A systematic review and meta-analysis of oral and maxillofacial trauma

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KEYWORDS

Trauma;
Oro-maxillofacial;
Injuries;
Accidents;
Epidemiology

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ABSTRACT

Objective of work: The aim of this study was to determine the most frequent injuries and their relationship with gender, age and aetiology.

Materials and Methods: An Epidemiologic Systematic Review was carried out, in the databases PUBMED and Scopus, between 2010-2020. We used Joanna Briggs Institute Checklist to access the Risk of Bias and Grading of recommendations, assessment, development, and the evaluations (GRADE) method was applied to assess the quality of the evidence of the 78 included articles.

Results and Conclusions: Out of the 78 articles included, 14 were classified as moderate-risk bias and 58 as low risk. Only 20.5% had a prospective design and the male/female ratio ranged from 0.299 to 11.83. The majority of the studies described fractures (67) and only 26 reported dental injuries. The studies were distributed into five regions of countries: Asia, Africa, Latin America, Europe and Muslin regions.

The results showed that road traffic accidents (55.37%) were the most frequent type of trauma, followed by assault (17.56%) and falls (10.21%). Fractures were the most prevalent injuries (84.3%). It was possible to establish an association between road traffic accidents and Asian countries. Assaults were more frequent in Africa, predominantly males, whilst falls increased with age, amongst women, in European countries. Fractures were usually observed in Muslin regions.

INTRODUCTION

Trauma is defined as an unexpected event beyond the victim's control, resulting in the presence of a traumatic injury. There are several types of trauma, the most common being those caused by physical injuries, constituting one of the greatest health concerns worldwide.[1-23] In the event of a traumatic situation, this can culminate in either the full recovery of the injury, or the presence of a temporary disorder or a sequel.[23, 24]

These lesions can occur in any part of the body, and in this case, the focus will be on oral maxillofacial region. By oral maxillofacial injuries it is understood any lesion that includes the region of the oral cavity, the teeth, the tongue, the mucous membranes, the mandible, the maxilla, the zygomatic bones, the vessels, the nerves, the temporo-mandibular joint and the soft tissues that form the face. At the dental level, injuries can be divided into periodontal tissue injuries such as: concussion, subluxation, extrusion, lateral dislocation, intrusion, and

avulsion; lesions of the tooth itself: incomplete enamel fracture, uncomplicated coronary fracture, complicated coronary fracture, coronal-radicular fracture, root fracture and finally bone fracture, i.e., fracture of the alveolar process. This division follows the classification proposed by Andreasen.[25,26]

Oral-maxillofacial trauma represents between 7.4 to 8.7% of medical emergencies.[27-29] Their causes differ from country to country, depending on culture, socio-economic status, and environmental factors, [3, 4, 5, 12, 31-54] the main causes being road accidents, falls and violence.

The treatment of these traumas is quite challenging, involving not only the aesthetic aspect but also the function of the injured structures, always taking into consideration the psychological damage.[3, 6-8, 11, 33, 37, 42- 45, 55-62]

To establish the significance and the applicability of the Disabilities Tables for oral-maxillofacial evaluation in civil and labour laws, an evaluation of the prevalence of the type of oral maxillofacial trauma and the aetiology of the injuries are required. Understanding the epidemiology of oral and maxillofacial trauma is essential to shape public health policy and create more adjustable evaluation tables for disabilities. Therefore, the aim of this study was to investigate the epidemiological characteristics of oral maxillofacial trauma, namely to analyse the following features:

- Probabilities of attaining each type of oral and maxillofacial trauma by aetiology.
- Descriptive statistics on age and gender distribution within the different types of trauma.
- Association between oral and maxillofacial trauma type, sequelae, aetiology, age, and gender.

MATERIAL AND METHODS

Protocol and registration

In carrying out this systematic review, the guidelines of the PRISMA recommendations (Preferred Reporting Items for Systematic Reviews and Meta-analyses), version 2020 were followed, rules usually chosen in the performance of systematic reviews and meta-analyses. The protocol was registered in the PROSPERO database (International Prospective Register of Systematic Review), in 2021 (CRD42021251364).

Information sources and search strategy

In this study, the following databases were searched: PubMed/MEDLINE and SCOPUS between the years 2010 and 2020 with Mandarin language restriction. This study included individuals aged 21 years or older who had trauma in the oral maxillofacial region. The age of 21 was chosen because at that time we reach the completion of growth and we are considered adults.

Moreover, no restriction regarding the type of study (retrospective or prospective) was considered. Letters to the editor and studies on individuals that had injuries caused by military service were excluded.

The Medical Subject Headings (MeSH) terms selected for the purposes of this research included 'oral maxillofacial', 'trauma', 'accident' and 'injuries', and included all possible combinations.

Subsequently, we used the PICO framework, which stands for P (Patient Population), I (Intervention or Exposure, in case of observational studies), C (Comparison) and O (Outcomes). In this systematic review, the PICO approach involved Population (adults with oral maxillofacial injuries), Exposure (aetiology of oral maxillofacial trauma), Comparison (different countries with different emergency services) and Outcome (association between aetiology, age, gender and type of trauma).

Eligibility criteria

The following eligibility criteria were implemented for the acquisition of research studies that were directly related to the aim of this investigation: studies needed to be available as full text articles and not merely in the form of an abstract. Moreover, they needed to use a retrospective or prospective design that focused on adult aged 21 years or older and on civilian-type injuries. In addition, studies were included provided that injuries were diagnosed as a result of patients' complaints, and verified clinically, radiographically and during treatment.

The articles were then analyzed through their titles and abstracts, carried out by three evaluators, who independently applied the exclusion and inclusion criteria. Disagreements were discussed among evaluators until a consensus was reached. Finally, the studies were selected after full text assessment. As a result, an Excel form was developed for this purpose and filled out for each study. Cohen's Kappa index [63] was used to verify the agreement of the two main reviewers in the selection of included studies and thus reduce the

risk of losing an admissible study and the possibility of bias (Cohen's Kappa index of 1).

Data extraction was performed using a standardized form that included information on: 1) Study number; 2) Article; 3) Year of publication; 4) Type of Study; 5) Country; 6) Group Countries; 7) Risk of Bias; 8) n (sample size); 9) Male(No.); 10) Female (No.); 11) Proportion of male gender; 12) Male/female ratio; 13) Average age; 14) Standard deviation; 15) Aetiology of trauma; 16) Total injuries; 17) Average number of injuries per patient; 18) Number of patients with fractures; 19) Number of patients with soft tissue injuries; 20) Number of patients with dental lesions. (Table 1)

Table 1. Articles included in this systematic review and the results from the analyzed studies

Article	Type of study	Country	n	Male	Mean age	SD	A	F	RTA	W	S	O	Total Injuries	P/F	P/STI	P/DI
Richard et al [73], 2013	P	UK	64	56			28	18	0	0		18		32	32	6
Shreya et al, [63] 2015	P	Australia	111	98			0	0	0	0	0	0	159	111		
Daniel et al, [30] 2015	R	Germany	409	323	42,7	21,1	185	103	55	20	29	17	775	409		20
Marcus et al, [9] 2015	R	Brasil	47	21	72,4	8,33	5	5	22	0	0	15				
Sahand et al, [3] 2015	R	Iran	221	169	26,9	12	27	25	157	5	0	7	384	221	146	
Benjamin et al,[7] 2015	R	Germany	1305	784	14,7	15,7	87	456	81	22	175	484	2319	1287	355	1287
Razia et al, [39] 2017	R	India	136	104			44	12	59	0	11	10				
Tiwary et al,[74] 2017	P	India	84	57	33,6	14,55	19	6	47	3	9	0		84		
Amare et al, [32] 2017	R	Ethiopia	326	261	29,12	8,62	247	0	70	0	0	9		164	162	
Sahand et al,[4] 2017	R	Iran	502	403	28,8	13,56	36	56	405	0	0	5		502		
Omri et al, [33] 2017	R	Israel	1091	853	36,7	24,8	122	495	428	0	0	46		1091		
Felix et al, [34] 2017	R	Venezuela	334	284			70	23	118	0	3	120	522	334		
Alessandro et al[64], 2017	R	Italy	112	79	41		0	0	0	112	0	0		112		
Seyed et al, [8] 2018	R	Iran	330	291	27,2	6,5	0	0	330	0	0	0		330		228
Mohammed et al,[12] 2019	R	Saudi Arabia	270	241	24,29	11,89	18	43	171	8	22	8	476	270		
Farzin et al [11], 2019	R	Iran	293	231			54	47	160	0	11	21	474	293		
Joab et al,[1] 2018	R	Brasil	332	276	32,9	15,11	38	18	213	7	21	35		319	226	

Dur et al [75], 2018	P	Pakistan	42	36			1	4	34	0	3	0	58	42		
Maher et al,[36] 2019	R	Malaysia	473	389	30,6	18,35	17	27	393	7	6	23		473		
Maximilian et al,[37] 2019	R	Germany	573	441	41,8	19,9	165	137	18	22	45	186	921	573		
Brucoli et al, [76] 2019	R	Europa	1334	599	79,3	6,5	55	1054	105	30	28	62	1717			
Ziyad et al, [10] 2019	R	Saudi Arabia	295	262			0	0	295	0	0	0		295	21	
Safal et al, [38] 2020	R	Nepal	528	425			49	63	226	0	15	25		182	196	
Liu et al,[6] 2020	R	China	829	624	36,1		72	256	379	0	73	49	1486	829		
Fouad et al, [27] 2020	R	Saudi Arabia	166	140	30,69	14,65	26	24	87	8	14	7		166		
Patiguli et al,[2] 2020	R	China	2492	1981			0	383	1042	45	0	1022	3597		826	
Vivek et al, [5] 2020	R	India	64	53			9	12	31	12	0	0		64		8
Sergio et al, [77] 2012	R	Brasil	923	735			0	0	923	0	0	0	1151	471	452	242
Miika et al, [78] 2018	R	Finland	161	110			36	82	28	0	10	5		161		
Muhammad et al,[13] 2019	P	Europa	326	225			0	0	268	0	0	58	442			
Chee et al, [14] 2017	R	Malaysia	618	529	31		73	78	406	0	18	43		193	458	148
Sebastian et al,[79] 2019	R	Germany	62196	44274	42,7	20,5	0	0	52195	0	0	10001		12613		
Satshkumar et al,[54] 2018	P	India	300	273			9	12	279	0	0	0		432		
Yu et al,[18] 2020	R	Japan	130	88	28	17,2	0	0	130	0	0	0		74	143	103
Mats et al, [80] 2020	P	Norway	1543	1126	39,2	18,9	0	0	1543	0	0	0	753	1420		123
Scmuel et al,[81] 2020	P	Israel	4829	1112			0	0	4632	0	0	197	12064		115	2462
Scmuel et al,[46] 2016	R	Israel	8444	6157			0	3881	4563	0	0	0				
Olojede et al,[41] 2016	P	Nigeria	33	25	28,2	7,4	33	0	0	0	0	0		26	33	3
Utsad et al, [58] 2020	R	India	1110	823	25,95	9,35	0	0	1110	0	0	0		586	1110	661

Karuna et al,[48] 2018	R	India	104	82			29	9	51	0	7	8		104		
Adeola et al, [82] 2015	P	Nigeria	259	206	32,21	16,588	29	22	204	0	0	4		177	82	
Max et al, [83] 2015	R	Germany	67	55			9	25	27	0	0	6	287	67		
Lokesh et al,[40] 2019	R	India	1278	1053			158	91	1029	0	0	0		1278		
Arabion et al,[43] 2014	R	Iran	768	660	26,6	126	40	88	520	0	10	110	1118	730	104	57
Fouzia et al,[44] 2019	R	Pakistan	148	130	30,76	1274	4	10	127	3	2	2		148		
Paolo et al, [16] 2015	P	Europa	1309	1207	32,3	14	1309	0	0	0	0	0	1485	1309		
Cavalcanti et al,[56] 2010	R	Brasil	186	166	33,2	131	38	15	74	0	1	58		169	185	14
Phillipo et al,[45] 2011	P	Tanzania	154	112	28,32	16,48	25	22	88	0	4	15	154	54		
Meire et al, [28] 2014	R	Brasil	772	521			140	0	0	0	0	0	2772			
Elitsa et al, [65] 2012	R	Bulgaria	276	216			98	40	56	6	14	2	285			
Mohammed et al,[57] 2018	R	Libya	187	161			32	19	109	0	1	26	326	187		
Kiran et al, [17] 2013	R	India	6872	4912	32,7		128	608	5936	0	64	136	12503			
Ashish et al,[47] 2018	R	India	1850	1228	29	172	489	199	781	0	326	34	1465	1850		
Rishi et al, [66] 2013	R	India	740	600			42	120	532	0	21	35	1054	740		82
Pranav et al,[59] 2012	R	India	1000	853	37,4		538	37	404	0	11	10		180	840	225
Umar et al, [50] 2010	R	Pakistan	340	254	25,85	16,45	14	101	154	0	8	63	387	340		
George et al,[84] 2012	R	Greece	727	618	34,3	16,5	191	100	369	23	22	22	1142	727		
Kumar et al,[51] 2015	R	India	2731	2370			315	260	2086	16	54	0		2052	172	555
La Salete et al,[85] 2014	P	Portugal	209	181	45		6	0	145	35	0	23	546	209		
Parveen et al,[19] 2014	R	India	787	646			105	89	582	3	0	7		667	39	81
Loutroukis et al,[86] 2020	R	Switzerland	201	139	33,67	12,76	86	25	7	8	11	64		148	73	53

Mabrouk et al,[87] 2014	R	Egypt	215	183	25,7256	9,168	88	17	88	0	0	22		215		
Majambo et al,[52] 2013	P	Rwanda	182	126			27	32	83	0	10	30		172	181	67
Sergio et al, [20] 2016	R	Brasil	1179	769			136	362	136	5	17	73	1213	118	760	39
Thanvir et al,[29] 2017	R	India	136	117	32,58	11,5	4	31	92	0	4	5		136	136	
Obitade et al, [53] 2013	R	Nigeria	34	22	21,4	6,26	34	0	0	0	0	0		14	18	2
Stella et al, [21] 2015	P	Nigeria	70	56	30,11	14,97	8	9	49	0	0	4	128	42	52	
Cláudio et al,[88] 2011	R	Brasil	521	412			130	67	222	40	19	43	615	521		
Nathalie et al, [89] 2014	R	France	364	300	34	0,9	143	73	89	14	45	0		364		
Leeza et al, [90] 2015	R	Nepal	279	214			23	74	137	0	20	25	376	147	229	38
George et al,[91] 2015	R	Greece	9616	7532			1744	1633	5272	319	337	311	15484	9616		
Zahoor et al,[92] 2010	R	Pakistan	2112	1533			142	231	1202	0	0	537		941	904	267
Ilky et al,[22] 2017	R	Brasil	244	224	31,16	15,17	32	19	155	0	0	38		218	26	
Vibha et al, [67] 2012	R	India	1038	931			4	22	1008	0	0	4		1670		
Mohanavalli et al,[93] 2016	R	India	267	199	35	11,8	18	48	197	0	4	0		179	18	70
Udeabor et al,[61] 2014	R	Nigeria	86	65			6	0	40	0	0	40	135			
Weihsin et al,[94] 2014	R	India	4437	3730			1041	786	2347	126	54	83	3867	4437		
Mohammad et al,[60] 2011	P	Iran	2450	1887			404	202	858	113	126	747		895	2206	127

R - Retrospective and **P** - Prospective; **SD** - Standart deviation ; **A** - Assault, **F** – Falls, **RTA** - Road traffic accidents, **W** – Work, **S** – Sports, **O** – Others; **P/F** - Patients with fracture, **P/SFI** - Patients with soft tissues injuries, **P/DI** - Patients with dental injuries

Quality of the studies

To access the risk of bias in all identified and collected full text articles included in this study we used Joanna Briggs Institute Checklist for Prevalence Studies (Joanna Briggs Institute. JBI Critical Appraisal Tools for use in JBI Systematic Reviews. Checklist for Prevalence Studies, 2017) (Table 2)[64]. For the qualification of potentially included studies, an independent analysis of the studies was performed by the two main reviewers, with the aim of detecting similarities and differences between them and thus avoiding a selection bias. Each item was scored in "yes", "unclear", "no", or "not applicable" and then each study was classified into three categories:
(a) low risk of bias, if studies reached more than 70% scores of "yes",
(b) moderate risk of bias, if "yes" scores were between 50% and 69%, and
(c) high risk of bias, if "yes" scores were below 49%.

Moreover, GRADE (Grading of Recommendations, Assessment, Development, and Evaluation) method was applied to assess the quality of the evidence, i.e. the cumulative evidence of the included articles. (Table 2)

The value of weighted kappa statistic between author agreements was 100%. After confirming the quality of each study, 2 authors independently extracted the data to the pre-specified data extraction sheet in Microsoft Excel, 2022 version 16.64. Nevertheless, it was not possible to perform a cumulative analysis as the outcome of variables was not homogeneous across the selected studies.

Table 2. GRADE method applied to all articles to assess the quality of the evidence and risk of bias

Article	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Risk of bias	GRADE
Richard et al, 2013	yes	yes	no	yes	yes	yes	yes	unclear	unclear	moderate	low
Shreya et al, 2015	yes	yes	yes	yes	yes	unclear	unclear	yes	yes	low	moderate
Daniel et al, 2015	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Marcus et al, 2015	yes	yes	yes	yes	yes	unclear	unclear	yes	yes	low	low
Sahand et al, 2015	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Benjamin et al, 2015	yes	yes	yes	yes	yes	unclear	unclear	yes	yes	low	moderate
Razia et al, 2017	yes	yes	yes	yes	yes	yes	yes	unclear	unclear	low	moderate
Tiwary et al, 2017	yes	yes	no	yes	yes	yes	yes	yes	yes	low	moderate
Amare et al, 2017	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Sahand et al, 2017	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Omri et al, 2017	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Felix et al, 2017	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Alessandro et al, 2017	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Seyed et al, 2018	yes	yes	yes	yes	yes	yes	yes	yes	no	low	low
Mohammed et al, 2019	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Farzin et al, 2019	yes	yes	yes	yes	yes	unclear	unclear	unclear	yes	moderate	low
Joab et al, 2018	yes	yes	yes	yes	yes	unclear	yes	yes	no	low	moderate
Dur et al, 2018	yes	yes	no	yes	yes	yes	yes	unclear	no	moderate	low
Maher et al, 2019	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Maximilian et al, 2019	yes	yes	yes	yes	yes	unclear	unclear	yes	yes	low	moderate
Brucoli et al, 2019	yes	yes	yes	yes	yes	yes	yes	yes	unclear	low	moderate
Ziyad et al, 2019	yes	unclear	yes	yes	yes	unclear	yes	yes	yes	low	low
Safal et al, 2020	unclear	unclear	yes	no	unclear	unclear	unclear	yes	yes	high	very low
Liu et al, 2020	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Fouad et al, 2020	yes	yes	yes	yes	no	yes	unclear	unclear	yes	moderate	low
Patiguli et al, 2020	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Vivek et al, 2020	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	low
Sergio et al, 2012	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate

Miika et al, 2018	yes	yes	yes	yes	yes	yes	yes	yes	unclear	low	moderate
Muhammad et al, 2019	yes	yes	yes	yes	unclear	yes	unclear	unclear	unclear	moderate	low
Chee et al, 2017	yes	yes	yes	yes	yes	unclear	unclear	unclear	yes	moderate	low
Sebastian et al, 2019	yes	yes	yes	yes	unclear	yes	no	yes	yes	low	moderate
Satshkumar et al, 2018	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Yu et al, 2020	yes	yes	yes	yes	yes	yes	yes	yes	unclear	low	low
Mats et al, 2020	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Scmuel et al, 2020	yes	yes	yes	yes	yes	yes	unclear	yes	yes	low	moderate
Scmuel et al, 2016	yes	unclear	yes	no	yes	yes	unclear	yes	yes	moderate	low
Olojede et al, 2016	yes	unclear	no	yes	no	unclear	unclear	yes	unclear	high	Very low
Utsad et al, 2020	yes	yes	yes	yes	yes	unclear	unclear	yes	yes	low	moderate
Karuna et al, 2018	yes	yes	yes	yes	yes	unclear	unclear	unclear	yes	moderate	low
Adeola et al, 2015	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Max et al, 2015	yes	yes	no	yes	yes	yes	yes	yes	yes	low	low
Lokesh et al, 2019	yes	yes	yes	yes	yes	yes	yes	unclear	unclear	low	moderate
Arabion et al, 2014	yes	yes	yes	yes	yes	yes	yes	unclear	yes	low	moderate
Fouzia et al, 2019	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Paolo et al, 2015	yes	yes	yes	yes	yes	yes	unclear	unclear	yes	low	moderate
Cavalcanti et al, 2010	yes	yes	yes	yes	yes	unclear	unclear	yes	yes	low	moderate
Phillipo et al, 2011	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	Moderate
Meire et al, 2014	yes	yes	yes	no	yes	unclear	unclear	yes	yes	moderate	low
Elitsa et al, 2012	yes	unclear	yes	yes	yes	unclear	unclear	unclear	unclear	high	Very low
Mohammed et al, 2018	yes	yes	yes	yes	yes	yes	yes	unclear	yes	low	moderate
Kiran et al, 2013	yes	yes	yes	yes	yes	yes	yes	unclear	yes	low	moderate
Ashish et al, 2018	yes	yes	yes	yes	yes	unclear	unclear	unclear	unclear	moderate	low
Rishi et al, 2013	yes	unclear	yes	no	unclear	unclear	no	no	no	high	very low
Pranav et al, 2012	yes	yes	yes	yes	yes	unclear	unclear	unclear	yes	moderate	low
Umar et al, 2010	yes	yes	yes	yes	yes	yes	yes	unclear	yes	low	moderate
George et al, 2012	yes	yes	yes	yes	yes	unclear	unclear	yes	unclear	moderate	low
Kumar et al, 2015	yes	yes	yes	yes	yes	yes	yes	unclear	unclear	low	moderate
La Salete et al, 2014	yes	yes	yes	yes	yes	yes	yes	unclear	unclear	low	moderate
Parveen et al, 2014	yes	yes	yes	yes	yes	unclear	unclear	unclear	yes	moderate	low
Triantafillos et al, 2020	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Mabrouk et al, 2014	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Majambo et al, 2013	yes	yes	yes	yes	yes	yes	yes	unclear	yes	low	moderate

Sergio et al, 2016	yes	yes	yes	yes	yes	yes	yes	unclear	yes	low	moderate
Thanvir et al, 2017	yes	unclear	yes	yes	yes	unclear	unclear	unclear	unclear	high	low
Obitade et al, 2013	yes	yes	yes	yes	yes	yes	yes	unclear	yes	low	moderate
Stella et al, 2015	yes	yes	no	yes	yes	yes	yes	unclear	yes	low	moderate
Cláudio et al, 2011	yes	yes	yes	yes	yes	unclear	unclear	unclear	unclear	moderate	low
Nathalie et al, 2014	yes	yes	yes	yes	yes	yes	yes	yes	unclear	low	moderate
Leeza et al, 2015	yes	yes	yes	yes	yes	unclear	yes	unclear	yes	low	moderate
George et al, 2015	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Zahoor et al, 2010	yes	unclear	yes	yes	yes	unclear	unclear	unclear	unclear	high	low
Ilky et al, 2017	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate
Vibha et al, 2012	yes	yes	yes	yes	yes	yes	yes	unclear	unclear	low	moderate
Mohanavalli et al, 2016	yes	yes	yes	yes	yes	yes	yes	yes	unclear	low	moderate
Udeabor et al, 2014	yes	yes	no	yes	yes	unclear	yes	yes	yes	low	moderate
Weihsin et al, 2014	yes	yes	yes	yes	yes	yes	yes	unclear	yes	low	moderate
Mohammad et al, 2011	yes	yes	yes	yes	yes	yes	yes	yes	yes	low	moderate

Q1. Was the sample frame appropriate to address the target population?
Q2. Were study participants recruited in an appropriate way?
Q3. Was the sample size adequate?
Q4. Were the study subjects and setting described in detail?
Q5. Was 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 the low response rate managed appropriately?

RESULTS

Study selection

The review search process yielded 404 articles. Of these, 16 were duplicated on the databases and were excluded. Therefore, 388 articles were screened by titles and abstracts evaluation and only 83 articles were included according to the eligibility criteria. The final number of studies included was 78. The remaining 5 studies were excluded due to discrepancies in the results available in the article. Figure 1 shows the flow diagram with all phases of the review process.

The main results from the analysed studies are described in Table 1, including the number of the study, name of the article, year of publication, study type, country, risk of bias, N (number of patients), number of males and females, male proportion, male/female ratio, mean age, standard deviation of mean age, aetiology, total injuries, average of injuries per patient, number of patients with fractures, number of patients with injuries in the soft tissues and number of patients with dental injuries.

Study characteristics

A total of 78 articles published between 2010 and 2020 that fulfilled the inclusion criteria were included in the review. Out of 78 studies selected, 58 were classified as low risk bias and 14 were classified as moderate-risk bias (Table2).

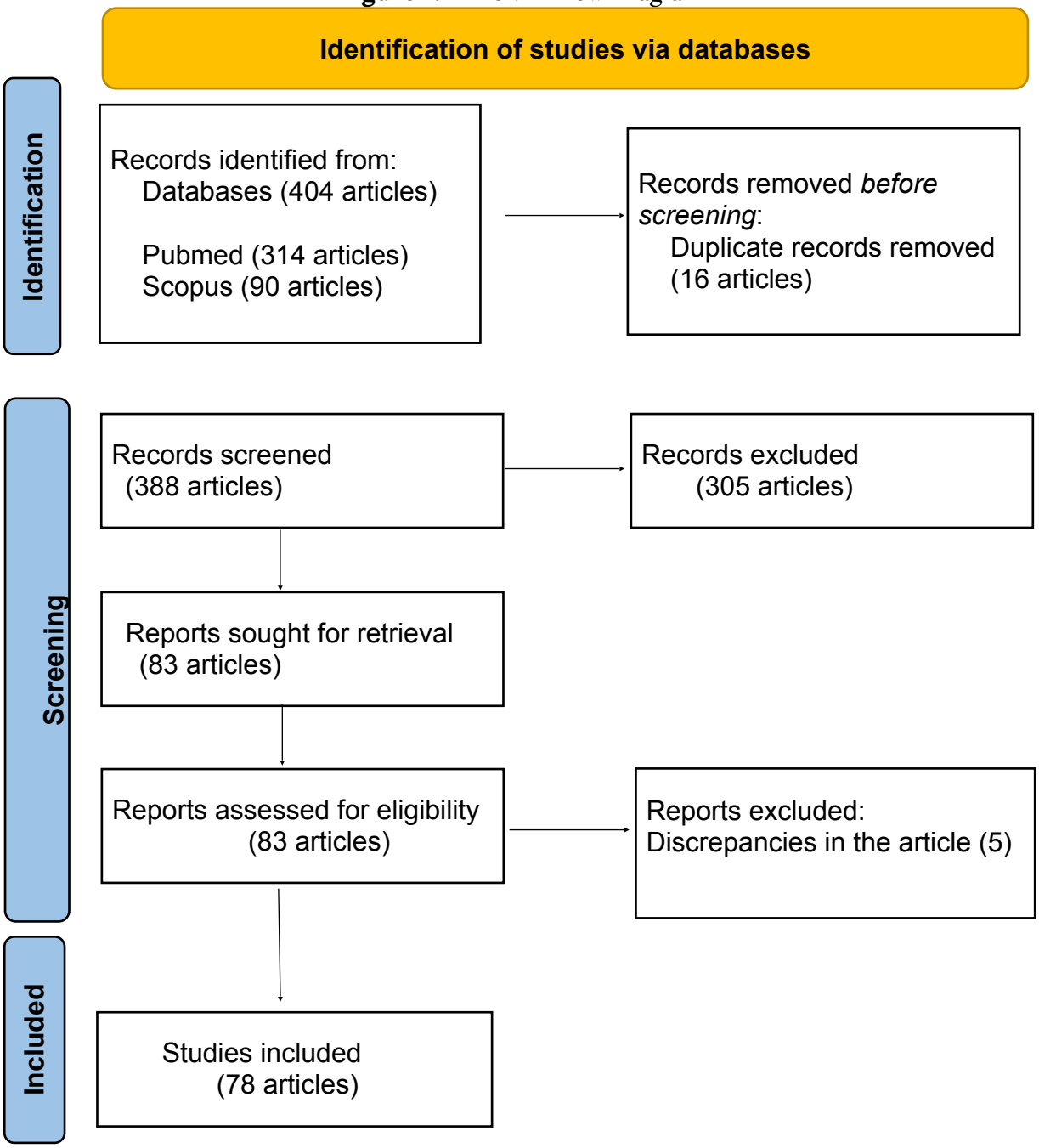
The majority of the studies were retrospective, and only 20.5% had a prospective design. The male/female ratio was discrepant and ranged from 0.299 to 11.83. Dental injuries were reported in 26 studies, fractures were described in 67 and only 31 articles presented information on soft tissue injury.

The distribution according to the region of countries was as follows: nine studies from Latin America, twenty-one from Europe, twenty-four from Asia, nine from Africa and fourteen from Muslin countries. Israel was included in the European group because of similar social lifestyle.

Eight of the 78 articles were not included in the aetiological meta-analysis as they did not contain the necessary information [21,29,39,48,65-68].

In terms of statistical analysis, the I^2 statistic from Higgins and Thompson was applied to assess the degree of inconsistency across studies in the meta-analysis, i.e. to measure the impact of the heterogeneity of the studies on the conclusions of the meta-analysis. Once the heterogeneity was greater than 50% (measures Q and I^2), it was not possible to apply a fixed effects model. Hence, we cannot consider that all studies come from the same population and, therefore, there is no homogeneity among them. Thus, the overall failure estimate and the weight assigned to each study were determined through the random effects model, for the estimation of a proportion and the construction of 95% confidence intervals using the DerSimonian-Laird method. A sensitivity analysis was also carried out, due to the high heterogeneity, through a meta-regression that included the predictors: risk of bias, mean age, ratio between the number of male and female individuals and the region. For statistical treatment, the R software was used, applying the package Meta.

Figure 1. PRISMA Flow Diagram



Figures 2-4 show the aetiologies for each study eligible for the meta-analysis, as well as the combined estimated prevalence. The analysis was based on a random effects model for each aetiology separately, in spite of the multivariate (multinomial) nature of the data. The multivariate approach was not considered here, since the data does not allow the evaluation of some important multivariate statistics, such as Cochran's Q statistic. This occurs because for the calculation of this statistic it is required to invert matrices that, in the database under analysis, are not invertible. The main cause of trauma was road traffic accidents with a prevalence of 55.37 % (95% confidence interval - CI, 43.80% - 66.94%), followed by assault with 17.56% (95% CI, 15.39% - 19.73%) and falls with 10.21% (95% CI, 9.78% - 10.64%). The observed heterogeneity was quite within all aetiologies, even when stratified by world region.

By performing a meta-regression, it was possible to establish an association between some predictors. Assaults were more frequent in males and Africa (p-value <0.001). Falls increased with age and usually occurred in women and in the European and Muslin countries (p-value <0.001). The frequency of road traffic accidents was higher in Asia (p-value between 0.01 and 0.05) and lower in Europe. For sports events, an association between Europe and Latin America and young ages had been established (p-value <0.001).

As for the meta-analysis of injuries, 3 studies [55,66,69] were not taken into account, since in the last two the number of injuries was higher than the sample size. Figures 5, 6 and 7 showed the estimated prevalence of the type of injuries. Fractures were the most frequent type of injury with a prevalence of 84.30% (95% CI, 82.99 - 85.61%). These injuries were often observed in the Muslin regions.

Regarding the soft tissues injuries, the estimated prevalence was 52.11% (95% CI, 32.79% - 71.44%), although no association had been established between the predictors.

The frequency of dental injuries was 25.41% (95% CI, 8.60% - 42.23%). A statistical association had been made between these injuries, young ages and Europe and Asia (p-value <0.001).

DISCUSSION

The main aetiology differed from country to country, being influenced by culture, social environment and laws. The results regarding the road traffic accidents being the most frequent cause of trauma corroborated the literature.[15, 56, 70-74] This finding can be explained by the lack of safety measures or negligence in complying with them, the poor quality of the roads and aggressive driving.[15, 56, 71-74] This aetiology being more frequent in Asia and less in Europe had been verified by many studies,[15, 70-72] which established that in recent years this tended to decrease in Europe due to strict road laws.

In this study, assault and falls were also considered as the main cause of maxillofacial trauma.[15, 70-73] Assault was more usual [71, 74] in the European and Latin America countries, while the falls were more frequent in Europe.[72,74]

The systematic reviews of Al Qahtani et al.[71,72] and Boffano et al.[15] showed that falls were more frequent in elderly people and Chrcanovic [74] revealed that females were more likely to fall. These studies were in agreement with the obtained results.

As we can see, the remaining aetiologies were less frequent,[15, 71-74] however sport had a higher incidence in young people in Europe and Latin America.[15, 74]

Despite the fact of the male/female ratio between the studies being quite discrepant, we can observe a higher number of males, which is corroborated by several authors.[70-74]

As for the type of injury, the prevalence of fractures was significant,[71-74] although few systematic reviews addressed the different types of injuries.

Our study had some limitations, one of them was the high heterogeneity, which can be explained by the different sample sizes and the fact that the majority of the studies were observational, which made the data obtained through the analysis of processes distinct, as each hospital was different and the quality of the information contained in each report can differ.

CONCLUSIONS

Based on the results of our review, it was concluded that road traffic accidents were the main aetiology of oral maxillofacial trauma and special attention should be given to Asia, which presented the highest prevalence. Assault was also a main cause of trauma, being more frequent in males, while falls were more evident in European countries, amongst females and with ageing.

Regarding the type of trauma, fractures were the main type, and dental injuries were frequently seen in young people and Europa/Asia.

Figure 2. Articles included in this systematic review showing aetiology of road traffic accidents

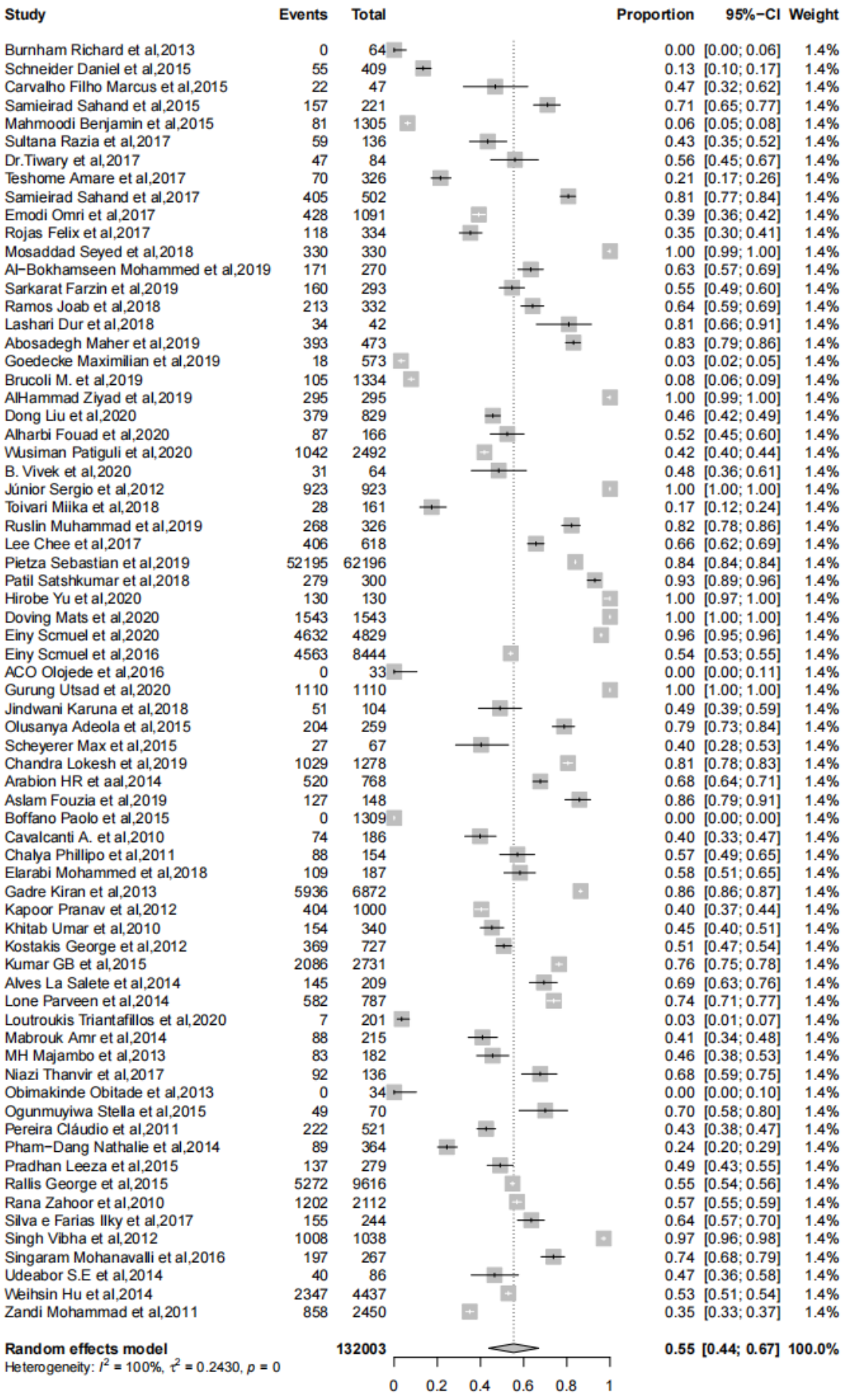


Figure 3. Articles included in this systematic review showing the aetiology assault

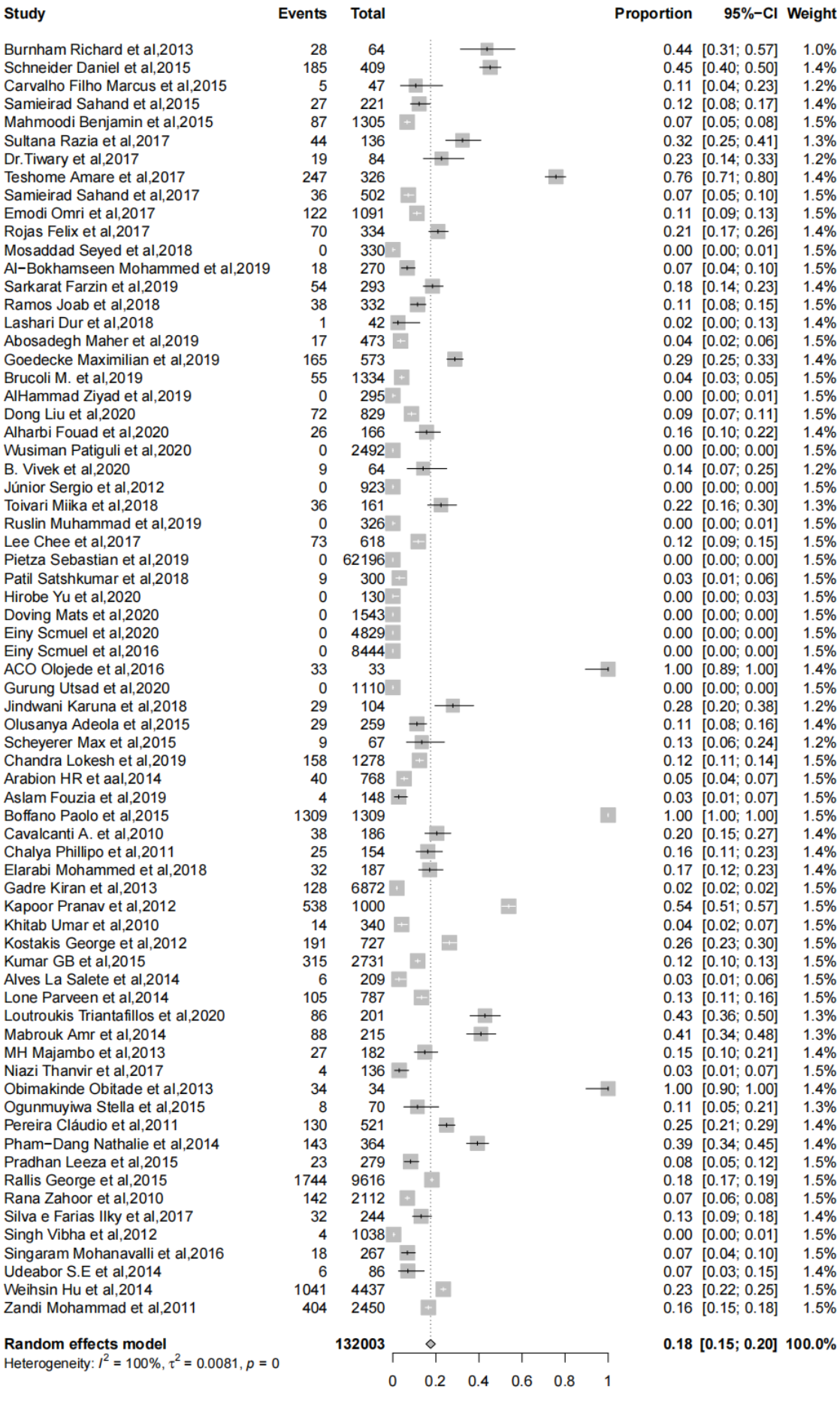


Figure 4. Articles included in this systematic review showing the aetiology falls

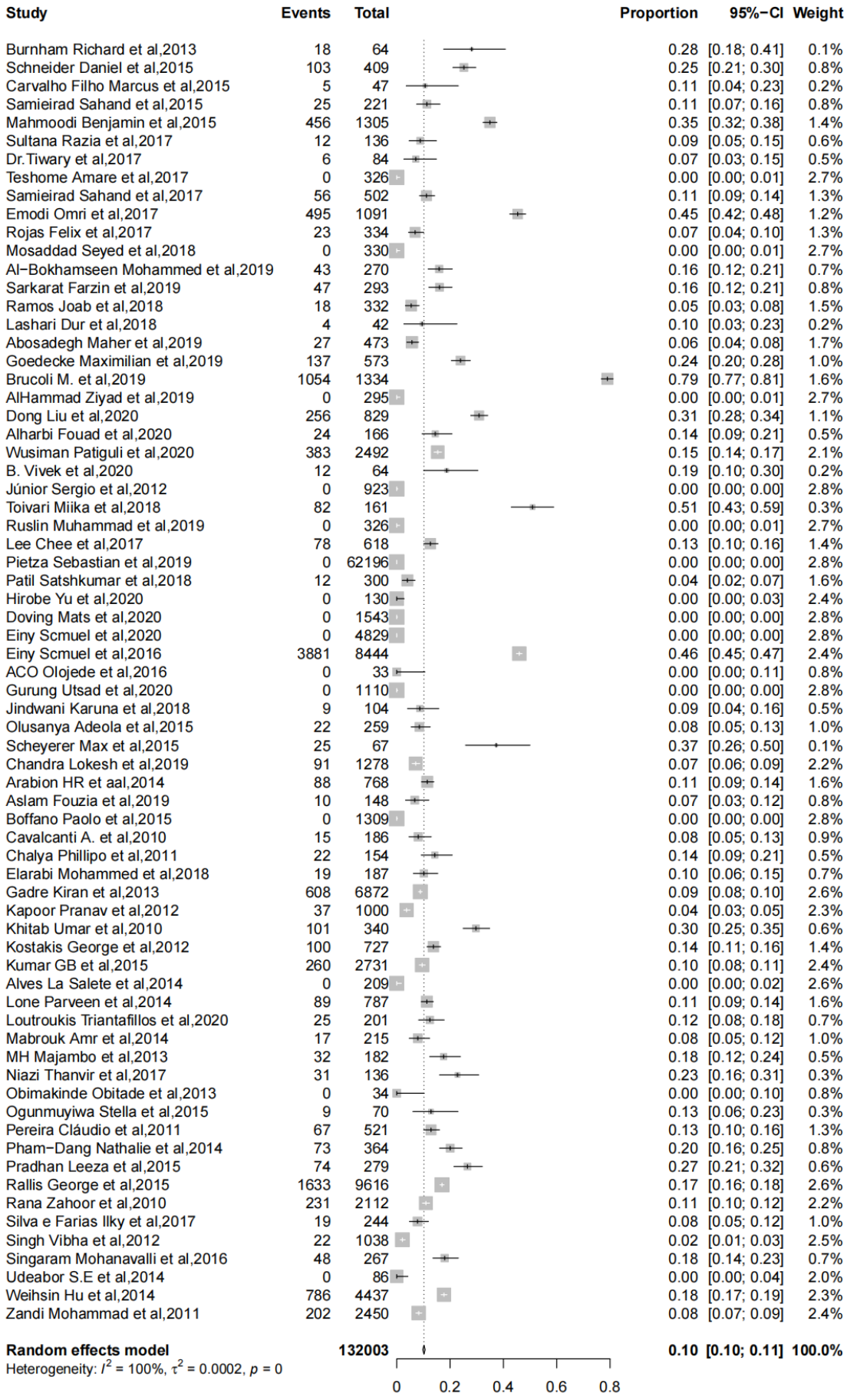


Figure 5. Articles included in this systematic review showing the proportion of fractures

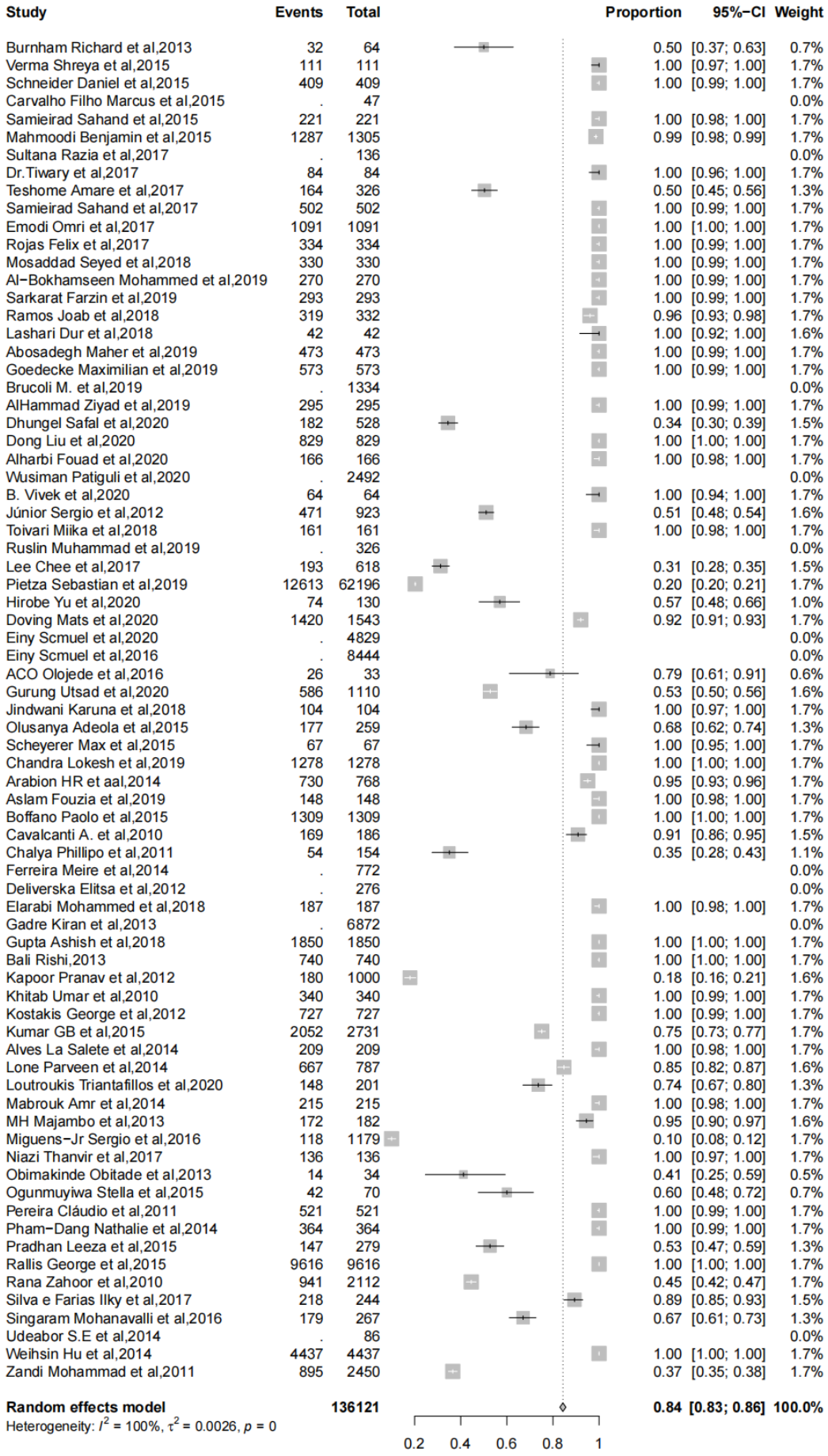


Figure 6. Articles included in this systematic review showing the proportion of soft tissue injuries

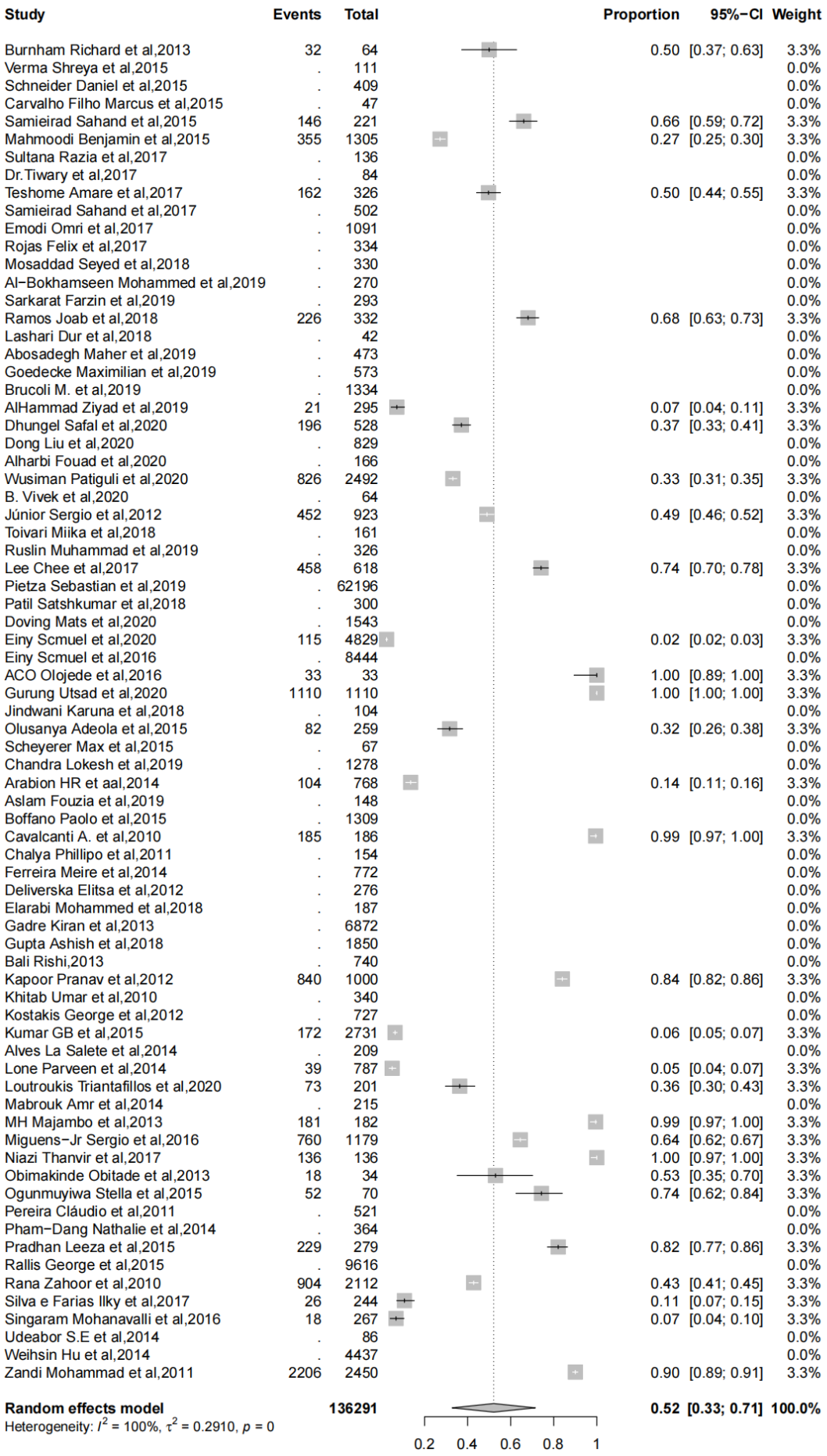
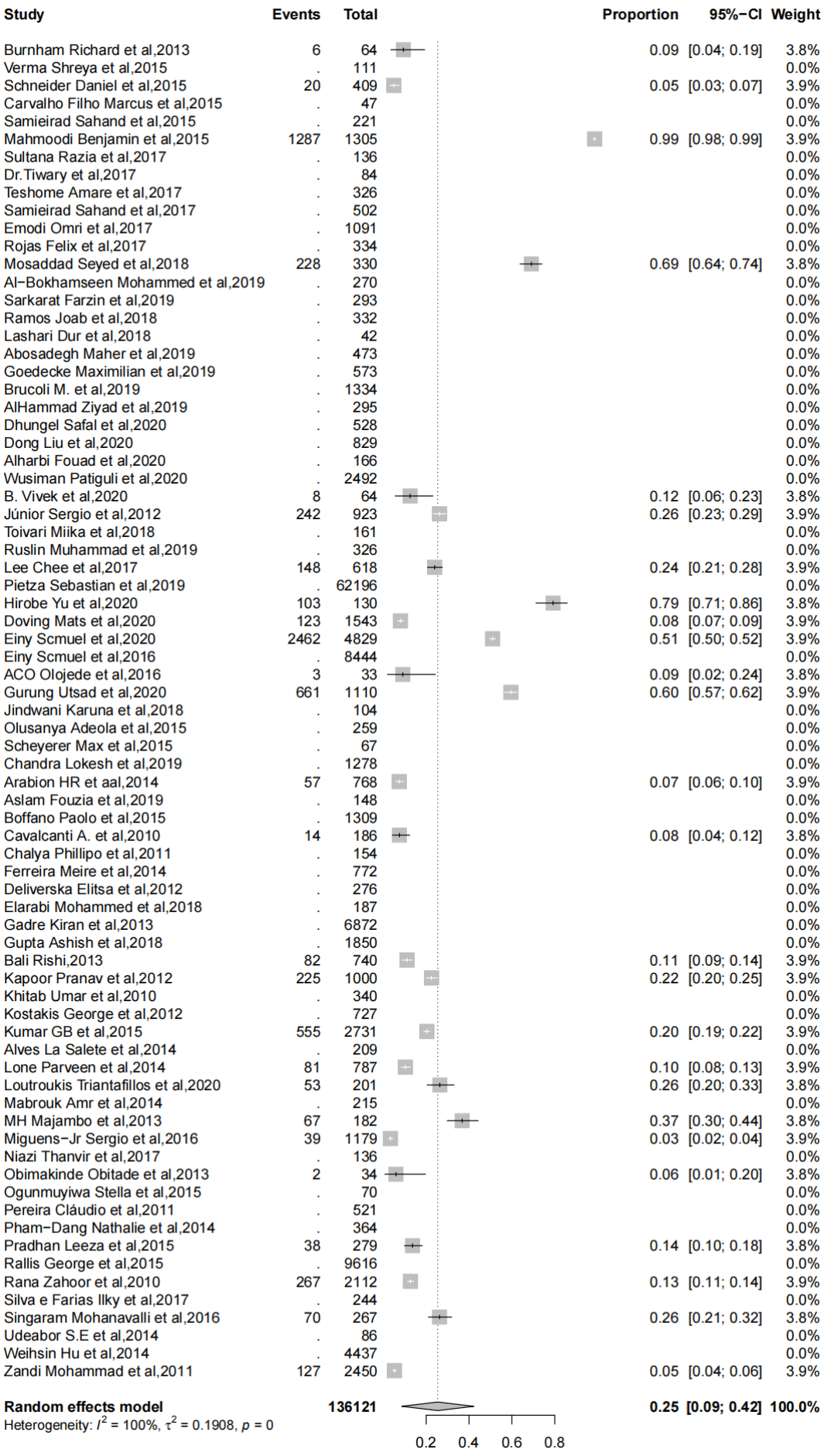


Figure 7. Articles included in this systematic review showing proportion of dental injuries



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