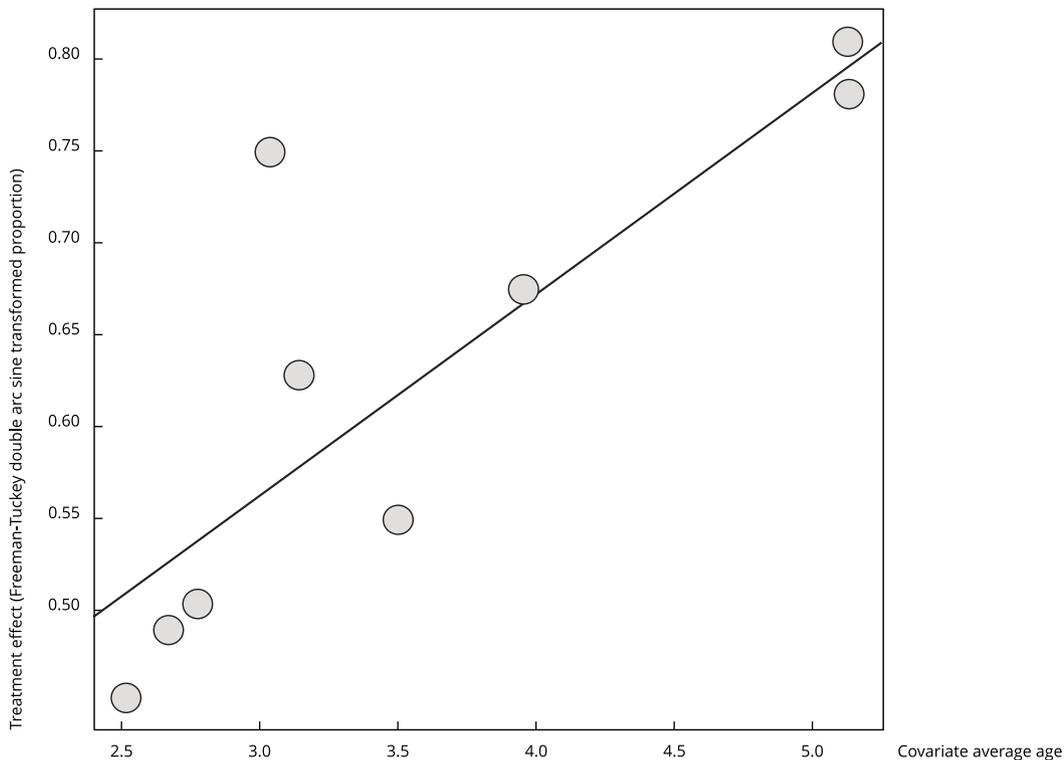


2b) Sex (boys)



**Figure 3**

Meta-regression analysis of the influence of the sample average age in the prevalence of dental trauma in deciduous teeth.



### • Prevalence in permanent teeth

Nineteen studies <sup>14,24,28,29,32,36,37,39,42,43,44,45,46,47,49,50,53,54,57</sup> were included in this analysis, with a total sample of 19,781 children and adolescents aged between 7 and 19 year old. The prevalence of dental trauma was 21% (95%CI: 16.0; 26.0,  $I^2 = 99\%$ ). Considering the Brazilian regions, the study shows that the Northeastern (14%, 95%CI: 8.0; 22.0,  $I^2 = 96\%$ ) and the Central-West (17%, 95%CI: 16.0; 19.0,  $I^2 =$  not available) regions presented the smallest prevalence; however, without statistical difference from Southeastern and Southern regions (Figure 4a). Regarding the variables studied in the meta-regressions, none of them contributed to the variability of the estimates: year of publication ( $p = 0.471$ ); HDI ( $p = 0.528$ ); diagnostic criteria ( $p = 0.718$ ); average age ( $p = 0.222$ ); and population size ( $p = 0.897$ ).

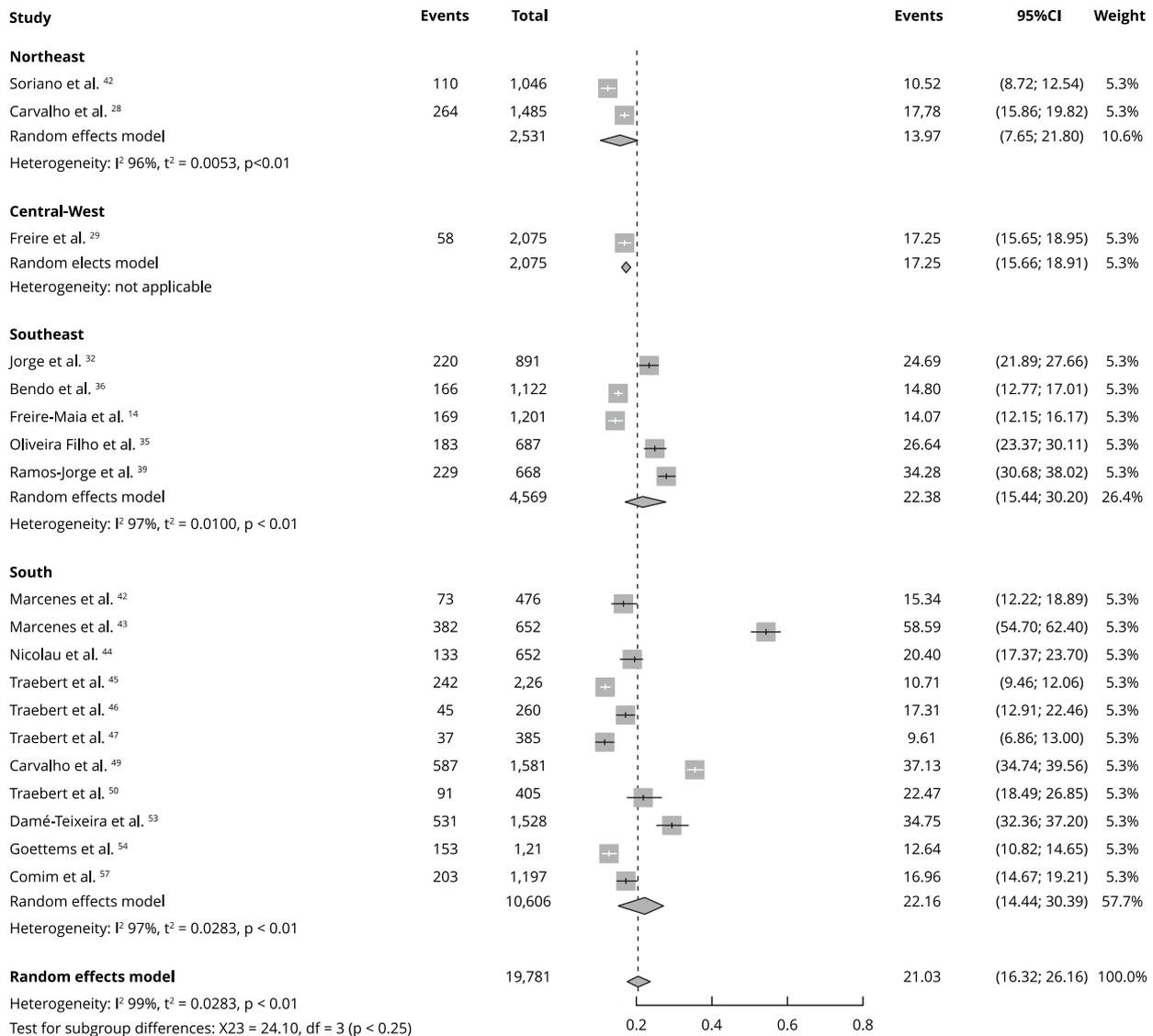
Regarding the subgroup analysis by sex, the prevalence of dental trauma in boys (25%, 95%CI: 20.0; 31.0,  $I^2 = 98\%$ ) was significantly higher than in girls (17%, 95%CI: 13.0; 22.0,  $I^2 = 97\%$ ) (Figure 4b). None of the variables studied in the meta-regressions contributed to the variability between the prevalence of each subgroup: (1) boys: year of publication ( $p = 0.306$ ); HDI ( $p = 0.796$ ); average age ( $p = 0.278$ ); diagnostic criteria ( $p = 0.625$ ); region ( $p = 0.683$ ) and population size ( $p = 0.791$ ); (2) girls: year of publication ( $p = 0.847$ ); HDI ( $p = 0.918$ ); average age ( $p = 0.150$ ); diagnostic criteria ( $p = 0.950$ ); region ( $p = 0.912$ ) and population size ( $p = 0.845$ ).

Visual inspection of the funnel plot did not reveal asymmetry in the distribution of studies. The Egger test confirmed this finding ( $p = 0.514$ ).

Figure 4

Subgroup analyses of the prevalence of dental trauma in permanent teeth.

## 4a) Brazilian regions



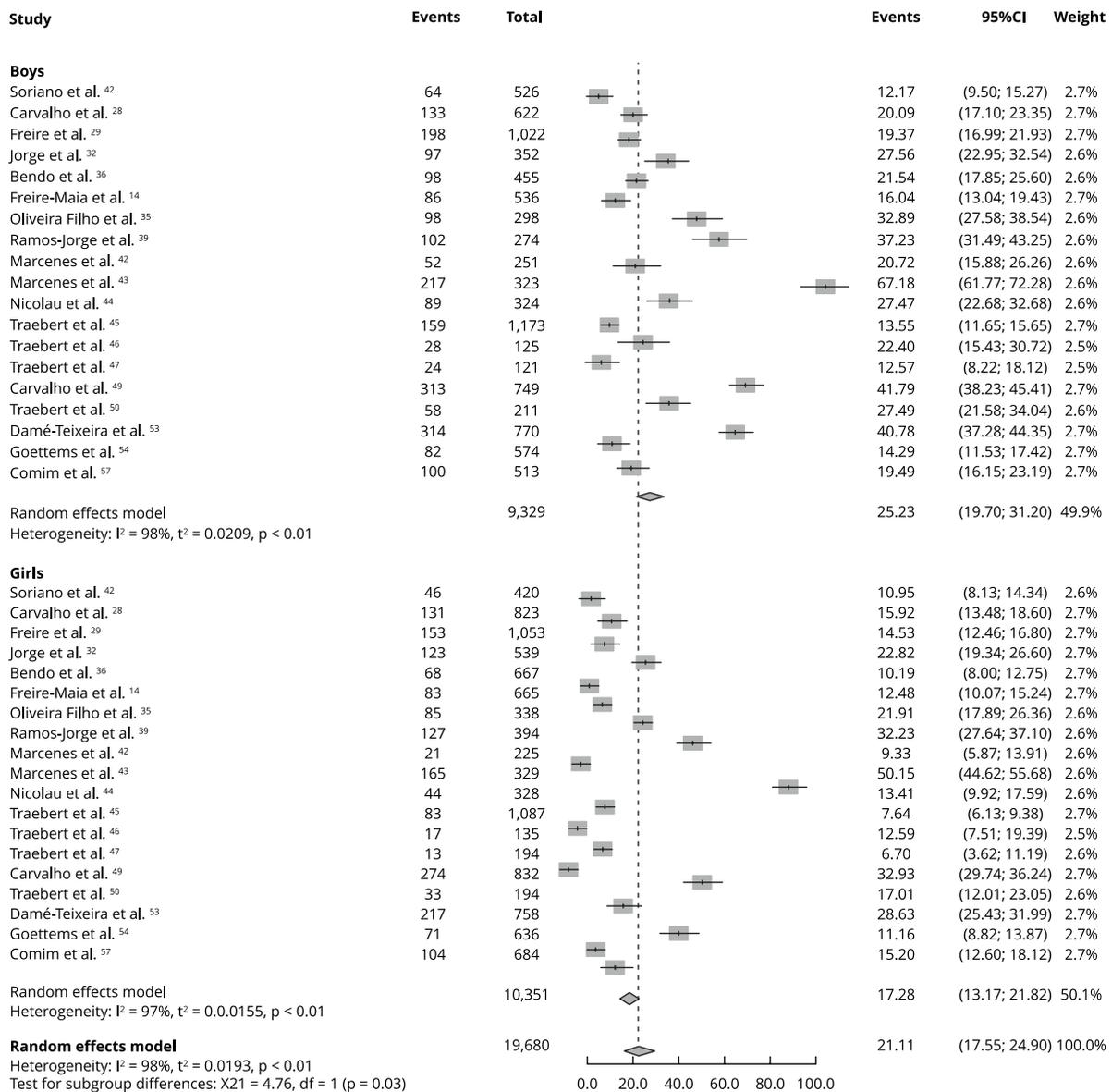
(continues)

- **Certainty of evidence**

The certainty of the evidence was classified as “low” for both permanent and deciduous analysis. The certainty of the prevalence of dental trauma in permanent dentition was downgraded in two levels due to inconsistency, while the certainty of the prevalence of dental trauma in deciduous teeth was downgraded in one level due to inconsistency and one level due to imprecision (Supplementary Material. Table S2. [http://cadernos.ensp.fiocruz.br/static//arquivo/suppl-e00015920\\_9970.pdf](http://cadernos.ensp.fiocruz.br/static//arquivo/suppl-e00015920_9970.pdf)).

Figure 4 (continued)

4b) Sex (Girls)



## Discussion

Being aware of the epidemiological profile of a given disease is the first step in establishing coping policies. dental trauma is a relevant injury that directly affects people's quality of life. This study indicates a considerable dental trauma prevalence among the young population in Brazil, which should be considered a public health problem.

Brazil is a large country, divided into five geographical regions with distinct social, cultural, economic, and natural characteristics. The Brazilian population is concentrated in metropolitan regions near the coast, more specifically in the Southeast, Northeast, and South, where 88% of the population

is located <sup>59</sup>. Understanding this aspect helps to explain the fact that most studies included in this systematic review were conducted in these particular regions. Plus, despite being the country that publishes the most articles on the prevalence of dental trauma in the world <sup>3</sup>, such publications come from the most populous states with the largest research centers.

However, the knowledge of this unequal distribution of publications is extremely alarming, since almost half of the Brazilian states have not had an assessment of the dental trauma prevalence index. The lack of epidemiological data on dental trauma, especially in the North Region, can lead to unawareness of treatment needs for these conditions caused by possible sequelae, such as tooth loss, pulp necrosis, and decreased quality of life <sup>5</sup>.

One aspect noticed in the eligible studies was the use of different criteria for dental trauma evaluation. In this review, we chose to include only studies that used the criteria of Andreasen or that of O'Brien, as they are the methods used in epidemiological surveys of government agencies. The method of classifying dental trauma proposed by Andreasen is currently the one recommended by the IADT since it is easy to reproduce in addition to having great objectivity in diagnosing traumatic dental injuries. The main difference of the Andreasen criteria from O'Brien's criteria is that tooth discoloration is not used to diagnose dental trauma given that this characteristic may be associated with other pathological changes. The literature about the influence of these criteria on epidemiological results is scarce, and they do not even discuss the possibility of aggregating data from studies that used different methods in meta-analyses. Based on this, we investigated this variable as a possible source of heterogeneity in the estimates of this review; however, the results of the meta-regression showed no association. The current evidence supports the fact that there is no suitable system for establishing the diagnosis of the studied injuries that could be applied to epidemiological surveys since these systems do not evaluate traumatic injuries that can only be diagnosed radiographically <sup>60</sup>.

Furthermore, a significant methodological characteristic of eligible studies that must be highlighted and discussed is the sampling method. In epidemiological studies, random probabilistic sampling from a defined subset of the population (sample frame) should be used in most cases to guarantee the representativeness of the population. In this review, we decided to include only studies that used this sampling method to provide the best evidence possible, which can explain the high number of studies with a low risk of bias included in our qualitative analysis.

The prevalence of dental trauma in permanent teeth was 21%, whereas in deciduous teeth was 35%. Such results are higher than those obtained by Petti et al. <sup>3</sup>, which performed a systematic review with studies from different countries and found a prevalence of 15% in permanent teeth and 22% in deciduous teeth. This difference may be explained by methodological differences between these two reviews, and because Petti et al.'s <sup>3</sup> revision included several other countries with socioeconomic, behavioral, and phenotypic differences from Brazil. However, it is important to highlight that in both reviews, the prevalence of dental trauma in deciduous dentition was higher than in permanent dentition, which can be explained by the great vulnerability of younger children to falls and accidents <sup>3</sup>.

When evaluating the subgroup analysis by Brazilian region, we can observe similar prevalence in permanent dentition in the Northeast, Central-West, Southeast, and the South. Similar results were found in the epidemiological survey conducted by the Brazilian Ministry of Health in 2010 <sup>55</sup>, where it was observed that the prevalence of pediatric dental trauma between regions varied from 18% to 25%. However, unlike the survey results, this meta-analysis included children and adolescents aged 7 to 19 years. Regarding the prevalence of dental trauma in deciduous dentition, the Northeastern Region presented a significantly higher prevalence than the Southeastern and the Southern region. Yet, the results for prevalence in deciduous teeth in the Northeastern region ought to be interpreted with caution since they correspond to the results of a single study.

The prevalence of dental trauma in boys was higher than in girls in most eligible studies from this review. Also, according to the meta-analysis, the prevalence of trauma among boys follows the same high prevalence. The results agree with the literature and can be explained by the fact that boys culturally present more hyperactive habits and behaviors in daily life than girls, such as physical contact sports, and consequently, they are more involved in dangerous situations <sup>61,62</sup>.

All meta-analyses in this review presented high heterogeneity. Even though we run a meta-regression with several variables, only the heterogeneity in the analysis of the prevalence in deciduous teeth could be partially explained by the mean age of the sample included in the studies. The meta-

regression shows that the prevalence of dental trauma increases with age; this finding is due to the cumulative characteristic of dental trauma in this age group and was confirmed in a previous systematic review<sup>62</sup>. Maybe this variable was not capable of explaining the heterogeneity in the permanent dentition because this age group is exposed to others risk factors that are not directly related to age, such as malocclusions<sup>63</sup>, alcohol or illicit drugs use<sup>64</sup>, or sport practice<sup>65</sup>.

This study has some limitations. The first one is the high and unexplained heterogeneity in some of the analysis. Then, the discrepancy between the number of eligible studies published when comparing the regions of Brazil is another limitation. Furthermore, this study does not explain the causes of dental trauma occurrence, it only indicates the existing prevalence.

On the other hand, the current study is original and contributes to the literature with the following points: it is the first systematic review with meta-analysis of the literature to evaluate the prevalence of dental trauma in different regions of Brazil, considering the type of dentition and sex of the population. Plus, it is also noteworthy that publication bias was not observed in any analysis. So, this finding can be attributed to the extensive research performed in databases, without restrictions on language, year, and publication status. Moreover, this review encompassed a much larger number of studies than previous systematic reviews of prevalence.

Overall, it is important to keep in mind that dental trauma is a public health problem, and it must be prevented. Subsequently, well-designed studies are needed to indicate which preventive actions must be developed to reduce the dental trauma occurrence and their effect on the quality of life of children and adolescents.

## Conclusion

The prevalence of dental trauma among Brazilian children and adolescents is higher than that found worldwide, both in the permanent and primary dentition, and is similar throughout the Brazilian regions. Also, the prevalence of dental trauma among boys is higher than in girls.

## Contributors

W. A. Vieira conceived the idea, contributed substantially to the study design, data analysis and interpretation, writing of the manuscript, final approval of the manuscript and is also guarantor of the study, responsible for the integrity of the work as a whole, from inception to the published article. V. G. A. Pecorari participated on meta-analysis, data analysis, drafting and revision of the manuscript, and its final approval. R. Figueiredo-de-Almeida, J. F. A. Almeida and A. de-Jesus-Soares contributed substantially to the study design, data analysis and interpretation, writing of the manuscript, and its final approval. J. Vargas-Neto, E. C. A. Santos and B. P. F. A. Gomes contributed substantially to data analysis and interpretation, and the writing of the manuscript and final approval of the manuscript. N. Carvas Junior participated on data analysis and interpretation, writing and review of the manuscript, and its final approval.

## Additional informations

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## Resumo

O estudo buscou investigar a prevalência de trauma dentário em crianças e adolescentes brasileiros. Foi realizada uma revisão sistemática em oito bases de dados: MEDLINE (via PubMed), LILACS, BBO, Scopus, Embase, Web of Science, Open Access Theses and Dissertations e OpenThesis. Foram incluídos apenas estudos de prevalência que usavam métodos de amostragem probabilística, sem limitação de ano ou idioma de publicação. Para avaliar o risco individual de viés, foram utilizadas as ferramentas de avaliação crítica da JBI para estudos de prevalência. Os estudos individuais foram combinados na metanálise com o uso do modelo de efeitos aleatórios. A heterogeneidade entre os estudos foi analisada pelas estatísticas Q de Cochran e I-quadrado. A análise de metarregressão foi realizada para avaliar as fontes de heterogeneidade. A abordagem GRADE avaliou a certeza das evidências entre os estudos incluídos. A busca resultou em 2.069 registros, dos quais 36 foram incluídos no estudo. Os estudos elegíveis foram publicados entre 2000 e 2021, com uma amostra total de 40.194 crianças e adolescentes. A maioria dos estudos (75%) teve baixo risco de viés. Nos dentes permanentes, a prevalência de trauma dentário foi de 21% (IC95%: 16,0; 26,0) e nos dentes decíduos foi de 35% (IC95%: 26,0; 44,0). A prevalência de trauma dentário foi mais alta no sexo masculino que no feminino, para ambas as dentições. Com base na baixa certeza, a prevalência das lesões dentárias traumáticas em crianças e adolescentes brasileiros é mais alta que no resto do mundo, tanto nos dentes decíduos quanto nos permanentes. Além disso, a prevalência de trauma dentário é mais alta em meninos que em meninas.

Traumatismos Dentários; Criança; Adolescente; Revisão Sistemática

## Resumen

Este estudio tuvo como meta investigar la prevalencia de trauma dental en niños y adolescentes brasileños. Se realizó una revisión sistemática considerando ocho bases de datos: MEDLINE (via PubMed), LILACS, BBO, Scopus, Embase, Web of Science, Open Access Theses and Dissertations y OpenThesis. Solamente se incluyeron estudios de prevalencia que usaron un método de muestreo probabilístico, sin restricción sobre el año o lengua de publicación. Se usó las herramientas de evaluación crítica del JBI para estudios de prevalencia studies para evaluar el riesgo individual de sesgo. Los estudios individuales se combinaron en metaanálisis, usando un modelo de efectos aleatorios. La heterogeneidad entre los estudios se analizó mediante las estadísticas de Cochran Q e I-cuadrado. Se realizó un análisis de meta-regresión para evaluar las fuentes de heterogeneidad. El enfoque GRADE evaluó la certidumbre de evidencia a través de los estudios incluídos. La búsqueda resultó en 2.069 registros, de los cuales treinta y seis se incluyeron en el estudio. Los estudios elegibles se publicaron entre 2000 y 2021, con una muestra total de 40.194 niños y adolescentes. La mayoría de los estudios (75%) tenían un bajo riesgo de sesgo. En los dientes permanentes la prevalencia de trauma dental fue 21% (IC95%: 16,0; 26,0) y en los dientes deciduos la prevalencia de trauma dental fue 35% (IC95%: 26,0; 44,0). La prevalencia trauma dental entre niños fue más alta que entre niñas en ambas denticiones. Basado en una baja certidumbre, la prevalencia de lesiones traumáticas dentales en niños y adolescentes brasileños es más alta que la encontrada en el resto del mundo, tanto en dientes deciduos como en dientes permanentes. Asimismo, la prevalencia de trauma dental entre niños es más alta que entre niñas.

Traumatismos de los Dientes; Niño; Adolescente; Revisión Sistemática

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