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# Brazilian school teachers' knowledge about dental trauma in children: systematic review and meta-analysis

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**Abstract:** The objective of this review was to assess the knowledge on emergency management of dental trauma among Brazilian school teachers. The Pubmed, Scopus, Web of Science, Embase, Scielo, Cochrane and LILACS databases were used for research. Studies evaluating Brazilian school teachers' knowledge regarding emergency management of dental trauma were included. Data were extracted on the following items: procedure in case of tooth fracture/dental avulsion, time elapsed to seek treatment and storage medium for the tooth. The JBI critical appraisal checklist for cross-sectional studies was used for assessment of the risk of bias. Prevalence meta-analyses were performed using the statistical method of Restricted Maximun-Likelihood ($p<0.05$). The search strategy retrieved 474 articles. After analysis, 19 articles met the inclusion criteria and 84% of the studies were classified with a low risk of bias. For the questions, procedure in case of tooth fracture/ tooth avulsion, time elapsed to seek treatment and storage media, 49%, 17%, 65% and 44% of teachers answered correctly, respectively. The prevalence meta-analysis found that less than 50% of Brazilian teachers have adequate knowledge about the proper management of cases of dental trauma in children.
**Keywords**: school teachers, knowledge, tooth injuries

## Conhecimento de professores brasileiros sobre traumatismo dentário em crianças: revisão sistemática e meta-análise

**Resumo:** O objetivo desta revisão foi avaliar o conhecimento sobre manejo emergencial em casos de trauma dentário entre professores brasileiros. Para a pesquisa foram utilizadas as bases de dados *Pubmed, Scopus, Web of Science, Embase, Scielo, Cochrane e LILACS*. Foram incluídos estudos que avaliaram o conhecimento de professores brasileiros sobre manejo emergencial em casos de trauma dentário. Os dados foram extraídos para os seguintes itens: procedimento em caso de fratura/avulsão dentária, tempo decorrido para busca de tratamento e meio de armazenamento do dente. A lista de avaliação crítica do JBI para estudos transversais foi utilizada para avaliação do risco de viés. Metanálises de prevalência foram realizadas pelo método estatístico de *Restricted Maximun-Likelihood* ($p<0.05$). estratégia de busca recuperou 474 artigos.

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Após análise, 19 artigos atenderam aos critérios de inclusão e 85% destes foram classificados com baixo risco de viés. Para as questões, procedimento em caso de fratura/avulsão dentária, tempo de busca por tratamento e meio de armazenamento, 49%, 17%, 65% e 44% dos professores responderam corretamente respectivamente. As metanálises de prevalência verificaram que menos de 50% dos professores brasileiros possui conhecimento adequado sobre o manejo adequado em casos de traumatismo dentário em crianças.
**Palavras-chave:** Professores, Conhecimento, Traumatismo dental

## Introduction

Dental trauma (DT) is defined 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 (Levin *et al.* 2020). It is very frequent worldwide and is still a neglected condition which could rank fifth if it was included in the list of the world's most frequent acute/chronic diseases and injuries (Petti *et al.* 2018). The prevalence of traumatic dental injuries in Brazilian children and adolescents is higher than that found worldwide both in deciduous (35%) and permanent teeth (21%) (Vieira *et al.* 2021).

The first trauma incidence peak occurs during the first 3 years of life due to the child's growth and motor development which brings about the hazard of accidental injury. This is followed by the second incidence trauma peak between the ages of 6 and 12, that age group corroborates with increased overjet after eruption of the permanent central incisors and the practice of contact sports, which may increase the risk of traumatic injury **(**Correa-Faria *et al.* 2016; Martens *et al.* 2018).

Untreated DT results in pulp necrosis and infection, discoloration, abscess, poor aesthetics, periradicular inflammation, tooth loss, financial burden, low self-esteem and psychological disorders (Rocha Lima *et al.* 2015; Kallel *et al.* 2020; Chaudhary *et al.* 2021). Also, the occurrence of severe DT impacts on the oral health and quality of life of children and their families which strengthens the importance of health promotion strategies aimed at preventing trauma in children and providing treatment for severe injuries (Abanto *et al.* 2015; Freire-Maia *et al.* 2018; Pauli *et al.* 2020).

Preventive measures and early diagnosis can allow for less invasive and cost-effective treatment, but many patients still delay seeking emergency care for DT, which increases with the severity of the injuries (Bragança-Souza *et al.* 2021). Parents and teachers spend much time with children, so they have to be able to deal with DT emergencies. Particularly, teachers should be dental educated because primary school

students stay at schools 20–40 h/week, not only studying but also playing. There is a high risk of DT at school and many teachers witnessed DT; therefore, it is paramount that they know how to properly deal with DT in children (Raoof *et al.* 2012; Ghadimi *et al.* 2014; Daupare *et al.* 2020; Salaric *et al.* 2021).

Most DTs occur during school hours or in school-related sport activities (Singh *et al.* 2014; Aldrigui *et al.* 2014; Tewari *et al.* 2021) and the time elapsed prior to the adequate management of DT is critical in influencing the prognosis of the traumatized tooth (Andreasen *et al.* 2002; Chaudhary *et al.* 2021). Therefore the aim of this systematic review was to assess the knowledge on emergency management of dental trauma among Brazilian school teachers. The information generated by this review may serve as a basis for diagnosing and planning public health education policies for education professionals in Brazil, regarding the proper management of victims of dental trauma in the school environment.

## Material and methods

### *Registration and protocol*

The present systematic review was undertaken in accordance with the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (PAGE *et al.* 2020), registered in PROSPERO (protocol number: CRD42022310059).

### *Eligibility criteria*

The review question was created using the CoCoPop framework (Condition, Context, Population) as recommended by the Joanna Briggs Institute (JBI) protocol (MUNN *et al.* 2015). The condition chosen was the level of knowledge about the management of victims of dental trauma, the population and context defined were teachers from Brazilian schools.

Studies evaluating Brazilian school teachers' knowledge about the management of victims of DT were included. The exclusion criteria were clinical cases, case series, literature review, books, reports, letter to the editor, studies in which data could not be collected. No restrictions were imposed regarding language or publication date.

### *Search strategy*

The search was carried out in February 2022 by one of the researchers using seven databases (Pubmed, Scopus, Web of Science, Embase, Scielo, Cochrane Library and LILACS) and updated in November 2024. The search strategy included the use of text words and MeSH terms according to each database. Manual searches of the list of references from the studies included were also performed. The *Reference Manager Software*® (Reference Manager, Thomson Reuters, version 12.0.3, New York, NY, USA) was used to organize the list of studies.

*Study selection*

Two independent and calibrated reviewers carried out study selection independently and in duplicate. The title and abstract were read in the first analysis. As a calibration exercise, an initial amount of 10% of retrieved studies was selected independently by the reviewers (kappa = 0.79). In cases of disagreement, decisions regarding eligibility were discussed between the researchers until reaching a consensus. Studies that met the inclusion criteria were submitted to full-text analysis. When information in the title was insufficient and the abstract was not available, the full text was obtained for analysis. Studies that did not meet the inclusion criteria were excluded. Authors were contacted to send their full texts or provide additional information when necessary.

*Data extraction*

Data extraction was performed by two reviewers and disagreements between reviewers were resolved by consensus or by the decision of a third independent reviewer. The following information was collected from the studies: research location, article's publication language, type of study (observational or interventional), type of schools (public, private or both) and sampling strategy. Regarding the characteristics of the samples, the following data were extracted from the studies: sample size and number of men and women, teacher experience, previous knowledge regarding DT and experience with DT.

For the data extraction regarding teachers' knowledge on how to properly act in situations involving dental trauma, the answers were divided into correct or incorrect for the following items: procedure in case of tooth fracture, procedure in case of dental avulsion, time elapsed to seek treatment and storage medium for the tooth. For the procedure in case of tooth fracture, the answer was considered correct when the teacher

replied that he would locate the tooth fragment and take it to the dentist. For the procedure in case of tooth avulsion, it was considered correct when the teacher replied that he would perform the immediate replantation of the tooth. Regarding the time elapsed to seek treatment, it was considered correct when the teacher replied that he would seek treatment immediately; and regarding the storage medium for transporting the tooth, if it is not replanted, it was considered correct when the teacher answered water, milk, saline solution, saliva or transported in the child's mouth.

*Evaluation of methodological quality*

Two reviewers carried out an evaluation of the methodological quality of the studies. The JBI critical appraisal checklist for analytic cross-sectional studies and randomized-clinical-trial was used for assessment of the risk of bias (MOOLA *et al.* 2017). Studies were scored on the basis of: a) inclusion criteria, b) study subjects and setting, c) validity and reliability of measured exposure, d) objectivity and standardization of measurement criteria, e) confounding factors identification, f) strategies to deal with confounding factors, g) validity and reliability of outcomes measurement and h) appropriateness of statistical analysis.

The JBI questions were scored as: “yes”, “no”, “unclear” or “not applicable”. The “yes” answers were used to determine the final score of each paper. The papers were categorized as presenting “high” risk of bias (scores equal or lower than 49%), “moderate” (scores from 50% to 69%), or “low” (scores above 70%) (MARTINS *et al.* 2020). An inter-observer reliability test between both evaluators was performed. A score of 0.62 was considered to be a good agreement and rates divergences were debated until a final consensus was reached.

*Statistical analysis*

For the four questions about correct conduct in situations of dental trauma (procedure in case of tooth fracture, procedure in case of dental avulsion, time elapsed to search for treatment and storage medium for the tooth) a meta-analysis was performed using random effects model. Prevalence meta-analyses were performed using the *JAMOVI Software*, using the statistical method of *Restricted Maximun-Likelihood* and considering a statistically significant result when p-value is less than 0.05. Heterogeneity was evaluated from the Chi-square, $I^2$, Tau and Prediction Interval (PI) results.

## Results

*Selection of studies*

The search strategy retrieved 474 articles (111 articles listed in PubMed, 6 articles in Scielo, 123 articles in Scopus, 132 articles in Web of Science, 85 articles in Embase, 3 articles in Cochrane and 14 articles in LILACS), of which 271 duplicates were excluded since they were found by different databases. A total of 203 titles and abstracts were analysed, of which 19 studies were selected for reading the full text. After analysis, 16 articles met the inclusion criteria. Three studies were included through manual search. Therefore, 19 studies included in qualitative synthesis and 18 for meta-analysis. Figure 1 illustrates the selection process and initial evaluation of the studies

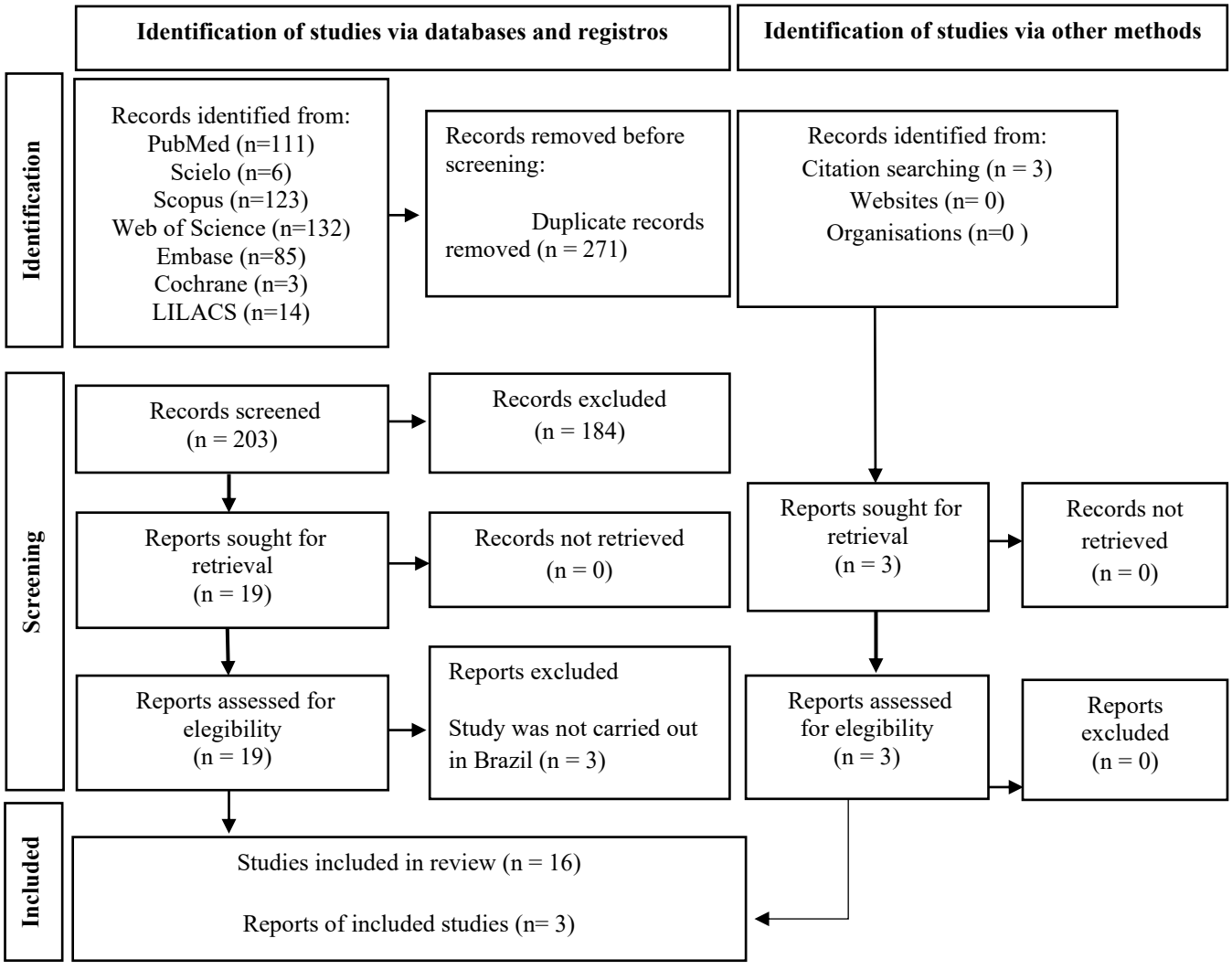



**Figure 1** - Flow diagram with the article-selection process

*Evaluation of methodological quality*

The Joanna Briggs Institute critical appraisal score ranged from 50% to 100%. Sixteen studies presented low risk of bias (Alves *et al.* 2015; Antunes *et al.* 2016; De Lima *et al.* 2021; De Lima Ludgero *et al.* 2012; Feldens *et al.* 2010; Frujeri & Costa Jr, 2009; Haragushiku *et al.* 2010; Junges *et al.* 2015; Lima *et al.* 2021; Pitton *et al.* 2014; Mori *et al.* 2007; Siqueira *et al.* 2016; Costa *et al.* 2014; Berti *et al.* 2011; Curylofo *et al.* 2012; Hanan & Costa, 2010) and three studies presented a moderate risk of bias (Araújo *et al.* 2010; Martins *et al.* 2014; Pacheco *et al.* 2003) (Table 1).

**Table 1 -** Joanna Briggs Institute critical appraisal score for risk of bias assessment of included studies

| Studies | Joanna Briggs Institute critical appraisal score | Risk |
|---|---|---|
| Alves *et al.* 2015 | 87.5 % | *** |
| Antunes *et al.* 2016 | 100 % | *** |
| Araújo *et al.* 2010 | 50 % | ** |
| Berti *et al.* 2011 | 87.5 % | *** |
| Costa *et al.* 2014 | 87.5 % | *** |
| Curylofo *et al.* 2012 | 87.5 % | *** |
| De Lima *et al.* 2021 | 100 % | *** |
| De Lima Ludgero *et al.* 2012 | 87.5 % | *** |
| Feldens *et al.* 2010 | 100 % | *** |
| Frujeri & Costa, 2009 | 100 % | *** |
| Hanan & Costa, 2010 | 87.5 % | *** |
| Haragushiku *et al.* 2010 | 75.0 % | *** |
| Junges *et al.* 2015 | 100 % | *** |
| Lima *et al.* 2021 | 100 % | *** |
| Martins *et al.* 2014 | 62.5 % | ** |
| Mori *et al.* 2007 | 75 % | *** |
| Pacheco *et al.* 2003 | 50 % | ** |
| Pitton *et al.* 2014 | 87.5 % | *** |
| Siqueira *et al.* 2016 | 100 % | *** |

* - high risk, ** - moderate risk, *** - low risk.

Source: Elaborated by the authors

*Profile of included studies*

The articles included in the present review were published between 2003 and 2021, in English or Portuguese, 6 studies collected data in cities in the Southeast region of Brazil (Antunes *et al.* 2016; Curylofo *et al.* 2012; De Lima *et al.* 2021; Martins *et al.* 2014, Mori *et al.* 2007; Pacheco *et al.* 2003), 6 in the South (Berti *et al.* 2011; Feldens *et al.* 2010; Haragushiku *et al.* 2010; Junges *et al.* 2015; Lima *et al.* 2021; Siqueira *et al.* 2016), 5 in the Northeast (Alves *et al.* 2015; Araújo *et al.* 2010; Costa *et al.* 2014; De

Lima Ludgero *et al.* 2012; Pitton *et al.* 2014), 1 in the Midwest (Frujeri & Costa Jr, 2009) and 1 in the North (Hanan & Costa, 2010) (Table 2).

Four studies carried out educational actions on the management of patients with DT after the application of the questionnaires (Araújo *et al.* 2010; Berti *et al.* 2011; Frujeri & Costa Jr, 2009; Lima *et al.* 2021), the other studies were observational, that is, no intervention was carried out. Most studies carried out data collection only in public schools, however two studies compared data from public and private school teachers (Haragushiku *et al.* 2010; Siqueira *et al.* 2016) and one study collected data only from private school teachers (Alves *et al.* 2015). Thirteen studies used a randomization strategy for sample selection (Alves *et al.* 2015; Antunes *et al.* 2016; Araújo *et al.* 2010; Berti *et al.* 2011; Costa *et al.* 2014; Hanan & Costa, 2010; Feldens *et al.* 2010; Frujeri & Costa Jr, 2009; Haragushiku *et al.* 2010; Junges *et al.* 2015; Lima *et al.* 2021; Pitton *et al.* 2014; Mori *et al.* 2007), the others used convenience sampling (Curylofo *et al.* 2012; De Lima *et al.* 2021; De Lima Ludgero *et al.* 2012; Pacheco *et al.* 2003; Martins *et al.* 2014; Siqueira *et al.* 2016) (Table 2).

**Table 2** – Data from the studies addressed in the systematic review

| Studies | City State | Language | Type of study | Type of Schools | Sampling Strategy |
|---|---|---|---|---|---|
| Alves *et al.* 2015 | Patos - PB | Portuguese | Observational | Private | Random sampling |
| Antunes *et al.* 2016 | Nova Friburgo - RJ | English | Observational | Public | Random sampling |
| Araújo *et al.* 2010 | São Luis – MA | Portuguese | Interventional | Public | Random sampling |
| Berti *et al.* 2011 | Cascavel – PR | Portuguese | Interventional | Public | Random sampling |
| Costa *et al.* 2014 | Patos – PB | Portuguese | Observational | Public | Random sampling |
| Curylofo *et al.* 2012 | Ribeirão Preto - SP | Portuguese | Observational | Public | Convenience sampling |
| De Lima *et al.* 2021 | Alfenas - MG | English | Observational | Public | Convenience sampling |
| De Lima Ludgero *et al.* 2012 | Jaboatão dos Guararapes - PE | English | Observational | Public | Convenience sampling |
| Feldens *et al.* 2010 | Canoas - RS | English | Observational | Public | Random sampling |
| Frujeri & Costa, 2009 | Brasília - DF | English | Interventional | Public | Random sampling |
| Hanan & Costa, 2010 | Manaus - AM | Portuguese | Observational | Public | Random sampling |
| Haragushiku *et al.* 2010 | Curitiba - PR | English | Observational | Public and Private | Random sampling |
| Junges *et al.* 2015 | Porto Alegre - RS | English | Observational | Public | Random sampling |
| Lima *et al.* 2021 | Pato Branco – PR | English | Interventional | Public | Random sampling |
| Martins *et al.* 2014 | Araçatuba – SP | English | Observational | Public | Convenience sampling |
| Mori *et al.* 2007 | Adamantina – SP | English | Observational | Public | Random sampling |
| Pacheco *et al.* 2003 | Rio de Janeiro - RJ | English | Observational | Public | Convenience sampling |

| | | | | | |
|---|---|---|---|---|---|
| Pitton *et al.* 2014 | Jequié - BA | English | Observational | Public | Random sampling |
| Siqueira *et al.* 2016 | Curitiba - PR | English | Observational | Public and Private | Convenience sampling |

*Schoolteachers' profile*

The sample size of the studies ranged from 23 (Costa *et al.* 2014) to 442 teachers (Junges *et al.* 2015). In all studies, most teachers were female, with percentages ranging between 70.2% (Pitton *et al.* 2014) and 100% (Araújo *et al.* 2010) (Table 3).

Thirteen studies considered the variable "teacher's years of experience". In seven studies it was possible to categorize this as viable in more or less than 10 years, four of these observed that most teachers had less than 10 years of experience (Antunes *et al.* 2016; De Lima *et al.* 2021; Hanan & Costa, 2010; Mori *et al.* 2007) with percentages varying between 59% (Mori *et al.* 2007) and 74.5% (De Lima *et al.* 2021), and three studies observed that most teachers had more than 10 years of experience (Feldens *et al.* 2010; ; Haragushiku *et al.* 2010; Siqueira *et al.* 2016), with percentages ranging between 51% (Siqueira *et al.* 2016) and 68.4% (Haragushiku *et al.* 2010). Two studies categorized this as more or less than 15 years, in one most teachers (62.4%) had less than 15 years (De Lima Ludgero *et al.* 2012) and in the other most teachers (56.6%) had more than 15 years of experience (Junges *et al.* 2015). Four studies cited only the teacher's average years of experience (Curylofo *et al.* 2012; Lima *et al.* 2021; Martins *et al.* 2014; Pitthon *et al.* 2014), which varied between 5 (Martins *et al.* 2014) and 15 years (Curylofo *et al.* 2012) (Table 3).

Fourteen studies considered the variable "prior knowledge of dental trauma" (Alves *et al.* 2015; Antunes *et al.* 2016; Berti *et al.* 2011; Costa *et al.* 2014; Curylofo *et al.* 2012; De Lima *et al.* 2021; De Lima Ludgero *et al.* 2012; Frujeri & Costa jr, 2009; Hanan & Costa, 2010; Haragushiku *et al.* 2010; Junges *et al.* 2015; Lima *et al.* 2021; Martins *et al.* 2014; Pitthon *et al.* 2014) and all observed that most teachers had no prior knowledge of the subject, with percentages ranging between 64.8% (Lima *et al.* 2021) and 97.5% (Martins *et al.* 2014). Sixteen studies looked at how many teachers had previous experience with DT (Alves *et al.* 2015; Antunes *et al.* 2016; Berti *et al.* 2011; Costa *et al.* 2014; Curylofo *et al.* 2012; De Lima *et al.* 2021; De Lima Ludgero *et al.* 2012; Feldens *et al.* 2010; Frujeri & Costa jr, 2009; Hanan & Costa, 2010; Haragushiku *et al.* 2010; Martins *et al.* 2014; Mori *et al.* 2007; Pacheco *et al.* 2003; Pitthon *et al.* 2014;

Siqueira *et al.* 2016) and the percentages ranged from 6.4% (Feldens *et al.* 2010) to 60.0% (Martins *et al.* 2014) (Table 3).

**Table 3** – Schoolteachers' profile

| Studies | Sample Size | | | Teacher experience | | Knowledge of dental trauma | | Dental trauma experience | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | Males (%) | Female (%) | <10 years (%) | >10 years (%) | Yes (%) | No (%) | Yes (%) | No (%) |
| Alves *et al.* 2015 | 138 | 5 (3.6) | 133 (96.4) | - | - | 23 (16.7) | 115 (83.3) | 10 (13.8) | 128 (86.2) |
| Antunes *et al.* 2016 | 205 | 21 (10.2) | 184 (89.8) | 129 (62.9) | 68 (33.2) | 4 (2.0) | 189 (92.1) | 34 (16.6) | 163 (79.5) |
| Araújo *et al.* 2010 | 84 | 0 (0.0) | 84 (100) | - | - | - | - | - | - |
| Berti *et al.* 2011 | 76 | 3 (3.95) | 73 (96.0) | - | - | 7 (9.2) | 69 (89.8) | 11 (14.5) | 65 (85.6) |
| Costa *et al.* 2014 | 23 | 1 (4.3) | 22 (95.7) | - | - | 2 (8.7) | 21 (91.3) | 2 (8.7) | 21 (91.3) |
| Curylofo *et al.* 2012 | 52 | 2 (3.8) | 50 (96.2) | 15 years average | | 14 (26.9) | 38 (73.1) | 21 (40.4) | 31 (59.6) |
| De Lima *et al.* 2021 | 212 | 15 (7.1) | 197 (92.9) | 158 (74.5) | 54 (25.5) | 15 (7.1) | 197 (92.9) | 23 (10.8) | 189 (89.2) |
| De Lima Ludgero *et al.* 2012 | 338 | 11 (3.3) | 327 (96.7) | 211 (62.4)* | 127 (37.6)* | 37 (10.9) | 301 (89.1) | 63 (18.6) | 275 (81.4) |
| Feldens *et al.* 2010 | 405 | 75 (18.5) | 330 (81.5) | 156 (38.6) | 248 (61.4) | - | - | 26 (6.4) | 379 (93.6) |
| Frujeri & Costa, 2009 | 101 | - | - | - | - | 3 (3.0) | 98 (97.0) | 8 (8.0) | 93 (92.0) |
| Hanan & Costa, 2010 | 311 | 80 (25.7) | 231 (74.3) | 218 (70.0) | 93 (29.9) | 12 (3.8) | 299 (96.2) | 38 (12.2) | 273 (87.8) |
| Haragushiku *et al.* 2010 | 95 | 14 (14.8) | 81 (85.2) | 30 (31.6) | 65 (68.4) | 18 (19.0) | 77 (81.0) | 26 (27.4) | 69 (72.6) |
| Junges *et al.* 2015 | 442 | 44 (10.0) | 398 (90.0) | 192 (43.4)* | 250 (56.6)* | 53 (12.0) | 389 (88.0) | - | - |
| Lima *et al.* 2021 | 221 | 17 (7.7) | 204 (92.3) | 14 years average | | 78 (35.2) | 143 (64.8) | - | - |
| Martins *et al.* 2014 | 40 | 2 (5.0) | 38 (95.0) | 5 years average | | 1 (2.5) | 39 (97.5) | 24 (60.0) | 16 (40.0) |
| Mori *et al.* 2007 | 117 | 11 (9.5) | 106 (90.5) | 69 (59.0) | 48 (41.0) | - | - | 27 (23.0) | 90 (77.0) |
| Pacheco *et al.* 2003 | 60 | - | - | - | - | - | - | 7 (11.7) | 53 (88.3) |
| Pitton *et al.* 2014 | 141 | 42 (29.8) | 99 (70.2) | 13.5 years average | | 19 (13.5) | 122 (86.5) | 75 (53.2) | 66 (46.8) |
| Siqueira *et al.* 2016 | 98 | 21 (21.5) | 77 (78.5) | 48 (49.0) | 50 (51.0) | - | - | 28 (28.6) | 70 (71.4) |

* Teacher experience <15 years or >15 years

*Teachers' knowledge of dental trauma*

Seven studies evaluated teachers' knowledge on how to properly act in situations regarding fractures and avulsion of permanent teeth (Antunes *et al.* 2016; Costa *et al.*

2014; De Lima *et al.* 2021; Junges *et al.* 2015; Martins *et al.* 2014; Pitton *et al.* 2014; Feldens *et al.* 2010) the other studies evaluated only the knowledge in situations regarding tooth avulsion. As for procedures in cases of permanent tooth fracture, the percentage of teachers who answered correctly varied between 28.8% (De Lima *et al.* 2021) and 77.5% (Martins *et al.* 2012) for procedures in cases of permanent tooth avulsion, the percentage varied between 0.0% (Martins *et al.* 2012) and 49.6% (Pitton *et al.* 2014). The Feldens (2010) study categorized teachers' knowledge as "adequate" or "inadequate" in relation to knowledge regarding fracture and avulsion of permanent teeth. The authors observed that 77.5% had adequate or partially inadequate knowledge and 22.5% had inadequate knowledge (Table 4).

**Table 4** – Teachers' knowledge on how to properly act in situations of dental trauma.

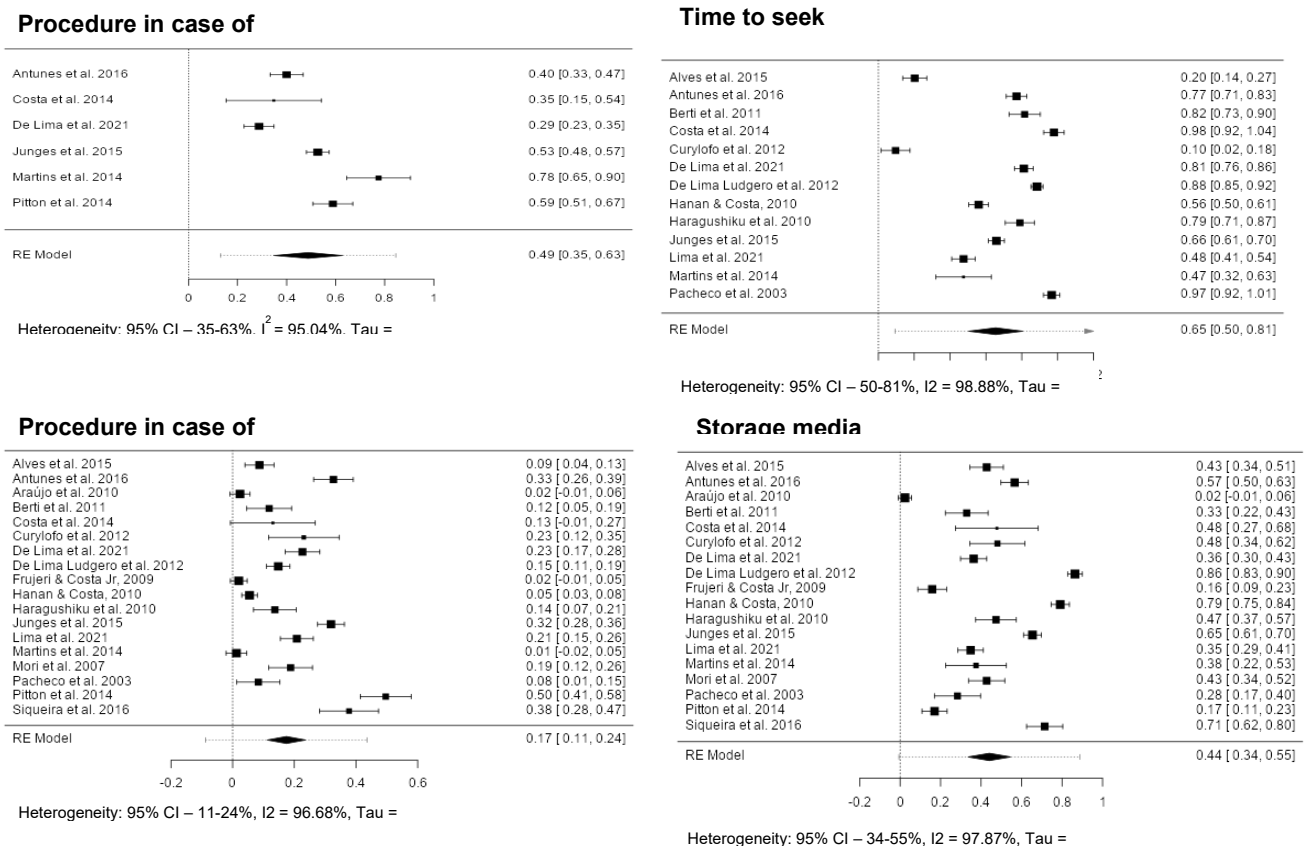
| **Studies** | **Procedure in case of permanent tooth fracture** | | **Procedure in case of permanent tooth avulsion** | | **Time to seek treatment** | | **Storage media** | |
|---|---|---|---|---|---|---|---|---|
| | Correct (%) | Incorrect (%) | Correct (%) | Incorrect (%) | Correct (%) | Incorrect (%) | Correct (%) | Incorrect (%) |
| Alves *et al.* 2015 | - | - | 12 (8.7) | 126 (91.3) | 28 (20.3) | 115 (79.7) | 59 (42.8) | 79 (57.2) |
| Antunes *et al.* 2016 | 82 (40.0) | 123 (60.0) | 67 (32.6) | 138 (67.4) | 158 (77.0) | 47 (23.0) | 116 (56.5) | 89 (43.5) |
| Araújo *et al.* 2010 | - | | 02 (2.4) | 82 (97.6) | - | - | 2 (2.9) | 82 (97.1) |
| Berti *et al.* 2011 | - | - | 9 (11.9) | 67 (88.1) | 62 (81.6) | 14 (18.4) | 25 (32.9) | 51 (67.1) |
| Costa *et al.* 2014 | 8 (34.8) | 15 (65.2) | 03 (13.0) | 20 (87.0) | 23 (100) | 0 (0.0) | 11 (47,7) | 12 (52.3) |
| Curylofo *et al.* 2012 | - | - | 12 (23,5) | 40 (76.5) | 5 (9.6) | 47 (90.4) | 25 (48.0) | 27 (52.0) |
| De Lima *et al.* 2021 | 61 (28.8) | 151 (71,2) | 48 (22.7) | 164 (77.3) | 172 (81.2) | 40 (18.8) | 77 (36.3) | 135 (63.7) |
| De Lima Ludgero *et al.* 2012 | - | - | 50 (14.8) | 288 (85.2) | 299 (88.5) | 39 (11.5) | 292 (86.4) | 46 (13.6) |
| Frujeri & Costa, 2009 | - | - | 02 (2.0) | 99 (98.0) | - | - | 16 (16.0) | 85 (84.0) |
| Hanan & Costa, 2010 | - | - | 17 (5.5) | 294 (94.5) | 174 (55.9) | 137 (44.1) | 246 (79.0) | 65 (21.0) |
| Haragushiku *et al.* 2010 | - | - | 13 (13.6) | 82 (86.3) | 75 (79.0) | 20 (21.0) | 45 (47.3) | 50 (52.7) |
| Junges *et al.* 2015 | 233 (52.7) | 209 (47.3) | 141 (32.9) | 301 (67.1) | 291 (65.8) | 151 (34.2) | 289 (65.4) | 153 (34.6) |
| Lima *et al.* 2021 | - | - | 46 (20.8) | 175 (79.2) | 105 (47.5) | 116 (52.5) | 77 (34.8) | 144 (65,2) |
| Martins *et al.* 2014 | 31 (77.5) | 9 (22.5) | 0 (0.0) | 40 (100.0) | 19 (47.5) | 21 (52.5) | 15 (37.5) | 25 (62.5) |
| Mori *et al.* 2007 | - | - | 22 (18.8) | 95 (81.2) | - | - | 50 (42.7) | 67 (57.3) |
| Pacheco *et al.* 2003 | - | - | 5 (8.3) | 55 (91.7)) | 58 (96.7) | 2 (3,3) | 17 (28.3) | 43 (71.7) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Pitton *et al.* 2014 | 83 (58.9) | 58 (41.1) | 70 (49.6) | 71 (50.4) | - | - | 24 (17.0) | 117 (83.0) |
| Siqueira *et al.* 2016 | - | - | 37 (37.7) | 51 (62.3) | - | - | 70 (71.4) | 28 (28.6) |
| | **Knowledge regarding dental trauma** | | | | | | | |
| Feldens *et al.* 2010 | Adequate or partially inadequate: 314 (77.5%) | | | | | Inadequate: 91 (22.5%) | | |

*Statistical analysis*

For the question "procedure in case of tooth fracture" 49% of teachers answered correctly (95% CI – 35-63%, $I^2$ = 95.04%, Tau = 0.16, PI = 13-83%). For the question "procedure in case of permanent tooth avulsion" 17% of teachers answered correctly (95% CI – 11-24%, $I^2$ = 96.68%, Tau = 0.13, PI = - 08-44%). For the question "time elapsed to seek treatment" 65% of teachers answered correctly (95% CI – 50-81%, $I^2$ = 98.88%, Tau = 0.27, PI = 10-100%). For the question "storage media" 44% of teachers answered correctly (95% CI – 34-55%, $I^2$ = 97.87%, Tau = 0.22, PI = 0-88%) (Figure 3).

**Figure 3 -** Meta-analysis of the prevalence of correct answers about procedures in cases of tooth fracture, tooth avulsion, time to seek treatment and storage médium



**Discussion**

The Brazilian population is concentrated in the country's metropolitan coastal areas, more specifically in the Southeast, Northeast and South, making up for 88% of the population (IBGE 2011; Vieira *et al.* 2021). these data reflect the distribution of dentistry undergraduate and graduate courses in brazil, which are also more concentrated in these regions (San Martin *et al.* 2018; Morita *et al.* 2020). This explains why most of the studies included in the present review were carried out in schools in cities around the South, Southeast and Northeast regions, with only 10.5% of the studies carried out in the North and Midwest regions.

Brazilian schools currently have a quality education standard and there are many differences between public and private schools (Akkari *et al.* 2013). among the studies included in the present review, only two compared data collected from public and private schools and observed that the teachers' knowledge on DT emergency care in public and private schools was similar (Haragushiku *et al.* 2010; Siqueira *et al.* 2016).

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 (Vieira *et al.* 2021). In this review, six studies used convenience sampling and the others used random sampling.

Theoretically, if teachers presented more years of experience and degrees, the probability of witnessing a dental avulsion case and knowing the correct procedures to be followed would be greater (Haragushiku *et al.* 2010). In the present review, eleven studies considered both variables, 'teaching experience' and 'experience with dental trauma'. In the studies that presented percentages of experience with DT greater than 25%, most teachers had more than 10 years of professional experience, confirming this theory.

Many countries use schoolteachers as health education promoters by increasing their knowledge on oral health and disease. However, despite the willingness to impart general oral health education, they seem to lack formal basic training on matters such as DT emergency management, which will hinder the effectiveness of the teacher's role in promoting oral health (Sae sankar *et al.* 2013; Yordi *et al.* 2017). In 14 studies, less than 36% of participants had undertaken DT first aid training. This emphasizes the need to include DT management as part of first aid training for Brazilian school teachers. These

data are similar to those observed in other countries where the percentages of participants who received training on DT first aid were also less than 50% (Alluqmani & Omar 2018; Marcano-Caldera *et al.* 2018; Hassan *et al.* 2018; Alsadhan *et al.* 2018; Taranath *et al.* 2017; Attarzadeh *et al.* 2017; Yordi *et al.* 2017; Mergany *et al.* 2017; Gupta *et al.* 2016; Nirwan *et al.* 2016; Junges *et al.* 2015; Shamarao *et al.* 2014; Ghadimi *et al.* 2014).

Dental trauma is considered a public health issue and if not treated timely and appropriately, will not only cause disability or loss of teeth, but also impact negatively on the quality of life of the individual. Emergency treatment of DT at the site of the accident is particularly important since an initial mismanagement will reflect directly in the subsequent treatment, which can be complicated and lengthy; thus affecting the prognosis of the case and the patient's wellbeing wellbeing (Nirwan *et al.* 2016; Yordi *et al.* 2017). In the present review, seven studies evaluated teachers' knowledge on how to act properly in situations of fractures of permanent teeth and the answer was considered correct when the teacher replied that he would locate the tooth fragment and take it to the dentist. The percentage of correct answers ranged from 28.8% to 77.5% among studies and the meta-analysis of the prevalence revealed that 49% of Brazilian school teachers knew how to act properly in cases of trauma with fracture of permanent teeth.

Avulsion is the complete displacement of a tooth out of its alveolus and is more common in young permanent teeth in which root formation is incomplete and for which the periodontium is very resilient (Walton & Torabinejad, 2014). Negative consequences of tooth avulsion can be minimized by increasing the knowledge on how avulsed teeth should be handled at the accident site; therefore, management of tooth avulsion is an important part of DT first aid training (Lima *et al.* 2021). All 19 included studies attempted to assess teachers' knowledge on the subject; however, all found that less than 50% of teachers would perform immediate tooth replantation and the meta-analysis of the prevalence revealed that only 17% would replant the tooth immediately after trauma with dental avulsion.

The time elapsed between DT and dental care significantly influences the treatment prognosis and thus it must be conducted in the first thirty minutes after the avulsion. This fact is extremely relevant for periodontal ligament cells lose their vitality as times goes by (Trope *et al.* 2002; De Lima *et al.* 2021). Nine studies observed that more than 50% of teachers would look for the dentist immediately after the trauma and the meta-analysis of the prevalence revealed that 65% would seek dental care

immediately after the accident, which shows that most teachers are aware of the correct time for initial care and the most qualified professional to do so.

When immediate replantation is not possible, an appropriate storage medium is needed to save the vitality of periodontal ligament cells, since drying leads to loss of normal morphology and metabolism of these cells (American Association Endodontists, 2002; Attarzadeh *et al.* 2017). In the present review, it was considered correct when the teacher answered milk, saline solution, saliva or transported in the child's mouth because the literature points out that the most important thing is to maintain humidity (Berti *et al.* 2011; Curylofo *et al.* 2012). However, it should be noted that when transporting the tooth in the child's mouth, there is a risk of swallowing and saline solution (0.9% NaCl) has an appropriate physiological pH and osmolarity but does not provide essential ions or glucose to the cell. Thus, milk is considered the most suitable, because it is easily available and can maintain the vitality of the periodontal ligament as it has a basic pH and adequate osmolarity. Furthermore, in a school environment, milk is often part of the menu, which makes it an affordable choice for professionals (Lima *et al.* 2021; Poi *et al.* 2013, Walton & Torabinejad, 2014)). In 13 out of 19 studies, less than 50% of the teachers were aware of the correct tooth storage media and the meta-analysis of the prevalence revealed that only 44% would store and transport the avulsed tooth correctly. This is a worrying fact that demonstrates the need for training Brazilian teachers on DT emergency care.

As limitations to the present review, it was observed that the included studies did not use a standardized data collection instrument and most of the investigated outcome parameters were not homogeneously reported in all included studies. Some were rarely reported (such as "teachers' experience" and "knowledge in cases of tooth fracture"). Therefore, there was a need for a standard data collection instrument to assess teachers' knowledge regarding emergency procedures in cases of dental trauma. The heterogeneity found in the meta-analyses measured by the values of $I^2$, Chi-square and Tau show that this is due to the variability of the true effects, that is, the sample size.

## Final considerations

The prevalence meta-analysis found that less than 50% of Brazilian teachers have adequate knowledge about the proper management of cases of dental trauma in children.

These data reflect the need for public policies aimed at training education professionals in Brazil regarding the correct management of victims of dental trauma.

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