

Global Epidemiological Patterns, Etiology, and Risk Factors of Traumatic Dental Injuries in Children and Adolescents: A Systematic Review

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Abstract

Traumatic dental injuries (TDIs) are a common public health problem in children and adolescents, but reported prevalence and associated risk factors vary substantially across studies. This systematic review synthesized recent evidence on the epidemiology, etiology, and risk factors of TDIs in pediatric populations. PubMed, Scopus, and Web of Science were searched for observational studies published between January 2015 and March 2026. Studies reporting prevalence, causes, or risk factors of TDIs in individuals aged 0–18 years were included. Methodological quality was assessed using Joanna Briggs Institute critical appraisal tools. Because of substantial heterogeneity in study design, populations, and outcome definitions, a meta-analysis was not feasible and a narrative synthesis was performed. Twenty-five studies comprising 157,486 participants were included. Reported prevalence ranged from 3.54% to 52.0%. Falls were the leading cause of injury, followed by collisions and sports-related activities. TDIs were more frequent in males, crown fractures predominated in permanent dentition, and luxation injuries were more common in primary teeth. The findings highlight substantial methodological and contextual heterogeneity and support the need for standardized research approaches and targeted prevention strategies.

Introduction

Traumatic dental injuries (TDIs) are a significant public health issue affecting children and adolescents worldwide. These injuries can involve both primary and permanent teeth and may lead to pain, difficulties in chewing, aesthetic concerns, and long-term dental problems [1]. In addition to their clinical impact, TDIs can affect psychological well-being and social interactions, potentially reducing quality of life [2]. Studies indicate that a substantial number of children experience dental trauma, although reported prevalence varies depending on age, region, and study methodology. Previous systematic reviews reported that approximately 17.5% of children and adolescents have experienced a traumatic dental injury, with boys generally being more affected than girls [1, 3].

The variation in prevalence can be explained by multiple factors. Falls, collisions, and sports activities are consistently identified as the main causes of dental injuries in children [4]. Certain anatomical characteristics, such as increased overjet or insufficient lip coverage, have also been associated with a higher risk of trauma [3, 5]. Moreover, behavioral and environmental factors, including activity level, supervision, and socioeconomic context, may contribute to the likelihood of injury [6].

Despite numerous epidemiological studies, findings are often fragmented and focused on specific populations or regions [1, 7]. A comprehensive synthesis that integrates prevalence data with information on causes and risk factors is still lacking, limiting our understanding of the broader patterns of TDIs in children and adolescents.

Therefore, the aim of this systematic review is to provide a comprehensive synthesis of current evidence regarding the epidemiology, etiology, and associated risk factors of traumatic dental injuries in children and adolescents, with the goal of identifying patterns and research gaps that may inform future clinical and public health interventions.

Unlike previous reviews, this study integrates epidemiological patterns with etiological and contextual risk factors, providing a more comprehensive understanding of TDI determinants in pediatric populations.

Materials and methods

A systematic review of the literature was conducted to identify studies investigating traumatic dental injuries (TDIs) in children and adolescents. The review was conducted and reported in accordance with the PRISMA 2020 statement. Electronic searches were performed in PubMed, Scopus, and Web of Science for articles published from 1 January 2015 to 31 March 2026.

Keywords and Boolean operators were used to capture relevant concepts, including:

("traumatic dental injury" OR "dental trauma" OR "TDI") AND ("children" OR "adolescents" OR "pediatric") AND ("prevalence" OR "risk factors" OR "etiology"). In PubMed, Medical Subject Headings (MeSH) such as "Tooth Injuries"[Mesh], "Child"[Mesh], "Adolescent"[Mesh], and "Risk Factors"[Mesh] were applied to improve search sensitivity. In Scopus and Web of Science, equivalent searches were performed using title, abstract, and keyword fields. Additionally, the reference lists of included articles were manually screened to identify further eligible studies.

Eligible studies were original observational studies, including cross-sectional, cohort, and case-control designs, that reported data on the prevalence, etiology, or risk factors of TDIs in participants aged 0–18 years. Systematic reviews, meta-analyses, narrative reviews, case reports, case series, letters, conference abstracts, studies focusing exclusively on special populations, and studies without primary data on TDIs were excluded.

All identified records were imported into EndNote for deduplication. After automatic and manual removal of duplicates, two independent reviewers screened titles and abstracts for relevance. Potentially eligible articles underwent full-text assessment. Any disagreements were resolved through discussion, and when necessary, by consultation with a third reviewer. The study selection process was documented using a PRISMA 2020 flow diagram (Fig. 1).

Data extracted from the included studies comprised: first author, publication year, country, study design, sample size, age and sex distribution, prevalence of TDIs, causes or etiology, and reported risk factors.

Methodological quality and risk of bias were assessed using the Joanna Briggs Institute (JBI) critical appraisal tools. The checklist for prevalence studies was applied to population-based studies estimating the frequency of traumatic dental injuries, the cohort checklist was used for longitudinal and follow-up studies, and the case series checklist was used for retrospective clinical studies including only children with traumatic dental injuries.

Due to heterogeneity in study designs, populations, and outcome measures, a narrative synthesis was conducted. Prevalence ranges, common causes of TDIs, and associated risk factors were summarized in tables and described in the text.

The review protocol was not registered. Due to substantial heterogeneity in study design, populations, and outcome definitions, a quantitative meta-analysis was not feasible, and a narrative synthesis was conducted

Results

A total of 25 studies published between 2015 and 2025 were included, comprising 157,486 children and adolescents overall. The number of participants per study ranged from 73 to 122,370. The included studies comprised both population-based prevalence studies and clinical or retrospective case-based studies, which were analyzed separately where appropriate. The included evidence consisted of 12 cross-sectional studies in the broad sense, including conventional cross-sectional designs [8–11, 31], retrospective cross-sectional studies [12, 13], one cross-sectional retrospective study [14], one multicenter cross-sectional study [15], one cross-sectional pathfinder study [16], and one national survey-based cross-sectional study [17, 32]. In addition, there were 6 retrospective studies [18–23], 2 retrospective cohort studies [24, 25], 1 retrospective comparative study [26], 2 retrospective longitudinal studies [27, 28], and 1 retrospective analysis of national health insurance data [29]. There was one prospective study with follow-up [30]. Studies including exclusively participants with TDIs (reporting 100% prevalence) were not considered in prevalence estimation but were included in the analysis of injury characteristics and etiology. The details of included studies are presented in Table 1.

Table 1
Prevalence of injuries according to study design, sample size, and gender

Author/ Year [reference]	Country	Study design	Total sample size	Subjects affected with TDI	Age	Sex distribution (with TDI)	Teeth affected
Akgun et al., 2025 [12]	Turkey	Retrospective cross-sectional study	822 children	59 children (7,2%)	0–14	Boys 59.3%, Girls 40.7%	Permanent 76.3%, Primary 23.7%
Alshayeb et al., 2025 [8]	Syria	Cross-sectional study	869 children	153 children (17.6%)	9–12	Boys 68%, Girls 32%	Primary and permanent teeth
Wang et al., 2025 [18]	China	Retrospective study	1,683 children	1,683 children (100%)	0–17	Boys 70.4% Girls 29.6%	Primary teeth 58.7% Permanent teeth: 41.3%
Xue et al., 2025 [19]	China	Retrospective study	9,039 children	9,039 children (100%)	0–12	Boys: 62.4% Girls: 37,6%	Primary teeth (100%)
Dolic et al., 2024 [13]	Bosnia and Herzegovina:	Retrospective cross-sectional study	73 children	73 children (100%)	1–15	Boys: 63% Girls: 37%	Primary teeth 46.6% Permanent teeth 53.4%
Luengo-Ferreira et al., 2024 [20]	Mexico	Retrospective study	3,281 children	116 children (3,54%)	1–13	Boys 62.9% Girls 37.1%	Primary teeth: 75% Permanent teeth: 25%
Wieland & Filippi, 2024 [29]	Switzerland	Retrospective analysis of national health insurance data	122,370 children	4,906 children (4%)	0–16	Boys 59.4%, Girls 40.6%	Primary teeth 44.9%, Permanent teeth 30.8%, Both 6.4%
Fitzgibbon et al., 2023 [14]	Italy	Cross-sectional retrospective study	298 children	298 children (100%)	0–9	Boys 65%, Girls 35%	Primary teeth (100%)
Olczak – Kowalczyk et al., 2022 [31]	Poland	Cross-sectional (questionnaire-based, self-reported)	1741 adolescents	315 adolescents (18%)	18	Boys 42.2% Girls 57.8%	Permanent teeth 100%
Rueda-Ibarra et al., 2022 [15]	Mexico	Multicenter cross-sectional study	477 children	87 children (18.2%)	6–12	Boys 48.9%, Girls 51.1%	Permanent teeth 100%
Agouropoulos et al., 2021 [21]	Greece	Retrospective study	236 children	236 children	1–18	Boys: 66% Girls: 34%	Primary teeth 20% Permanent teeth 80%
Anderson et al., 2021 [24]	Sweden	Retrospective cohort study	1,346 children	110 children (8.2%)	1–3	Boys: 64% Girls: 36%	Primary teeth 100%
Gümüő et al., 2021 [25]	Turkey	Retrospective cohort study	650 children	650 children (100%)	0–15	Boys 63,1% Girls 36,9%	Primary teeth: 21,2% Permanent teeth: 78,8%

Author/ Year [reference]	Country	Study design	Total sample size	Subjects affected with TDI	Age	Sex distribution (with TDI)	Teeth affected
Ng et al., 2020 [22]	Australia	Retrospective study	337 children	337 children (100%)	0–18	Boys 63.8% Girls 36.2%	Primary teeth 60.2%, Permanent teeth 39,8%
Zaleckienė et al., 2020 [9]	Lithuania	cross-sectional study	757 children	393 children (52%)	11–13	Boys 52% Girls 48%	Permanent incisors and canines (100%)
Bratteberg et al., 2019 [27]	Norway	Retrospective longitudinal study	2,055 children	338 children (16,4%)	16	Boys : 57,1% Girls 42,9%	Permanent incisors and canines (100%)
Das et al., 2019 [10]	India	Cross-sectional study	500 children	209 children (41,8%)	5–16	Boys 59.2% Girls 40.8%	Not specified, but mostly permanent teeth
Kaczmarek et al., 2019 [32]	Poland	Cross-sectional, national survey	992 adolescents	218 adolescents(22.0%)	15	Boys 56.4% Females43.6%	Permanent teeth 100%
Martoli et al., 2019 [28]	Brazil	Longitudinal study	150 children	150 children (100%)	1–6	Boys 63.3%, Girls 36.7%	Primary teeth (100%)
Mustafa Ali et al., 2019 [26]	Germany	Retrospective comparative study	245 children	245 children (100%)	6–14	Boys 70.9%, Girls 29.1%	Permanent teeth 100%
Odersjö et al., 2018 [30]	Sweden	Prospective study with follow-up	138 children	35 children (25,4%)	0–4	Boys: 60% Girls: 40%	Primary teeth 100%
Bilder et al., 2016 [16]	Georgia	Cross-sectional pathfinder study	823 children	86 children (10,4%)	Children aged 12 and 15	Boys48.8\% Girls51.2\%	Permanent teeth 100%
Blokland et al., 2016 [17]	England, Wales, Northern Ireland	Cross-sectional (Children's Dental Health Survey 2013)	6,707 children	590 children (9,1%)	Children aged 8, 12, 15.	Boys: 62% Girls 38%	Only permanent incisors were assessed
Škaričić et al., 2016 [23]	Croatia	Retrospective study	447 children	447 children (100%)	1–16	Boys 59.1%, Girls 40.9%	Primary teeth (28.6%), Permanent teeth (71.4%)
Ramaiah et al., 2015 [11]	India	Cross- sectional study	1450 children	186 children (12,8%)	9–14	Boys 63,4% Girls 36,6%	Permanent teeth 100%

Across all included studies, 20,426 participants were reported as having traumatic dental injuries (TDIs). In studies with a defined population denominator, the reported proportion of children affected by TDI ranged from 3.54% [20] to 52.0% [9]. Ten studies included exclusively children with TDIs and therefore reported 100% affected cases [13, 14, 8, 19, 21, 22, 23, 25, 26, 28].

Sex distribution was reported in 22 of the 23 studies. In the studies with available data, boys accounted for a higher proportion of TDI cases in nearly all reports, ranging from 52.0% [9] to 70.9% [26]. There was only one study in which girls slightly outnumbered boys (51.1% vs. 48.9%) [15].

With regard to the dentition affected, 5 studies focused exclusively on primary teeth, 7 on permanent teeth or permanent anterior teeth only, and 10 included both primary and permanent dentitions. In 1 study, the type of dentition affected was not explicitly specified, although permanent teeth appeared to predominate [10].

Table 2 shows heterogeneity in the reported types of traumatic dental injuries, their causes, and injury location.

Table 2
Distribution of Injury Types, Etiology, and Injury Location.

Author/Year [reference]	Types of injury	Causes of injury	Location of injury:	Classification system used
Akgun et al., 2025 [12]	Crown fractures – 76.2% Avulsion – 6.6% Subluxation – 5.2% Concussion – 5.2% Intrusive luxation – 3.4% Root fractures – 1.7% Extrusive luxation – 1.7%	Falls 77.9%; other causes not specified	School – 37.2% Home – 25.4% Playground – 16.9% Other – 20.3%	Andreasen & Andreasen (for primary and permanent teeth)
Alshayeb et al., 2025 [8]	Uncomplicated crown fractures – 46.9% Enamel fractures – 19.7% Complicated crown fractures – 14.3% Crown-root fractures – 4.4% Missing teeth – 8% Discoloration – 7.2%	Falls – 28.1% Fighting – 21.6% Collisions – 19% Traffic accidents – 13.7% Domestic violence – 3.9%	School – 38.6% Street – 26.8% Home – 15.7% Parks – 5.2% Clubs – 1.3% Other places – 2.6% Not clear – 9.8%	World Health Organization (WHO) system modified by Andreasen et al.
Wang et al., 2025 [18]	Primary teeth: Subluxation – 41.9% Concussion – 12.2% Lateral luxation – 10.0% Permanent teeth: Uncomplicated crown fracture – 28.6% Subluxation – 25.2%	Falls / slips Sports-related accidents / collisions Playground / outdoor activities Traffic accidents / commuting Other accidents at home or school	Home School Playground / Outdoor areas Sports facilities	IADT Guidelines / Criteria
Xue et al., 2025 [19]	Soft tissue/jaw injury – 22.3% of cases Single tooth injury – 50.8% Multiple teeth injured – 49.2%	Falls – majority Collisions / hits – frequent Traffic / vehicle accidents Sports / play injuries Other / unknown –	Home – most common Kindergarten / preschool – frequent School – less frequent Outdoor playground / park – frequent Other / unspecified – minor	Andreasen and Andreasen classification of traumatic dental injuries
Dolic et al., 2024 [13]	Primary dentition: Enamel fracture – 36.4% Enamel-dentin-pulp fracture – 27.3% Lateral luxation – 20.5% Permanent dentition: Enamel fracture – 35.9% Enamel-dentin fracture – 28.2% Lateral luxation – 24.0%	Falls Collisions / accidents Sports-related injuries Traffic accidents Other accidental injuries	Home School Playground / outdoor activities	ICD-11 TDI classification (WHO, 2022)

Author/Year [reference]	Types of injury	Causes of injury	Location of injury:	Classification system used
Luengo-Ferreira et al., 2024 [20]	Concussion – 20.7% Subluxation – 15.8% Uncomplicated crown fracture – 13.6% Complicated crown fracture – 10.3% Avulsion – 8.2% Extrusive luxation – 8.2% Intrusive luxation – 7.1% Root fracture – 6.5% Lateral luxation – 4.3% Complicated crown-root fracture – 3.3% Enamel infraction – 2.2%	Not reported	Not reported	Not reported
Wieland & Filippi, 2024 [29]	Crown fracture with pulp involvement – 20.7% Avulsion – 6.4% Luxation injury (other than avulsion) – 25.6% Root fracture – 2.8% Concussion / minor injury – 44.5% (remaining injuries, less severe, no pulp involvement)	Fall – 68% Impact – 14% Collision – 8% Crash – 7% No information – 1% Other – remaining cases	Ground – 39.0% Scooter – 6.8% Bicycle – 4.8% Stairs – 4.6% Swimming pool – 3.2% Table – 3.0% Football – 2.8% Physical education – 2.5% Trampoline – 2.3% Bed – 2.0% Swing – 1.5% Sofa – 1.4% Bathtub – 1.3% Slide – 1.3% Balance bike – 1.2% Chair – 1.1% Ski – 1.1% Other / no information – 26.1%	Not explicitly stated
Fitzgibbon et al., 2023 [14]	Hard tissue injuries: 51% Root fracture: 31% Other hard tissue injuries: 69% Periodontal tissue injuries: 62% Concussion: 35% Other luxation injuries: 65% Single tissue lesion: 87%	Accidental falls: 69.5% Collisions (people/objects): 33.9% Sport-related: 2.7% Road accidents: 1.3% Abuse: 0.3%	Home 55% School 25% Playground: 18% Other: 5%	Andreasen (1970)

Author/Year [reference]	Types of injury	Causes of injury	Location of injury:	Classification system used
	Combined lesions: 13%			
Olczak – Kowalczyk et al., 2022 [31]	Crown fracture : 56% Subluxation / lateral luxation / extrusion: 25% Intrusion: 10% Avulsion : 9%	Fall: 43% Collision with object/person: 36% Hit with an object: 22%	School: 86% Outside school: 14%	Questionnaire-based (self-reported) according to WHO criteria
Rueda-Ibarra et al., 2022 [15]	Enamel fracture 17.2%, Missing tooth 8.1%, Lip wound 3.4%, without consequences 71,3%	Recreational activity – 34.5% Sports – 31.0% Misuse of teeth – 19.6% Falls – 6.9% Automobile accident – 4.6% Violence / Not remembered – 3.4%	Not specified	O'Brien (1994)
Agouropoulos et al., 2021 [21]	Permanent Teeth Fractures: 60% Luxations: 39% Primary Teeth Luxations: 69% Fractures: 28%	Falls Sports / collisions with others – Assaults / traffic accidents Bunk bed falls	Not specified	Andersson et al. (2019) classification
Anderson et al., 2021 [24]	Lateral luxation: 23.6% Enamel fracture: 15.5% Enamel-dentin fracture: 7.3% Subluxation: 7.3% Intrusive luxation: 7.3% Crown-root fracture: 1.8% Root fracture: 1.8% Avulsion: 3.6% Concussion: 1.8% Extrusive luxation / alveolar fracture: 0%	Not reported	Not reported	International Association of Dental Traumatology (IADT) classification for primary dentition
Gümüş et al., 2021 [25]	Primary teeth: Subluxation: 21.5% Intrusion: 13.8% Lateral luxation: 15.4% Extrusion: 4.0% Avulsion: 11.7% Hard tissue fractures (enamel, enamel-dentin, crown/root fractures): 10.4% (combined) Permanent teeth:	Falls: primary 59.0%, permanent 64.1% Struck by object: primary 33.5%, permanent 15.6% Car/bicycle accident: primary 4.7%, permanent 12.6% Collision with people: primary 2.4%, permanent 4.9% Fight: primary 0%, permanent 0.9%	Primary teeth: home 65.1%, street 20.8%, playground 9.0%, school 4.7%, unknown 0.5% Permanent teeth: school 41.9%, home 16.4%, street 22.8%, playground 17.3%, unknown 1.6%	Andreasen & Andreasen

Author/Year [reference]	Types of injury	Causes of injury	Location of injury:	Classification system used
	Enamel-dentin fracture: 35.9% Concussion: 28.5% Complicated crown fracture: 12.6% Subluxation: 9.8% Lateral luxation: 2.2% Extrusion: 1.4% Avulsion: 3.1% Other hard tissue fractures: 6.5% (combined)	Unknown: primary 0.5%, permanent 1.9%		
Ng et al., 2020 [22]	Deciduous teeth: Lateral luxation – 33.8% Subluxation – 20.6% Avulsion – 12.7% Intrusion – 12.9% Extrusion – 5.6% Uncomplicated crown fracture – 5.0% Permanent teeth: Uncomplicated crown fracture – 24.6% Subluxation – 19.6% Lateral luxation – 18.1% Avulsion – 9.6% Extrusion – 9.6% Intrusion – 6.2% Complicated fracture – 5.4% Root fracture – 1.5%	Falls – 64.4% Collision with person – 9.5% Bicycle accidents – 8% Skateboarding / skating activities – 5.9% Trampoline – 4.2% Struck by person – 2.7% Motor vehicle accidents – 1.7% Other causes – 3.6%	Home – 48.5% Road / footpath – 11.3% Sports ground / facility – 8.9% Childcare center – 8.6% Playground – 8.3% Rural outdoor – 3.9% School – 3.6% Swimming pool – 3.0% Other – 3.9%	ICD-10-AM (International Statistical Classification of Diseases and Related Health Problems, 10th revision, Australian Modification)
Zaleckienė et al., 2020 [9]	Minor enamel fracture (TI code 1): 89% Untreated dentine fracture (TI code 2): 5% Restored fracture (TI code 5): 6% Severe trauma with pulp involvement / likely luxation (TI code 3): 0.2% Missing tooth due to trauma / avulsion (TI code 4): 0%	Falls or collisions with objects: 63% Sport/leisure activities: 32% Traffic accidents: (not separately quantified in study, very low) Violence: (not separately quantified, likely very low) Other accidents	Not reported	Trauma Index (TI)
Bratteberg et al., 2019 [27]	Injuries were categorized as mild, moderate, or severe according to Skaare & Jacobsen (2003). Mild: 83.7%	Not reported	Not reported	Skaare & Jacobsen (2003)

Author/Year [reference]	Types of injury	Causes of injury	Location of injury:	Classification system used
	Moderate/Severe: 16.3%			
Das et al., 2019 [10]	No injury: 58.2% Other damage: 16.8% Enamel fracture only: 6.4% Pulp involvement: 4.2% Enamel + dentin fracture: 3.8% Missing tooth due to trauma: 3.4% Treated injury: 3.2% Excluded tooth: 4.0%	Falls Sports activities Fights / collisions	Not specified	World Health Organization Oral Health Assessment Form (2013)
Kaczmarek et al., 2019 [32]	Crown fracture: 46.2% Luxation: 43.9% Avulsion: 9.9%	Accidental falls: 96.3% (including sports-related 27.1%) Violence/fight: 3.7%	School: 13.8% of cases Other locations not specified	Questionnaire-based (self-reported) according to WHO criteria
Martioli et al., 2019 [28]	No injury to hard tissue/pulp: 64.1% Uncomplicated crown fracture: 28.5% Complicated crown fracture: 6.7% Crown-root fracture: 0.8% Lateral luxation: 22.3% Subluxation: 12.5% Concussion: 11.7% Other supporting tissue injuries: remaining %	Falls from own height: 78.1% Other accidents: 21.9%	Not explicitly stated	Andreasen & Andreasen (for primary and permanent teeth)
Mustafa Ali et al., 2019 [26]	Crown fractures – 50.7% Subluxation – 21.1% Lateral luxation – 6.6% Intrusive luxation – 1.4% Extrusive luxation – 0.5% Avulsion – 1.9% Root fracture – 1.4%	Fall/slip – 32.5% Sports/exercise – 18.8% Biking – 14.5% Playing – 20.5% Violence/fighting – 2.6% Other (car accidents, misuse) – 11.1%	School – 36.5% Home – 19.1% Sports facilities – 13.9% Street – 13.9% Other / unspecified – 16.6%	IADT classification
Odersjö et al., 2018 [30]	Fractured teeth: 11% Mobile teeth: 14% Displaced teeth: 8% Teeth involved but no significant injury: 67%	Falling accidents: 83% Other causes (e.g., collisions, unknown, playing on slides outdoors): 17%	At home: 80% At kindergarten: 15% At playground: 2%	Not reported
Bilder et al., 2016 [16]	T1 (Enamel fracture): 91.3% T2 (Enamel + dentine fracture): 8.7% T3–T6: 0%	Not reported	Not reported	Sgan-Cohen et al. classification of traumatic dental injuries

Author/Year [reference]	Types of injury	Causes of injury	Location of injury:	Classification system used
Blokland et al., 2016 [17]	Traumatic dental injuries to permanent incisors, types not distinguished.	Not reported	Not reported	CDHS criteria for permanent incisors
Škaričić et al., 2016 [23]	Crown fracture (enamel + enamel-dentin ± pulp) – 61.2% Crown-root fracture – 1.4% Root fracture – 1.8% Subluxation – 27.3% Avulsion – 8.2% Intrusion – 8.0% Extrusion – 5.1% Displacement – 1.4%	Falls – 63.8% Collisions with objects – 21.9% Bicycle / rolling accidents – 11.8% Violence – 2.5%	Home (1–6 yrs) – majority School (7–12 yrs) – majority Free time (13–16 yrs) – majority	Andreasen & Andreasen (for primary and permanent teeth)
Ramaiah et al., 2015 [11]	Enamel fracture: 63.32% Enamel/dentine fracture: 19.60% Pulpal involvement: 7.04% Non-vital tooth: 6.03% Displacement: 1.51% Avulsion 2.51%	Fall: 46.24% Sports-related injury: 24.19% Accident (other than fall/sports) 11.83% Violence: 6.99% Biting trauma: 5.91% Unknown cause 4.84%	Not reported	WHO Classification of Tooth Fractures

In studies involving permanent dentition, crown and enamel fractures were the most frequently reported injury types [8, 12, 13], whereas in studies focused on primary dentition, luxation injuries, particularly subluxation and lateral luxation, were more commonly observed [18, 22, 25].

Across the included studies, falls were the most consistently reported cause of injury [12, 29, 30, 31, 32] while collisions, sports-related accidents, and, less frequently, traffic-related events were also identified [8, 15, 26]. When injury location was reported, home and school were the most common settings, with playgrounds/outdoor areas also frequently represented [14, 18, 19].

The classification of injuries varied across studies. The most commonly used systems were those of Andreasen and Andreasen and the IADT, although other approaches, including WHO-based systems, ICD-based classifications, the Trauma Index, and study-specific criteria, were also applied.

Methodological quality was predominantly moderate across the included studies. Of the 25 studies, 7 were rated as high quality, 16 as moderate quality, and 2 as low quality. Higher ratings were more common among the prevalence studies and retrospective clinical studies, whereas the cohort/longitudinal group included the only low-quality studies. The most frequent concerns were limited representativeness and unclear response rates in prevalence studies, insufficient baseline and follow-up reporting in cohort studies, and unclear consecutive/comprehensive case inclusion with lack of follow-up outcomes in retrospective clinical studies. The details of quality assessment are presented in Tables 3–5.

Table 3

Methodological quality assessment of prevalence studies using the JBI Critical Appraisal Checklist for Studies Reporting Prevalence Data.

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Total "Yes"	Overall appraisal	Main comments
Akgun et al., 2025	N	Y	Y	Y	Y	Y	U	Y	NA	6	moderate	Single-center retrospective design; non-population-based sample; examiner reliability not reported
Alshayeb et al., 2025	Y	Y	Y	Y	Y	Y	Y	Y	U	8	high	Overall response rate not explicitly stated.
Wieland & Filippi, 2024	Y	Y	Y	Y	Y	Y	U	Y	NA	7	moderate	Diagnostic standardization and recording completeness were not fully described
Luengo-Ferreira et al., 2024	N	Y	Y	Y	Y	Y	U	Y	NA	6	moderate	Clinic-based sample limits generalizability; measurement standardization and examiner reliability not clearly reported
Rueda-Ibarra et al., 2022	Y	U	Y	Y	Y	Y	U	Y	U	6	moderate	Participant sampling, examiner reliability, and response rate were not clearly reported
Olczak-Kowalczyk et al., 2022	Y	Y	Y	Y	Y	U	U	Y	U	6	moderate	TDI was self-reported using non-clinical questionnaire terms, questionnaire validity was not clearly reported, and the overall response rate was not explicitly stated
Zaleckienė et al., 2020	Y	Y	Y	Y	Y	Y	Y	Y	N	8	high	Low response rate may limit representativeness
Das et al., 2019	Y	Y	Y	Y	Y	Y	U	Y	U	7	moderate	Examiner reliability and response rate were not clearly reported
Kaczmarek et al., 2019	Y	Y	Y	Y	Y	Y	Y	Y	U	8	high	Overall response rate/non-response at the population level was not explicitly reported
Bilder et al., 2016	Y	U	Y	Y	Y	Y	U	Y	U	6	moderate	Participant sampling, examiner reliability, and response rate were not clearly reported
Blokland et al., 2016	Y	Y	Y	Y	Y	Y	U	Y	U	7	moderate	Restricted outcome definition (permanent incisors only), unclear measurement reliability, and lack of explicit response-rate reporting
Ramaiah et al., 2015	U	U	Y	Y	Y	Y	U	Y	U	5	moderate	Insufficient detail on school sampling, no formal sample size calculation, no examiner calibration/reliability data, and no reported response rate

Legend: Y = Yes; N = No; U = Unclear; NA = Not applicable. Overall appraisal may be categorized as High (8–9 Yes), Moderate (5–7 Yes), or Low (0–4 Yes) quality.

Question guide

Q1. Was the sample frame appropriate to address the target population?

Q2. Were study participants sampled in an appropriate way?

Q3. Was the sample size adequate?

Q4. Were the study subjects and the setting described in detail?

Q5. Was the data analysis conducted with sufficient coverage of the identified sample?

Q6. Were valid methods used for the identification of the condition?

Q7. Was the condition measured in a standard, reliable way for all participants?

Q8. Was there appropriate statistical analysis?

Q9. Was the response rate adequate, and if not, was it managed appropriately?

Table 4

Methodological quality assessment of cohort and longitudinal studies using the JBI Critical Appraisal Checklist for Cohort Studies.

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Total "Yes"	Overall appraisal	Main comments
Anderson et al., 2021	Y	Y	U	Y	U	N	Y	Y	U	U	Y	6	moderate	Unclear exposure measurement, insufficient reporting of confounder adjustment, absence of a clearly outcome-free baseline, and incomplete reporting of follow-up completeness
Bratteberg et al., 2019	Y	Y	U	Y	Y	N	Y	Y	N	N	Y	7	moderate	Insufficient detail on questionnaire validity/reliability, no clearly outcome-free baseline, low participation rate, no reported strategy to address incomplete participation/follow-up
Martoli et al., 2019	N	N	Y	N	N	N	Y	Y	N	N	Y	4	low	No unexposed comparison group was defined, no confounder-adjustment strategy was reported, follow-up decreased markedly without clearly explained attrition handling
Odersjö et al., 2018	N	N	U	N	N	Y	U	Y	U	N	Y	3	low	Absence of defined exposed/unexposed groups, no reported questionnaire validation, no confounder framework, partial reliance on non-verified parent-reported outcomes, no clear reporting of cohort completeness or handling of incomplete follow-up

Legend: Y = Yes; N = No; U = Unclear; NA = Not applicable. Overall appraisal may be categorized as High (9–11 Yes), Moderate (6–8 Yes), or Low (0–5 Yes) quality.

Question guide

Q1. Were the two groups similar and recruited from the same population?

Q2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?

Q3. Was the exposure measured in a valid and reliable way?

Q4. Were confounding factors identified?

Q5. Were strategies to deal with confounding factors stated?

Q6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?

Q7. Were the outcomes measured in a valid and reliable way?

Q8. Was the follow-up time reported and sufficient to be long enough for outcomes to occur?

Q9. Was follow-up complete, and if not, were the reasons for loss to follow-up described and explored?

Q10. Were strategies to address incomplete follow-up utilized?

Q11. Was appropriate statistical analysis used?

Table 5

Methodological quality assessment of retrospective clinical studies using the JBI Critical Appraisal Checklist for Case Series.

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total "Yes"	Overall appraisal	Main comments
Wang et al., 2025	Y	Y	Y	U	U	Y	Y	Y	Y	Y	8	high	Insufficiently explicit reporting of consecutive case inclusion and completeness of record inclusion
Xue et al., 2025	U	U	Y	U	U	Y	Y	N	Y	Y	5	moderate	Formal inclusion criteria, examiner reliability, and completeness of case inclusion not clearly described, no follow-up outcomes reported
Dolic et al., 2024	Y	Y	Y	U	Y	Y	Y	Y	Y	Y	8	high	Consecutive inclusion of all eligible cases was implied rather than explicitly state
Fitzgibbon et al., 2023	Y	Y	Y	U	Y	Y	Y	N	Y	Y	8	high	Non-explicit consecutive inclusion and absence of follow-up outcome reporting
Agouropoulos et al., 2021	U	Y	Y	U	U	Y	Y	N	Y	Y	6	moderate	Lack of explicit inclusion criteria, no clear statement on consecutive or complete case inclusion, and no follow-up outcome reporting
Gümüř et al., 2021	Y	Y	Y	U	U	Y	Y	N	Y	Y	7	moderate	Complete case inclusion over 2016–2019 were not explicitly documented, and follow-up outcomes were not reported
Ng et al., 2020	Y	U	Y	U	U	Y	Y	N	Y	Y	6	moderate	Limited reporting on diagnostic standardization, no explicit statement on complete inclusion of all eligible presentations, and no follow-up outcome reporting
Mustafa Ali et al., 2019	U	U	Y	U	U	Y	Y	N	Y	Y	5	moderate	Limited reporting of eligibility criteria, uncertain diagnostic comparability, no explicit statement on complete case inclusion or follow-up outcome
Škaričić et al., 2016	U	U	Y	U	U	Y	Y	N	Y	Y	5	moderate	Lack of explicit eligibility criteria, unclear diagnostic standardization, no clear statement on inclusion, no follow-up outcome reporting

Legend: Y = Yes; N = No; U = Unclear; NA = Not applicable. The overall methodological quality may be categorized as High when 8–10 items are rated “Yes”, Moderate when 5–7 items are rated “Yes”, and Low when 0–4 items are rated “Yes”.

Question guide

Q1. Were there clear criteria for inclusion in the case series?

Q2. Was the condition measured in a standard, reliable way for all participants included in the case series?

Q3. Were valid methods used for identification of the condition for all participants included in the case series?

Q4. Did the case series have consecutive inclusion of participants?

Q5. Did the case series have complete inclusion of participants?

Q6. Was there clear reporting of the demographics of the participants in the study?

Q7. Was there clear reporting of clinical information of the participants?

Q8. Were the outcomes or follow-up results of cases clearly reported?

Q9. Was there clear reporting of the presenting site(s)/clinic(s) demographic information?

Q10. Was statistical analysis appropriate?

Discussion

Traumatic dental injuries (TDIs) in children and adolescents constitute a significant and complex global public health issue, characterized by marked heterogeneity in prevalence, etiology, and clinical presentation. The present systematic synthesis integrates findings across epidemiological and clinical studies, providing a more comprehensive understanding of TDI patterns by jointly considering prevalence data, causative factors, and contextual risk determinants.

The wide range of reported TDI prevalence (3.54% to 52.0%) reflects substantial methodological and contextual variability across studies [8, 9, 20]. Differences in diagnostic criteria, age groups, dentition assessed, and study design contribute significantly to this heterogeneity [1, 3]. Notably, clinical and hospital-based studies tend to overrepresent more severe cases, whereas population-based surveys may underestimate minor injuries that do not require professional care [13, 20, 22].

Importantly, studies including exclusively affected individuals (reporting 100% prevalence) reflect injury characteristics rather than population burden and should be interpreted separately [14, 22]. This distinction highlights the need for standardized epidemiological approaches to enable more reliable comparisons across studies.

A robust and consistent finding across the included studies is the higher prevalence of TDIs among males [14, 21, 22, 23, 25]. This disparity is most plausibly explained by behavioral factors, including greater participation in high-risk physical activities and contact sports [22]. However, variability in the magnitude of this difference across studies suggests that sociocultural and environmental factors may also influence gender-related risk [16].

The observed bimodal age distribution of TDIs, with peaks in early childhood and school age, reflects developmental and behavioral transitions [14, 28]. In younger children, immature motor coordination increases susceptibility to falls, whereas in older children and adolescents, increased physical activity and social interaction contribute to injury risk [13, 23, 25].

Longitudinal evidence suggests that TDI risk may also be shaped by life-course factors, including psychosocial characteristics and behavioral traits [27]. This perspective indicates that TDIs are not solely acute events but may be influenced by cumulative exposures over time.

Across diverse settings, falls consistently emerge as the leading cause of TDIs [12, 29, 30, 31, 32]. Secondary causes, including collisions, sports-related injuries, and traffic accidents, become more prominent with increasing age [8, 15, 26]. The relative contribution of these factors varies depending on developmental stage and environmental exposure.

Contextual influences are particularly evident in settings affected by socioeconomic instability or conflict. For example, a relatively high proportion of injuries related to interpersonal violence has been reported in conflict-affected populations [8]. Similarly, environmental factors such as rural residence and limited access to safe recreational spaces may increase injury risk [16].

The distribution of injury types differs between dentitions. In permanent teeth, crown fractures—particularly enamel and enamel-dentin fractures—are most common [8, 23], whereas in primary dentition, injuries to supporting tissues, such as subluxation and luxation, predominate [22, 25]. These differences are consistent with anatomical and biomechanical characteristics of the developing dentition.

Maxillary central incisors are the most frequently affected teeth across studies, reflecting their anterior position and increased exposure to trauma [8, 16, 23]. Additionally, multiple-tooth injuries and soft tissue involvement are frequently reported, underscoring the complexity of TDI presentations [22, 23].

Delayed presentation following TDI is a recurrent finding across studies. A substantial proportion of patients seek care more than 24 hours after injury, which may negatively affect prognosis and increase the risk of complications [13, 23]. Longitudinal data indicate that post-traumatic sequelae may develop months or years after the initial injury, highlighting the importance of timely management and long-term follow-up [28].

TDI risk is influenced by a combination of anatomical, behavioral, and socioeconomic factors. Increased overjet has been consistently associated with higher injury risk [16]. Socioeconomic determinants, including parental education and financial status, also appear to play a role in TDI occurrence [31, 32]. However, findings are not entirely consistent across studies, suggesting that these associations may be context-dependent [17].

This review provides a comprehensive synthesis of recent evidence, integrating multiple dimensions of TDI epidemiology. However, substantial heterogeneity in study design, diagnostic criteria, and reporting standards limits comparability and precludes quantitative meta-analysis. Additionally, the inclusion of both population-based and clinical studies introduces variability in case representation.

Future research should prioritize standardized definitions and reporting frameworks, as well as longitudinal designs that capture the multifactorial nature of TDI risk. Greater integration of psychosocial and environmental determinants within a life-course framework may further enhance understanding and inform prevention strategies.

Conclusions

Traumatic dental injuries (TDIs) in children and adolescents remain a significant global public health concern due to their high prevalence and multifactorial etiology. The findings of this systematic review indicate that falls, sports-related activities, and accidents occurring at home and school are the most common causes of TDIs, while increased overjet, inadequate lip coverage, male sex, and socioeconomic factors represent the most relevant risk factors.

The incidence and distribution of TDIs vary across regions and populations; however, their impact on oral health, function, aesthetics, and quality of life is consistently substantial. Early identification of high-risk individuals, implementation of preventive strategies, and increased awareness among parents, caregivers, teachers, and healthcare professionals are essential to reduce the burden of these injuries.

Future research should focus on standardized epidemiological reporting and high-quality prospective studies to improve comparability between populations and support the development of evidence-based preventive and clinical management protocols.

Declarations

Data availability

All data analyzed in this study were derived from published articles cited in the reference list. No new datasets were generated. The extracted data supporting the findings of this review are available from the corresponding author upon reasonable request.

Author contributions

K.S. conceived the study, performed the literature search, screened records, extracted data, and drafted the manuscript. P.P.-Z. contributed to study selection, data extraction, methodological appraisal, and critical revision of the manuscript. D.O.-K. supervised the study, resolved disagreements in study selection and interpretation, and critically revised the manuscript. All authors reviewed and approved the final version of the manuscript.

Competing interests

The authors declare no competing interests.

Use of artificial intelligence

A large language model was used only for language editing and stylistic refinement of the manuscript. All scientific content, study selection, data extraction, interpretation, and final approval of the manuscript were performed by the authors.

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This study is a systematic review based exclusively on previously published studies and publicly available data. No human participants, human tissue, personal data, or animals were directly involved in this research. Therefore, ethical approval was not required.

Consent to Participate declaration: not applicable.

This study is a systematic review based on previously published studies and did not involve direct participation of human subjects.

Consent to Publish declaration: not applicable.

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Figures

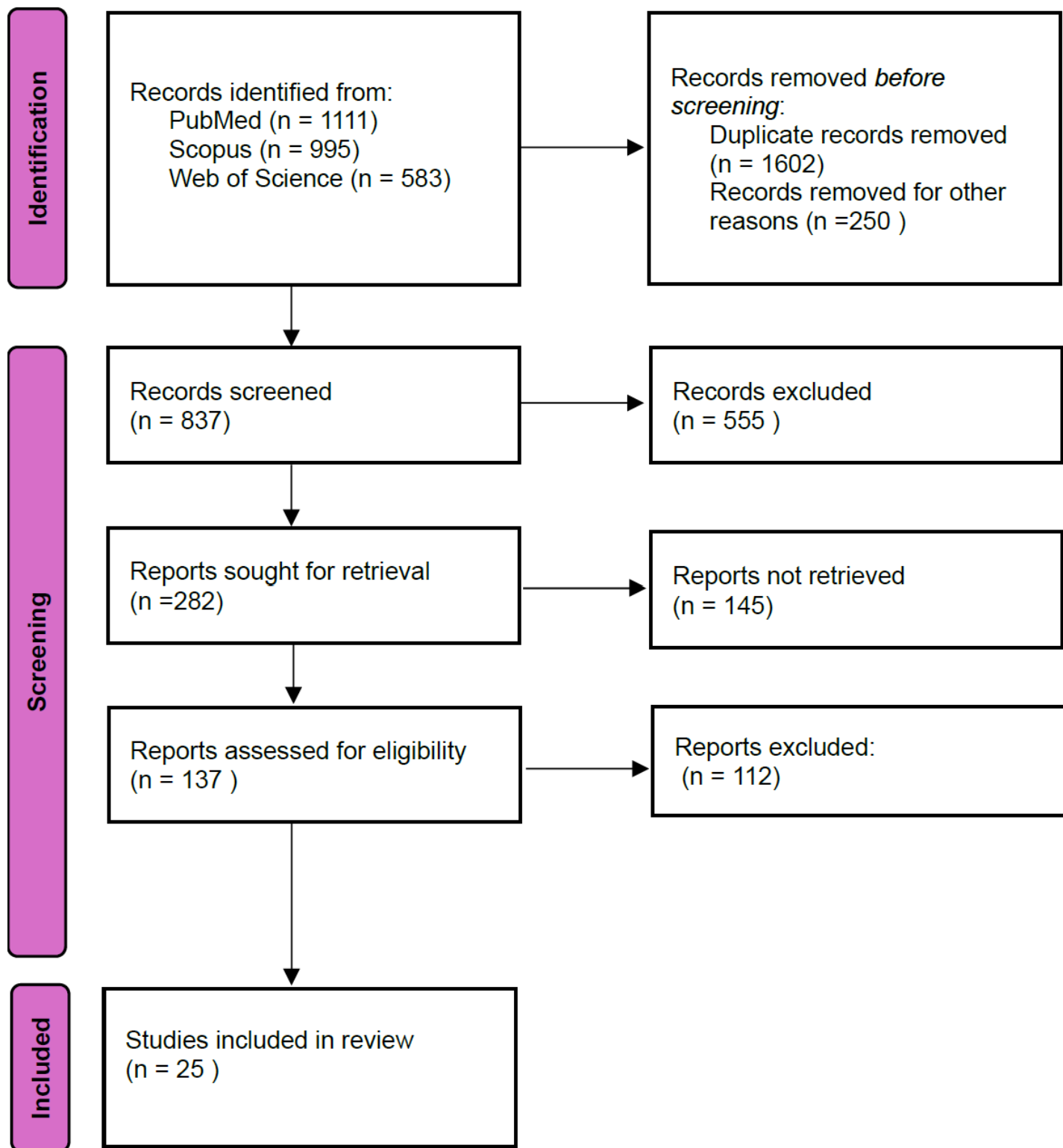


Figure 1

PRISMA 2020 flow diagram of study selection.