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REVIEW ARTICLE

Traumatic Dental Injuries' Prevalence across Diverse Healthcare Settings: A Systematic Review and Meta-Analysis

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Abstract: **Introduction:** Traumatic dental injuries (TDI) are a global public health concern, impacting individuals of various age groups. This systematic review aimed to consolidate current evidence on TDI prevalence, providing insights for improved management and prevention strategies. **Methods:** A comprehensive search was conducted across PubMed/MEDLINE, Embase, and Scopus databases for studies published between January 1, 2000, and July 1, 2024. Studies reporting on the prevalence of TDI in various populations were included. We followed PRISMA guidelines in the review process. Descriptive statistics were used to summarize study characteristics, and a random-effects model was applied in the meta-analysis using STATA version 14 to pool prevalence rates, while accounting for inter-study variability. Begg's and Egger's tests were conducted to assess publication bias. **Results:** The review included data of 151,205 patients from 30 studies across diverse healthcare settings. The prevalence rates varied significantly across studies, ranging from as low as 1.88% to as high as 86.98%. The overall pooled prevalence of TDI, calculated using a random effects model, was 19.48% (95% CI: 11.21% to 27.74%), indicating substantial heterogeneity among the studies (I-squared = 100.0%, $p < 0.001$). The prevalence varied significantly across different healthcare settings and demographic groups. No evidence of publication bias was found ($p > 0.05$).

Conclusion: This systematic review underscores the high prevalence of TDI and highlights the need for targeted preventive strategies and evidence-based interventions in dental trauma care.

Keywords: Dental care; Pediatric dentistry; Tooth injuries; Prevalence; Meta-analysis

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1. Introduction

Traumatic dental injuries (TDI), encompassing injuries to the teeth and their supporting structures, are a pervasive and significant public health concern globally (1, 2). These injuries result from a wide range of incidents such as falls, accidents, sports-related impacts, and interpersonal violence, affecting individuals of all ages and socio-economic backgrounds. It is estimated that 17–50% of adolescents and adults experience dental trauma, highlighting the prevalence and impact of TDI on oral health (3).

The consequences of TDI extend beyond immediate dental problems, often leading to long-term complications that include functional impairment, compromised aesthetics, and psychological distress (4-6). Studies indicate that untreated dental trauma can increase the risk of dental caries, pulp necrosis, and subsequent tooth loss, underscoring the importance of timely and appropriate management of these injuries (7-10). Despite advancements in preventive strategies and treatment modalities, disparities in the prevalence and management of TDI persist across different populations and geographical regions. Factors such as access to dental care, socio-economic disparities, and cultural practices influence the incidence and outcomes of TDI (11-13). Understanding the epidemiology, risk factors, and clinical characteristics of TDI is essential for developing effective preventive measures, improving clinical management protocols, and addressing the specific needs of affected individuals.

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While existing research has established the prevalence and consequences of TDI, there is a lack of a comprehensive synthesis of this information across diverse populations and settings. This systematic review aimed to fill this gap by analyzing the pooled prevalence of TDI from studies published over the past two decades. By doing so, it seeks to provide valuable insights for healthcare professionals, inform public health strategies, and guide future research directions in this critical area of oral health.

2. Methods

2.1. Study design and setting

In this systematic review and metanalysis, we searched PubMed/MEDLINE, Embase, and Scopus using comprehensive search terms including 'traumatic dental injuries', 'dental trauma', 'dental injuries', 'tooth injuries', and their variations. The search was conducted to find studies reporting on TDI from January 1st, 2000 to July 1, 2024. This study was conducted and reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (14). The search strategy in different databases is presented in supplementary table.

2.2. Study selection criteria

Eligible studies were required to include information on TDI. Specifically, the studies involved patients of any age who had experienced TDI and report the prevalence, incidence, or characteristics of these injuries. The review considered observational studies, including cross-sectional, retrospective, and prospective cohort studies. To be included, studies must have provided sufficient data on TDI, such as the type of teeth affected (primary or permanent), the number of teeth involved, and the nature of the injury. Only studies published in English were included.

Studies conducted in any geographical location and in various healthcare settings, such as emergency dental clinics, general hospitals, and pediatric departments, were considered. Studies that did not meet these criteria or lacked detailed information on TDI were excluded from the review.

2.3. Review process

All identified articles were uploaded to EndNote, and duplicates were removed manually. Two reviewers (SHN and AHSH) independently screened the titles and abstracts of the articles. Any disagreements were resolved by a third reviewer (MJN). Subsequently, the reviewers evaluated the full texts of all potentially eligible studies, with any disagreements again being resolved by the third reviewer.

2.4. Data extraction

Two reviewers (SHN and AHSH) systematically extracted data into a predefined spreadsheet using Microsoft Excel. In case of any discrepancies, a third reviewer (MJN) was involved. The extracted data encompassed various parameters, including the study characteristics (author, year of publication, country, and study design), patient demographics (age, gender), sample size, type of teeth affected (primary or permanent), number of teeth involved, nature of the injury, prevalence, and incidence rates of TDI, and details on the healthcare setting.

2.5. Quality Assessment

Two reviewers (SHN and AHSH) evaluated the quality of the studies using distinct assessment tools, with a third reviewer (MJN) intervening in case of inconsistencies. The Joanna Briggs Institute checklist for prevalence studies was used to assess the methodological quality of the included studies. This checklist evaluates various domains, such as the representativeness of the sample, adequacy of the sample size, clarity of the study setting, sufficiency of data analysis coverage, accurate identification of the condition, and appropriateness of statistical analysis.

Each study was scored on a scale from 0 to 9, with higher scores indicating better methodological quality.

2.6. Data analysis

The STATA version 14 software was used for statistical analysis. Descriptive statistics were used to summarize the characteristics of the included studies. Meta-analysis was performed to pool the prevalence rates of TDI across the studies using a random-effects model to account for variability between studies. Heterogeneity among studies was assessed using the I-squared statistic and Cochran's Q test. Publication bias was evaluated using funnel plots, along with Begg's and Egger's tests.

3. Results

3.1. Study characteristics

A total of 1,658 records were identified from databases. After removing 538 duplicates, 1,120 records were screened, with 1,034 excluded.

Eighty-six reports were assessed for eligibility, with 56 excluded for reasons such as not being an emergency dental service, non-eligible study design, and lack of TDI prevalence data. Ultimately, 30 studies were included in the systematic review and meta-analysis (Figure1).

Table 1 presents the characteristics of the 30 studies included in the systematic review, with a pooled total of 151,205 patients. These studies span multiple countries and timeframes, featuring a variety of study designs, including 14 cross-sectional and 16 retrospective cohort studies.

The types of services ranged from emergency dental clinics to general hospitals and pediatric departments. The number of patients in each study varied widely, from as few as 53 patients to as many as 88,610 patients. Gender distribution and age of the patients also varied, reflecting diverse demographics. The prevalence of TDI was reported across studies, with some focusing on primary teeth, permanent teeth, or

both. For instance, Sælen et al. (2024) reported a 47.40% TDI prevalence in Norway, while Dang et al. (2015) in Australia found a 4% prevalence. Details on the number of affected teeth and the type of teeth (primary vs. permanent) were provided where available, highlighting the varied impact of TDI across different populations and healthcare settings.

3.2. Quality assessment

The quality assessment of observational studies, performed using the Joanna Briggs Institute checklist for prevalence studies tool, was conducted on a total of 30 studies (Table 2). Among these, the majority demonstrated moderate to high methodological quality, with scores ranging from 6 to 9. This indicates robust methodology across various domains, such as the representativeness of the samples, selection of the patients, adequate sample size, well-described setting, sufficient data analysis coverage, accurate identification of the condition, and appropriate statistical analysis.

3.3. Pooled prevalence of TDI

Figure 2 illustrates the pooled prevalence of TDI from the included studies. The prevalence rates varied significantly across studies, ranging from as low as 1.88% to as high as 86.98%. The overall pooled prevalence of TDI, calculated using a random effects model, was 19.48% (95% CI: 11.21% to 27.74%), indicating substantial heterogeneity among the studies (I-squared = 100.0%, $p < 0.001$). Each study's weight in the meta-analysis is also presented, with most studies contributing equally to the overall estimate. The prevalence of permanent and primary teeth injuries varied across studies, with proportions ranging from 66.4% permanent and 33.6% primary to 94.8% permanent and 5.2% primary, while some studies did not report specific percentages.

Figure 3 shows the funnel plot of the included studies to assess publication bias. The plot demonstrates a symmetrical distribution of studies around the pooled effect size, indicating no evidence of publication bias. This visual assessment is supported by statistical tests, with both Begg's and Egger's tests yielding p-values greater than 0.05, further confirming the absence of significant publication bias in the meta-analysis.

4. Discussion

The systematic review conducted in this study synthesized data from 30 studies, revealing an overall pooled prevalence of TDI at 19.48% (95% CI: 11.21% to 27.74%). This prevalence highlights the significant global burden of TDI across diverse populations and healthcare settings. The included studies reported varying rates of TDI, influenced by factors such as age, socio-economic status, and geographical location. Predominantly affecting permanent teeth, TDI showed substantial variability in incidence and severity, underscoring the need for targeted preventive measures and improved clinical management strategies.

Our findings align closely with previous meta-analyses and systematic reviews, affirming the widespread occurrence and impact of TDI globally.

However, in comparison to Thiago César da Silva Lima's study (15), our research differs in some key aspects. While Silva Lima primarily focused on emergency dental services, our synthesis included studies from emergency dental clinics, general hospitals, and pediatric departments, enabling a more comprehensive analysis of TDI across diverse healthcare settings. Moreover, our study reported a slightly higher overall pooled prevalence of TDI at 19.04% (95% CI: 11.12% to 26.96%), compared to Silva Lima's finding of 15.4% (95% CI: 11%-21%, $I^2 = 100\%$). This difference underscores our incorporation of studies from broader healthcare contexts beyond emergency care, providing a more nuanced understanding of TDI prevalence across various patient demographics and clinical environments.

The findings have significant clinical implications for dental practitioners and healthcare providers. Early identification and prompt management of TDI are crucial in minimizing long-term complications such as pulp necrosis, dental caries, and aesthetic concerns (16-18). Tailored preventive strategies, including education on sports safety, use of mouthguards, and public awareness campaigns, are essential to reducing the incidence and severity of TDI, particularly among vulnerable populations. Enhancing access to emergency dental services and implementing evidence-based treatment protocols can further improve patient outcomes and reduce the economic burden associated with TDI-related treatments.

The main findings, including the strength of evidence for each main outcome, are now summarized considering their relevance to key groups such as healthcare providers, users, and policymakers. The strength of the evidence presented in this review is bolstered by the inclusion of a large and diverse sample size, with over 151,000 patients across different healthcare settings and regions. This comprehensive analysis provides valuable insights for healthcare providers, policymakers, and public health officials, emphasizing the need for widespread adoption of preventive measures and the implementation of standardized clinical protocols. For dental practitioners, these findings underline the importance of early detection and prompt management of TDI to prevent long-term complications. For policymakers, the study highlights the necessity of investing in public health campaigns and preventive initiatives, particularly targeting high-risk groups such as children and athletes.

The findings of this review have important implications for future research. Studies should focus on identifying the most effective preventive measures, particularly in vulnerable populations, and on exploring the long-term outcomes of TDI management across various healthcare settings. Future research should also aim to standardize diagnostic criteria and reporting practices to improve the comparability of studies and strengthen the evidence base for effective interventions. Additionally, there is a need for more research

on the socio-economic impacts of TDI, particularly in low-resource settings, where access to care may be limited.

4.1. Limitations

Some limitations should be acknowledged when interpreting the findings of this systematic review. Heterogeneity among the included studies, including variations in study designs, sample sizes, and diagnostic criteria, may have influenced the pooled prevalence estimate of TDI. The reliance on studies published in English and indexed in selected databases may have introduced publication bias, potentially limiting the generalizability of the findings to non-English-speaking populations and unpublished literature.

5. Conclusion

A general interpretation of our results in the context of other evidence suggests that TDI continues to be a significant public health concern, despite ongoing efforts in prevention and management. The identified pooled prevalence rate underscores the widespread nature of TDI and emphasizes the importance of preventive strategies and evidence-based interventions in clinical practice. Addressing the limitations identified, such as standardizing reporting practices and including diverse populations, will be critical for advancing knowledge, improving patient care, and guiding future research initiatives in this critical area of oral health.

6. Declarations

6.1. Acknowledgments

None.

6.2. Ethics approval and consent to participate

Not applicable.

6.3. Consent for publication

All authors have consented to the publication of this manuscript.

6.4. Availability of data and material

All data and materials relevant to this study are included within the manuscript.

6.5. Competing interests

The authors declare that they have no competing interests relevant to this study.

6.6. Authors' contributions

All authors contributed equally to the conception, design, data collection, analysis, interpretation, and writing of the manuscript. All authors read and approved the final version.

6.7. Using artificial intelligence chatbots

During the preparation of this work, the authors used ChatGPT 3.5 to edit the manuscript grammar and style.

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Table 1: Comparing the baseline characteristics as well as Geriatric Nutritional Risk Index (GNRI), Charlson Comorbidity Index (CCI), and Fournier's Gangrene Severity Index (FGSI) between survived and non-survived cases with Fournier's Gangrene

First author	Year	Country	Study period	Study design	Service	Patients (n)	Male %	Age (Year)	Patients (n)	Teeth (n)	Permanent n (%)	Primary n (%)
Sælen et al. (19)	2024	Norway	12 months	Cross-sectional	EDC	312	54.1	Range: 7 to 18	148	253	NR	NR
Zhou et al. (20)	2023	China	48 Months	Retrospective cohort	EDC	5220	58.3	Mean: 16.2	323	459	305 (66.4)	154 (33.6)
Heggie et al. (21)	2022	United Kingdom	12 months	Retrospective cohort	PED	667	53.1	Range: 0 to 17	234	NR	NR	NR
Mckenzie et al. (22)	2022	New Zealand	60 months	Retrospective cohort	PED	4030	54.0	Range: 11 to 40	282	NR	NR	NR
Cagetti et al. (23)	2021	Italy	12 Days	Cross-sectional	GH	285	61.0	Mean: 43.7	24	NR	NR	NR
Diago et al. (24)	2021	Italy	120 Months	Cross-sectional	EDC	26355	NR	Range: 0 to 68	565	860	542 (63.0)	318 (37.0)
Shubham et al. (25)	2021	Nepal	60 Months	Cross-sectional	EDC	10080	NR	Range: 0 to 79	793	NR	NR	NR
Petrescu et al. (26)	2020	Romania	01 Months	Cross-sectional	GH	160	56.3	Range: 2 to 78	3	NR	NR	NR
Loutroukis et al. (27)	2020	Switzerland	45 Months	Retrospective cohort	GH	53	66.0	Range: 16 to 81	8	NR	NR	NR
Guo et al. (28)	2020	China	10 Days	Cross-sectional	EDC	1567	47.5	Range: 2 to 92	222	NR	NR	NR
Alkhadra et al. (29)	2016	Canada	48 Months	Cross-sectional	GH	1893	NR	Range: 1 to 85	117	NR	NR	NR
Jung et al. (30)	2016	Taiwan	24 Months	Cross-sectional	GH	391	60.1	Range: 0 to 17	184	328	NR	NR
Costa et al. (31)	2015	Brazil	80 Months	Cross-sectional	PED	596	NR	Range: 0 to 12	124	254	0	254 (100.0)
Ritwik et al. (32)	2015	United States	56 Months	Retrospective cohort	PED	382	NR	Range: 0 to 21	264	548	290 (53.0)	258 (47.0)
Martens et al. (33)	2015	Belgium	36 Months	Retrospective cohort	PED	1000	56.1	Range: 0 to 16	267	NR	NR	NR
Mahmoodi et al. (34)	2015	Germany	48 Months	Cross-sectional	GH	16301	NR	Range: 0 to 88	1305	2319	1398 (60.3)	921 (39.7)
Dang et al. (35)	2015	Australia	48 Months	Retrospective cohort	EDC	88610	NR	Range: 0 to 86	3574	6001	4597 (76.6)	1404 (23.4)
Shqair et al. (36)	2012	Brazil	12 Months	Retrospective cohort	EDC	253	51.8	Range: 1 to 16	15	NR	NR	NR
Wong et al. (37)	2012	Australia	32 Months	Retrospective cohort	EDC	196	51	Range: 2 to 18	17	NR	NR	NR
Assunção et al. (38)	2011	Brazil	120 Months	Cross-sectional	PED	1703	NR	Range: 0 to 5	409	679	0	679 (100.0)
Bae et al. (39)	2011	South Korea	12 Months	Cross-sectional	GH	1425	62.7	Range: 0 to 92	940	NR	NR	NR
Díaz et al. (40)	2010	Chile	40 Months	Cross-sectional	GH	1719	NR	Range: 1 to 15	359	670	525 (78.4)	145 (21.6)
Tramini et al. (41)	2010	France	07 Months	Cross-sectional	GH	500	55	Mean: 39.8	42	NR	NR	NR
Tham et al. (42)	2009	Australia	12 Months	Cross-sectional	EDC	6938	NR	Range: 0 to 80	304	529	NR	NR
Tulip et al. (43)	2008	United Kingdom	08 Months	Retrospective cohort	EDC	1472	52.4	NR	29	NR	NR	NR
Rezende et al. (44)	2007	Brazil	08 Months	Cross-sectional	EDC	1650	NR	Range: 0 to 52	78	NR	NR	NR
Rowley et al. (45)	2006	United States	101 Months	Cross-sectional	GH	2683	NR	Mean: 6.8	1355	NR	NR	NR
Sakai et al. (46)	2005	Brazil	24 Months	Retrospective cohort	EDC	1166	50.3	Mean: 9.2	199	NR	NR	NR
Naidu et al. (47)	2005	Trinidad and Tobago	07 Months	Cross-sectional	PED	309	47.0	Range: 1 to 16	41	52	39 (75.0)	13 (25.0)
Al-Jundi et al. (48)	2002	Jordan	12 Months	Retrospective cohort	PED	620	NR	Range: 0 to 14	195	287	272 (94.8)	15 (5.2)

EDC: Emergency dental clinic; PED: Pediatric emergency department; GH: General hospital; NR: not reported.

Table 2: Multivariate analysis of independent predictors of mortality in patients with Fournier's Gangrene

First author	Was the sample representative of the target population?	Were study participants recruited in an appropriate way?	Was the sample size adequate?	Were the study subjects and the setting described in detail?	Was the data analysis conducted with sufficient coverage of the identified sample?	Were objective, standard criteria used for the measurement of the condition?	Was the condition measured reliably?	Was there appropriate statistical analysis?	Was the response rate adequate, and if not, was the low response rate managed appropriately?
Sælen et al.	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Zhou et al.	No	NA	Yes	Yes	Yes	Yes	No	Yes	Yes
Heggie et al.	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mckenzie et al.	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cagetti et al.	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Diago et al.	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Shubham et al.	Yes	NA	Yes	No	Yes	Yes	Yes	Yes	Yes
Petrescu et al.	No	NA	Yes	No	Yes	No	Yes	Yes	Yes
Loutroukis et al.	No	NA	Yes	Yes	No	Yes	Yes	Yes	Yes
Guo et al.	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Alkhadra et al.	Yes	NA	Yes	No	Yes	Yes	Yes	Yes	Yes
Jung et al.	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Costa et al.	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ritwik et al.	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Martens et al.	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mahmoodi et al.	Yes	NA	No	Yes	Yes	Yes	Yes	Yes	Yes
Dang et al.	Yes	NA	No	Yes	Yes	Yes	Yes	Yes	Yes
Shqair et al.	Yes	NA	No	Yes	Yes	Yes	Yes	Yes	Yes
Wong et al.	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Assunção et al.	Yes	NA	Yes	No	Yes	Yes	Yes	Yes	Yes
Bae et al.	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Díaz et al.	Yes	NA	Yes	No	Yes	Yes	Yes	Yes	Yes
Tramini et al.	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tham et al.	Yes	NA	Yes	No	Yes	Yes	Yes	Yes	Yes
Tulip et al.	Yes	NA	Yes	No	Yes	Yes	Yes	Yes	Yes
Rezende et al.	Yes	NA	Yes	No	Yes	Yes	Yes	Yes	Yes
Rowley et al.	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sakai et al.	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Naidu et al.	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Al-Jundi et al.	Yes	NA	Yes	No	Yes	Yes	Yes	Yes	Yes

NA: not applicable.

Supplementary Table 1: Search strategy in different databases

Database	Search Terms
PubMed/MEDLINE	((("traumatic dental injuries"[MeSH] OR "dental trauma"[MeSH] OR "tooth injuries"[MeSH]) OR ("traumatic dental injuries" OR "dental trauma" OR "dental injuries" OR "tooth injuries" OR "oral trauma" OR "tooth fractures" OR "tooth avulsion" OR "maxillofacial trauma"))
Embase	(('traumatic dental injuries'/exp OR 'dental trauma'/exp OR 'dental injuries'/exp OR 'tooth injuries'/exp) OR ('traumatic dental injuries' OR 'dental trauma' OR 'dental injuries' OR 'tooth injuries' OR 'maxillofacial injuries' OR 'tooth loss' OR 'dental fractures' OR 'oral trauma' OR 'facial trauma'))
Scopus	(TITLE-ABS-KEY ("traumatic dental injuries" OR "dental trauma" OR "dental injuries" OR "tooth injuries" OR "dental fractures" OR "oral trauma" OR "maxillofacial trauma" OR "facial trauma"))

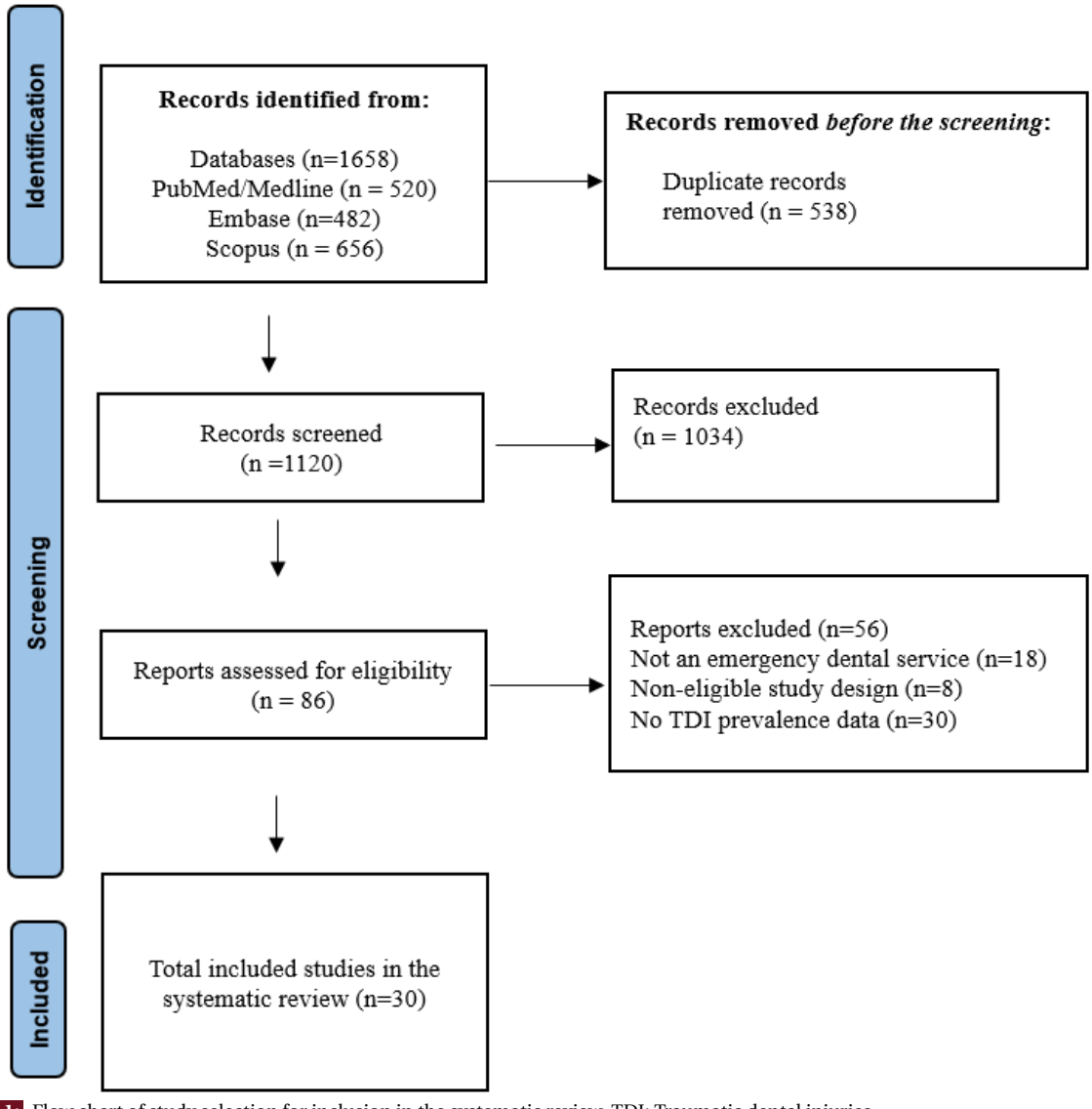

Figure 1: Flow chart of study selection for inclusion in the systematic review. TDI: Traumatic dental injuries.

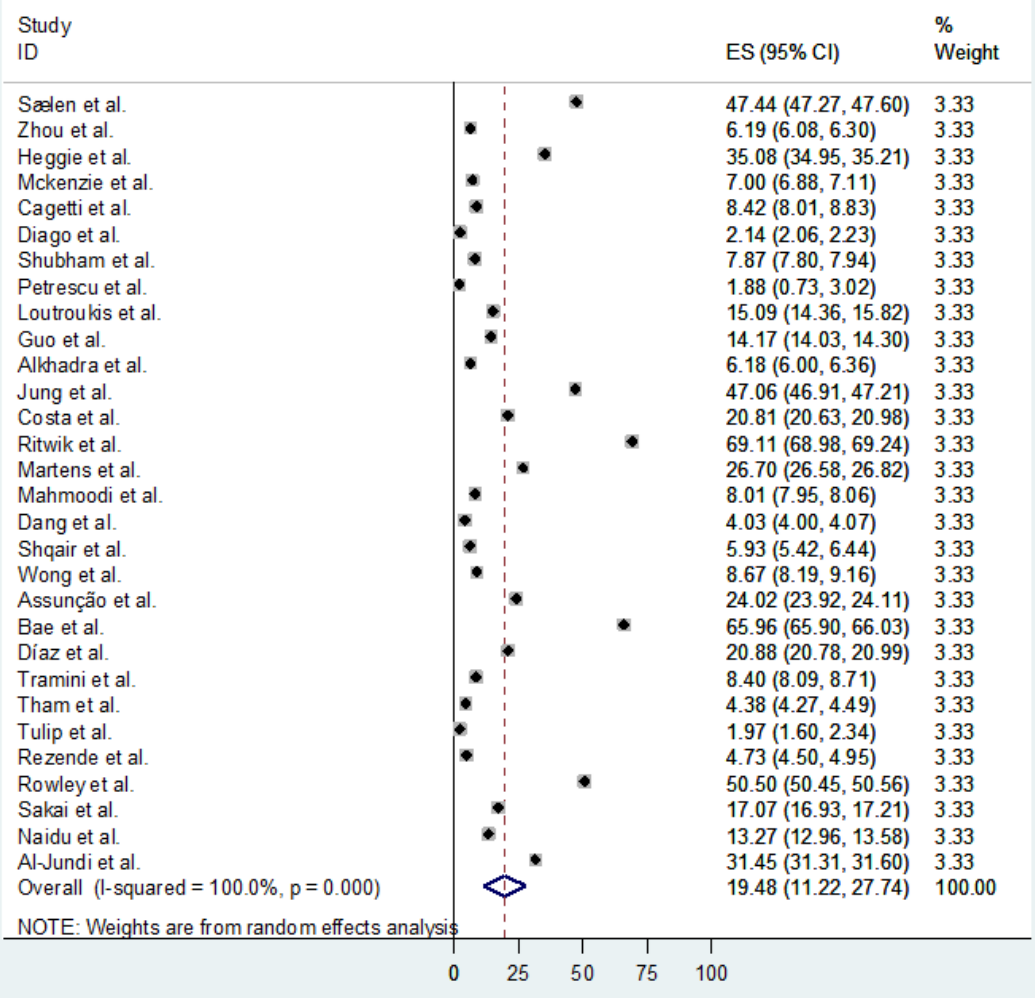

Figure 2: Pooled prevalence of traumatic dental injuries (TDI). CI: confidence interval; ES: Effect size.

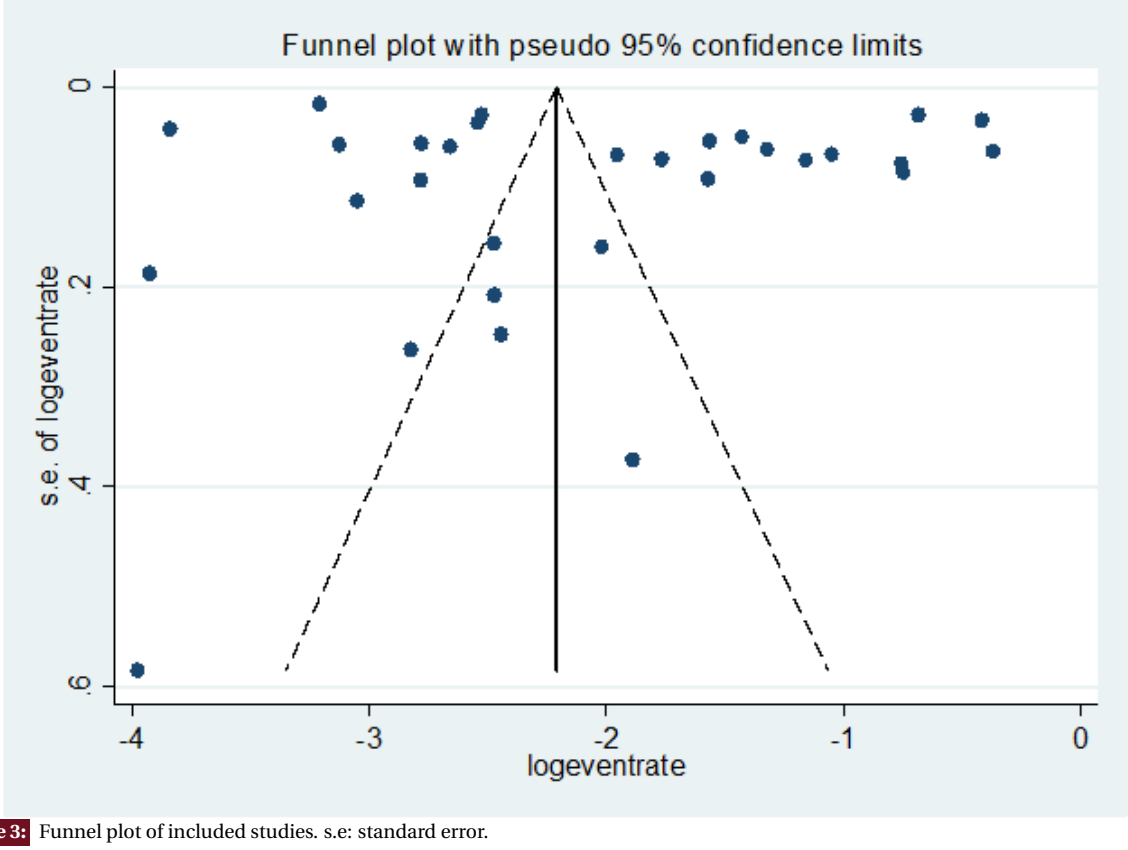

Figure 3: Funnel plot of included studies. s.e: standard error.