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Dental fear/anxiety among children and adolescents. A systematic review

ABSTRACT

Aim *The aim of this paper was to review the published scientific literature to quantify the prevalence and mean score of dental fear/anxiety (DFA) in children/adolescents and its variation according to several variables.*
Materials and methods *Cross-sectional and cohort studies published from 2000 to 2014, that measured DFA in children /adolescents (aged 0-19 years), in the general population, or visiting private or public dental services (general or pediatric) or attending school and kindergarten, were searched, with specific terms, in 3 electronic databases (Medline, Embase, Web Of Science). Primary data, collected with specific questionnaires of demonstrated reliability and/or validity, were extracted.*
Results *After screening 743 abstracts and evaluating 164 full-text publications, 36 articles were selected. Dental fear/anxiety prevalence rates were 12.2%, 10.0%, 12.2%,11.0% and 20.0% for the CFSS-DS, DAS, MDAS, DFS, and DFSS-SF scores, respectively. In the studies that used MCDAS Dental fear/prevalence rates varied from 13.3% to 29.3%. In the studies that used CFSS-DS ratings, the prevalence and the mean score of dental fear/anxiety was lower in Northern Europe than the remaining countries, the prevalence decreased with increasing age and the frequency was higher in females than males.*
Conclusions *Dental fear/anxiety is a common problem in children/adolescents worldwide, therefore, new strategies to overcome this relevant children/adolescent condition should be encouraged.*

Keywords *Children/adolescents; Dental fear/anxiety; Prevalence.*

Introduction

Dental fear usually refers to a normal unpleasant emotional reaction to specific threatening stimuli occurring in situations associated with dental treatment, while dental anxiety is an excessive and unreasonable negative emotional state experienced by dental patients. These psychological states consist of apprehension that something dreadful is going to happen in relation to dental treatment. Dental fear and dental anxiety are often used indistinctly in the scientific literature, but they represent different progressive degrees of the same psychological condition. The terms dental fear and anxiety (DFA) will be used throughout this review when we refer to strong negative emotions associated with dental treatment among children and adolescents Klingberg and Broberg, 2007]. This abnormal childhood or adolescent dental anxiety sometimes can be linked to a series of uncooperative or troublesome behaviours [Wogelius et al., 2003; Kyritsi et al., 2009; Gustafsson et al., 2010; Salem et al., 2012]. When clinicians treat patients with dental anxiety, the former are inevitably subjected to increased stress [Moore and Brodsgaard, 2001], with more time-consuming treatments, increased costs and other difficulties encountered during their dental practice [Rafique et al., 2008]. This dental-associated fear – with various degrees of severity – is a phenomenon described in studies carried out in different geographic areas, such as Western Europe [Caprioglio et al, 2009] the UK [Howard and Freeman, 2008], Denmark [Wogelius and Poulsen, 2005], Finland [Milen et al., 1990], Sweden [Gustafsson et al., 2010; Klingberg, 1995], Africa (Niger [Ajayi and Arigbede, 2012]), South America (Brasil [Colares et al., 2013]), Asia (Iran [Salem et al., 2012], Israel [Peretz and Kharouba, 2013], Taiwan [Lee et al., 2009], Japan [Nakai et al., 2005]) and Australia [Armfield, 2013]. Lack of oral health [Fayans, 1989; Cinar and Murtomaa, 2007; Gustafsson et al., 2010; Bezabih et al., 2013; Colares et al., 2013; Muppa et al., 2013], as well as poor oral health in children and adolescents [Avesalo et al., 1993; Kruger et al., 1998; Akbay Oba et al., 2009; Olak et al., 2013] motivated our interest in this psychological condition and its early detection. There are three methods to measure dental anxiety: (a) "behavioural assessment", in which

the dental team or researchers are asked to rate both the emotional and behavioural reactions shown by the children during treatment; (b)" psychometric assessment" in which the children or one of their parents have to complete a questionnaire, usually before the treatment, to indicate the child's level of anxiety associated with various common dental situations; (c)"physiological response analysis" in which variations of parameters linked to anxiety are measured, such as salivary cortisol levels [Porrit et al., 2013]. Psychometric assessments, using questionnaires, is the most common and easy measuring methods of childhood and adolescent DFA [Porrit et al., 2013].

The aim this systematic review is to determine the distribution and level of DFA during childhood and adolescence. Specifically this review aims to determine (a) the prevalence of DFA in children and adolescents; (b) the mean level of DFA in children and adolescents; and (c) how the prevalence and the mean level of DFA vary with age, gender, country, setting, questionnaire respondent (parent or child), and the threshold anxiety score (cut-off).

Methods

Inclusion criteria

Study design: Review of the literature. We included only cross-sectional and cohort studies that measured the prevalence and mean score of DFA and its variation with the abovementioned variables. Studies that did not report prevalence data, were not included. Population and setting: Children and adolescents (aged 0–19 years), belonging to the general population or visiting private or public dental services (general or paediatric) or attending school and kindergarten. Endpoints: Primary data, collected through psychometric evaluations with specific questionnaires, of demonstrated reliability and/or validity, clearly showing anxiety cut-off values and intelligible 5 points response scoring scales (e.g., Likert scale, Facial image scale), were extracted. The questionnaires having the aforementioned features, included in this review and listed in Table 1, were the following: Children's Fear Survey Schedule-Dental Subscale (CFSS-DS), Dental Fear Schedule Subscale-Short Form (DFSS-SF), Dental Anxiety Scale (DAS), Modified Corah Dental Anxiety Scale (MDAS), Modified Child Dental Anxiety Scale (MCDAS), Dental Fear Survey (DFS), and Modified Dental Fear Survey in two versions of 15 or 20 items (MDFS) [Porrit et al, 2013].

Exclusion criteria

Editorials, case reports and retrospective studies were excluded. Studies including wide age group ranges with no specific data for the target group (aged 0–19 years) were excluded. Studies including fewer than 50 individuals, studies with patients undergoing general anesthesia or conscious sedation or referred by other dental practitioners, and studies where the selection of patients did not have a population-based approach or did not use well-defined measures of fear/anxiety were excluded. In addition, studies employing a behavioural assessment or physiological response analysis, to measure childhood and adolescent dental anxiety, were excluded.

CFSS-DS 15	1 Dentists 2 Doctors 3 Injections 4 Having somebody examine your mouth 5 Having to open your mouth 6 Having a stranger touch you 7 Having somebody look at you 8 The dentist drilling 9 The sight of the dentist drilling 10 The noise of the dentist drilling 11 Having somebody put instruments in your mouth 12 Choking 13 Having to go to the hospital 14 People in white uniform 15 Having the dentist clean your teeth
DFSS-SF 11	Three out of the 15 item of CFSS-DS were omitted (n.3,7 and 14) and one is added : fear of dental treatment causing pain"
DAS 4	1 If you had to go to the dentist tomorrow, how would you feel? 2 When you are in the waiting room waiting for the dentist to call you, how do you feel? 3. When you are in the dentist's chair waiting for the dentist to begin the local anesthesia procedures, how do you feel? 4. You are in the dentist's chair, already anesthetized. While you are waiting for the dentist to get the instruments to begin the procedure, how do you feel?
MDAS 5	At four items of DAS the following question has been added: "when you are in the dentist's chair waiting for dentist to begin the teeth scaling procedure, how do you feel?"
MCDAS 8	1. How do you feel about going to the dentist generally? 2. How do you feel about having your teeth looked at? 3. How do you feel about having your teeth scrabed and polished ? 4. How do you feel about having an injection in the gum? 5. How do you feel about having a filling? 6. How do you feel about having a tooth taken out? 7. How do you feel about having being put to sleep to have treatment? 8. How do you feel about having a mixture of "gas and air" which will help you feel comfortable for treatment but cannot put you to sleep?
MDFS 15	1. Making an appointment 2. Approaching the dental office 3. Sitting in the waiting room 4. Being seated in the dental chair 5. Smell of the dental office 6. Seeing in the dentist walk in 7. Having oral examination 8. Seeing the injection needle 9. Feeling the needle injection 10. Seeing the drill 11. Hearing the drill 12. Feeling the drill 13.Having the teeth cleaned 14.Feeling pain after oral anesthesia 15.Overall fear of dental work
DFS 20	At 15 items of MDFS the following 5 questions has been added: when having work done 1. My muscles become tense 2. My breathing rate increases 3. I perspire 4. I feel nauseated and sick to my stomach 5. My heart beats faster
CFSS-DS: Children's Fear Survey Schedule-Dental Subscale (DFSS-SF: Dental Fear Schedule Subscale-Short Form DAS: Dental Anxiety Scale MDAS: Modified Corah Dental Anxiety Scale MCDAS: Modified Child Dental Anxiety Scale MDFS: Modified Dental Fear Scale - DFS: Dental Fear Scale)	

TABLE 1 Types and descriptions of questionnaires in the studies.

Literature search

We developed a detailed search strategy for Medline, but revised it appropriately for each database (Medline, Embase, Web Of Science). The following terms were used to formulate the search strategies: dental fear* OR dental anx* OR dental phobia* AND Prevalence OR Cohort studies OR Longitudinal studies OR Cross-Sectional Studies OR Mass Screening (Table 2).

Studies selection

After launching the search strategy, we imported the records from each database into the bibliographies software package EndNote X7 and merged them into one core database. Duplicate records were subsequently removed. When searching other sources (e.g., reference lists of relevant trials, reviews, articles and textbooks), we obtained all potentially relevant reports that were identified. Two reviewers (GL, AM) independently carried out a systematic screening of the titles and abstracts of the retrieved records. The search was limited to studies published in English language between 2000 and March 2014. We obtained the full text of studies that potentially fulfilled the inclusion criteria. Disagreements were resolved by discussion. Where resolution was not possible, a third reviewer was consulted (IA).

Ovid Medline (R)	Embase	Web of Science
1. dental anx*.mp.	#1.dental AND anx*	# 1 top. (dental anx*)
2. dental fear*.mp.	#2. dental AND fear*	# 2 top.(dental fear*)
3. dental phobia*.mp.	#3. dental AND phobia	# 3 top. (dental phobia*)
4. odontophobia*.mp.	#4. odontophobia*	# 4 top. (odontophobia*)
5. exp Dental Anxiety/	#5. 'dental anxiety'/exp	#5 (#4 OR #3 OR #2 OR #1)
6. 1 or 2 or 3 or 4 or 5	#6. 1 or 2 or 3 or 4 or 5	# 6 top. (prevalence)
7. Prevalence/	#7. 'prevalence'/exp	# 7 top. (Cross-Sect. Studies)
8. Cohort studies/	#8. 'cross-sectional study'/exp	# 8 top. (Cohort Studies)
9. Longitudinal studies/	#9. 'cohort analysis'/exp	# 9 top. (Longitud. studies)
10. Cross-Sectional Studies/	#10. 'longitudinal study'/de	# 10 top. (Mass Screening)
11. Mass Screening/	#11. 'mass screening'/exp	# 11top.(#10 OR #9 OR #8)
12. Multiphasic Screening/	#12. 7 or 8 or 9 or 10 or 11	# 11top. (OR #7 OR #6)
13. 7 or 8 or 9 or 10 or 11 or 12	#13. 6 AND 12	# 12top.(#11 AND #5)
14. 6 and 13	#14. 13 AND [embase]/lim	
15. limit 14 to yr="2000 -Current"	.	.
Records: 169		

TABLE 2 Search strategies used in each database for identification of studies included or considered for this review.

Data extraction and management

Two reviewers (GL, MO) independently extracted data, and disagreements were resolved by discussion with a third review author. The data extraction sheet was prepared and tested. Information regarding study characteristics (year of publication, country and setting of the study), patients' characteristics (number of participants, age, gender), the psychometric assessment method, the mean score and prevalence data, were collected.

Analysis

Crude prevalence estimates (number of cases/sample size), along with standard errors, were extracted. Prevalence rates were transformed to logit estimates using the following formula: lp=ln [p/ (1−p)], where lp=logit event estimate; ln=natural logarithm; p=study level estimate [Williams et al., 2006; Calvo-Munoz et al., 2013]. The DerSimonian and Laird random effects model was used to pool logit event estimates [1986]. Pooled logit estimates were subsequently transformed to prevalence estimates by the following formula: p=elp/ (elp+1): where p = prevalence and e=the base of natural logarithm [Gebremedhin and Tadesse, 2015]. The heterogeneity of the prevalence rates was assessed using the I2 index [Higgins and Thompson, 2002].

Results

The search strategy identified 743 records. After removing 118 duplicates, 625 records were evaluated. One hundred and two records were considered relevant for further evaluation and full-texts obtained. In addition, 62 full publications were retrieved from other sources (reference lists of relevant trials and reviews). Overall, 164 publications were assessed for eligibility, 128 studies were excluded with reasons (Table 3) and 34 studies (36 publications) were included in the final analysis.

The characteristics of the studies in terms of child and adolescent population, the setting, the prevalence and mean score of dental fear and type of respondent (child and/or adult) as well as the cut-off used are illustrated in Table 4 based on the type of questionnaire.

Children's Fear Survey Schedule-Dental Subscale (CFSS-DS)

Seventeen studies used the Children's Fear Survey Schedule-Dental Subscale (CFSS-DS). Sixteen were prevalence studies and one was a longitudinal study. The studies were performed in different geographical areas: 5 in the Netherlands, 2 in Taiwan and the remaining in

	Study ID	Reason
1	Abdulwahab 2010	The questionnaire considered was not of interest
2	Abrahmsson 2006	Age above 18 years
3	Acharya 2008	Age above18 years
4	Acharya 2010	Age above18 years
5	Al-Namankany 2012	Not present outcomes of interest
6	Araposthatis 2008	Absence of dental fear prevalence data
7	Armfield 2006	Age above 18 years
8	Armfield 2010	Absence of dental fear prevalence data
9	Armfield 2013	Age above18 years
10	Arnrup 2007	Childrens with behaviour management problems
11	Assuncao 2010	Threshold and mean values not reported
12	Bajric 2011	Absence of dental fear prevalence data
13	Bakarcic 2007	Children with dental trauma
14	Blonqvist 2006	Children with attention deficit hyperactivity disorder
15	Blonqvist 2007	Children with attention deficit hyperactivity disorder
16	Blonqvist 2013	Children with identified behavior and learning problems
17	Brogardh-Roth 2010	Born preterm children
18	Buchanan 2005	Not present questionnaires and outcomes of interest
19	Carrillo–Diaz 2013_b	Questionnaire used not of interest
20	Cinar 2007	The cut off matches the mean score of population dentar fear
21	Crego 1013	Absence of dental fear prevalence data
22	de Carvalho 2012	Spanish language
23	Ekanayake 2003	Not available
24	El-Quaderi 2004	Not present outcomes of interest
25	Fabian 2007	Age above 18 years
26	Folayan 2005	Absence of dental fear prevalence data
27	Folayan 2004_a	Absence of dental fear prevalence data
28	Folayan 2004_b	Absence of dental fear prevalence data
29	Freeman 2007	Subjects were 16–82 years of age
30	Furuta 2012	Not present questionnaires of interest
31	Gustafsson 2010	Children with dental behaviour management problems
32	Hakeberg 2001	Adult patients
33	Hoge 2008	Trial comparing Overweight Vs Normal Weight Children
34	Holmes 2005	Patients referred by generical dentists
35	Hosey 2009	Children subjected to extraction in general anesthesia
36	Hou 2002	Chinese language
37	Howard 2007	Absence of dental fear prevalence data
38	Howard 2009	Children with management of dental anxiety
39	Humphris 2000	Subjects were 16-65+ years of age
40	Ilguy 2005	Age above 18 years
41	Jalevik 2002	Children with severe hypomineralization of the first molars (MIH).
42	Jalevik 2012	Children with severe molar incisor hypomineralization
43	Javadinejad 2011	Absence of dental fear prevalence data
44	Julihn 2006	Questionnaire used not of interest
45	Jones 2010	Absence of dental fear prevalence data
46	Kanli 2008	Not available
47	Kanegane 2009	Age above 18 years
48	Karijalainen 2003	Not present questionnaires of interest
49	Kawamura 2008	Questionnaire used not of interest
50	Keith 2013	Orthodontic patients
51	Klaassen 2007	Children referred from other specialists
52	Klages 2010	Age above 18 years
53	Klingberg 2007	Review
54	Koroluk 2000	Adolescents with history of childhood dental sedation
55	Krekmanova 2009	Absence of dental fear prevalence data
56	Krikken 2010	Patients referred because of their dental fear
57	Krikken 2012	Absence of dental fear prevalence data
58	Kritsidima 2010	Age above 18 years
59	Kumar 2009	Subjects were 15-54 years of age
60	Lee 2009	Not present outcomes of interest
61	Lin 2007	Not present outcomes of interest
62	Locker 2003	Age above 18 years

TABLE 3 Studies removed with reason.

	Study ID	Reason
63	Lopes 2013	Not present outcomes of interest
64	Lundgren 2001	Age above 18 years
65	Luoto 2009	Children with cleft lip and/ or palate
66	Luoto 2010	Questionnaire used not of interest
67	Majstorovic 2001	Children with experience of dental trauma
68	Majstorovic 2003	Patients referred because of their dental fear
69	Majstorovic 2004	Not present outcomes of interest
70	Majstorovic 2007	Absence of dental fear prevalence data
71	Marya 2012	Absence of dental fear prevalence data
72	Marsac 2008	Not present outcomes of interest
73	McGrath 2004	Age between 16-64
74	Mickenautsch 2007	Patients number is lower than 50
75	Milsom 2003	Questionnaire used not of interest
76	Mora Leon 2000	Spanish language
77	Mungara 2013	Absence of dental fear prevalence data
78	Mustafa 2013	Patients referred by generical dentists because of dental fear
79	Naoumova 2012	Orthodontic patients
80	Nakay 2005	Absence of dental fear prevalence data
81	Newton 2000	Review
82	Newton 2005	Age above 18 years
83	Nuttal 2008	Questionnaire used not of interest
84	Pekkan 2011	Age above 18 years
85	Peretz 2000	Age above 18 years
86	Peretz 2013	Absence of dental fear prevalence data
87	Pickrell 2007	Children in need of two restorative treatment visits
88	Porrit 2012	Absence of dental fear prevalence data
89	Porrit 2013	Review
90	Poulton 2001	Questionnaire used not of interest
91	Pretty 2011	Age above 18 years
92	Ragnarsson 2003	Age > 18 years and questionnaire used not of interest
93	Rantavuori 2004	Questionnaire used not of interest
94	Rantavuori 2005	Not present outcomes of interest
95	Rantavuori 2012	Questionnaire used not of interest
96	Rantavuori 2013	Not present questionnaires of interest
97	Riddel 2007	The sample originated from a retrospective cohort
98	Settineri 2010	Age above 18 years
99	Shierz 2008	Questionnaire used not of interest
100	Shuller 2003	Age between 35-65
101	Sjogren 2010	Children with orthodontic consultation
102	Skaret 2000	Not present outcomes of interest
103	Sing 2010	Absence of dental fear prevalence data
104	Smith 2003	Review
105	Spivak 2004	Questionnaire used not of interest
106	Stenebrand 2013_b	Duplicate of Stenebrand 2013_a
107	Stenebrand 2013_c	Duplicate of Stenebrand 2013_a
108	Suprabha 2011	Children with caries
109	Tickle 2003	Questionnaire used not of interest
110	Tickle 2009	Questionnaire used not of interest
111	Thomson 2009	Outcomes of interest already published in Locker 2001
112	Tunc 2005	Age above 18 years
113	Veerkamp 2006	Dutch language
114	Versloot 2005	Children referred by other dentists needing local anesthesia
115	Versloot 2008_a	Children requiring two subsequent treatment sessions with local anaesthesia
116	Versloot 2008_b	Age above 18 years
117	Vika 2006	Questionnaire used not of interest
118	Vika 2009	Age above 18 years
119	Wigen 2009	Not present of questionnaire of interest
120	Wogelius 2003_b	Duplicate of Wogelius 2003_a
121	Wogelius 2005	Not present outcomes of interest
122	Wogelius 2009	Survivors of childhood cancer
123	Woodmansey 2005	Age above 18 years
124	Wright 2010	Orthodontic patients
125	Yamada 2002	Patients reffered for anxiety issues
126	Yan 2008	Age above 18 years
127	Yuzugullu 2014	Age above 18 years
128	Zhang 2013	Chinese language

TABLE 3 Studies removed with reason.

Autor ID	Country	Setting	Population	Age (range)	Type of rispondent	Mean score of DFA	Preva lence of DFA	Cut off
CFSS-DS 15 item. range of scale :15-75								
Akbay Oba 2009	Turkey	School	275 (M 146)	7-11	Children	28.1 (SD 9.193)	14.5%	≥38
Baier 2004	Greece	Clinic	421 (M221)	0-13	Parents	29.6	20% (CI 16-24%)	≥ 38
Caprioglio 2009	Italy	School	725 (M 362)	6-10	Children	--	26 %	>39
Chhabra 2012	India	Clinic	523 (M 272)	5-10	Parents	24	6.3%	>38
Klassen 2008	Netherlands	Clinic	218 (M 122)	8-13	Parents	23.17 (SD 8.12)	13.7%	≥32
Krikken 2013_a	Netherlands	School	325 (M 160)	7-11	Children	21.9 (SD 6.83)	10.5%	≥32
					Parents	23.3 (SD 6.65)		
Krikken 2013_b	Netherlands	School	454	4-13	Parents	21.79	2.4%	38
Kyritsi 2009	Greece	Clinic	88 (M 53)	3-11	Parents	---	25%	35
Lara 2012	Spain	School	183 (M 94)	7-12	Children	27.42 (SD9.46)	4.9%	≥45
Lee 2007	Taiwan	School / Kinder-garten	3597	5-8	Children and Parents	29.68 (SD 10.91)	20.6%	38/39
Lee 2008	Taiwan	Not specified	247 (M135)	2-10.5	Parents	35.31 SD 13.34	(28.3%)	≥4-5
Majstorovic 2005	Netherlands	Clinic	1946 (M 1007)	4-11	Parents	------	24.46%	---
Raadal 2002	Norway	Clinic	180 (M 92)	10	Children	22.5 (SD 6.8)	12%	>29 (1st dev above mean)
Salem 2010	Iran	Clinic	200 (M106)	3-6	Parents	32.1	22%	>38.
ten Berg 2002	Netherlands	Clinic	2144 (M1107)	4-11	Parents	23.9 (SD 8.1)	6%	≥ 38
Wogelius 2003_a	Denmark	Clinic	1281	6-8	Parents	23.8	5.7%	≥ 38
Dental Anxiety Scale (DAS) 4 item.range of scale : 4-20								
Bezabih 2013	Etipoia	Clinic	240 (M 147)	6-16	Children/ Adolescents	----	20.5%	≥15
De Carvalho 2013	Brazil	Clinic	340 (M143)	12 -18	Adolescents	----	1.76%	≥15-
Dogan 2006	Turkey	School	258 (M133)	8-12	Children	10.8 (SD 3.8	19 %	≥15
Locker 2001	New Zealand	Clinic	678	15	Adolescent	8.7 (SD 2.9)	10.6%	≥15
Ostberg 2013	Sweden	Home	758 (M 351)	19	Adolescents	7.2 (SD 3.2)	7.6%	≥15

TABLE 4A Characteristics of the included studies.

each of the following countries: Belgium, Denmark, Greece, Italy, India, Iran, Norway, Spain, Turkey and USA. In seven studies, the questionnaires were administered within schools [Versloot et al., 2004; Lee et al., 2007; Akbay Oba et al., 2009; Caprioglio et al., 2009; Lara et al., 2012; Krikken a et al., 2013; Krikken b et al., 2013], whereas in the remaining 10 studies, 7 were performed in general clinical settings [Raadal et al., 2002; ten Berge et al., 2002; Baier et al., 2004; Majstorovic and Veerkamp, 2005; Klaassen et al., 2008; Lee et al., 2008; Salem et al., 2012] and 3 were specialised for children [Wogelius et al., 2003; Kyritsi et al., 2009; Chhabra et al., 2012]. The median population was 421 and the interquartile range was (IQR) ranged from 218 to 725. The age of subjects varied from 0 to 13 years across the studies, with a mean age of 9.4. The threshold anxiety cut off score ranged from 29 to 45, while most studies had a cut off value of 38 (n =6). The pooled prevalence of DFA among the studies was 12.2% (95% CI 9.0-16.2; I2=97%). Only 10 studies provided the mean score and standard deviation. The pooled mean score was 26.2 (95% CI 24.0-28.4). The distribution and variability of the prevalence and the mean score of DFA based on the geographical area, the demographic characteristics, the setting, the type of informant and the used cut-off are depicted in Table 5 and Table 6, respectively.

Dental Anxiety Scale (DAS)

Five studies used the Dental Anxiety Scale (DAS) questionnaire [Locker et al., 2001; Dogan et al., 2006; Abu-Ghazaleh et al,. 2011; Bezabih et al., 2013; de Carvalho et al., 2013; Ostberg and Abrahamsson, 2013]. All the studies were performed in different countries (Ethiopia, Brazil, Turkey, New Zealand, Sweden). Four studies were performed in general dental services [Abu-Ghazaleh et al., 2011; Carrillo-Diaz et al., 2012; Bezabih et al., 2013; de Carvalho et al., 2013] and 1 in a school [Dogan et al.,

Autor ID	Country	Setting	Population	Age (range)	Type of rispondent	Mean score of DFA	Preva lence of DFA	Cut off
Modified Corah Dental Anxiety Scale (MDAS) 5 item; range of scale : 5-25								
Abu- Gazhaleh 2011	Jordan	School	1415 (M 690)	15-16	Adolescents	13.91 (SD 5.36)	22.6%	≥19
Carrillo-Diaz 2012	Spain	Clinic	147 (M 59)	8–16	Children Adolescents	12.57 (SD 4.98)	13.6%	≥19
Jaakkola 2013	Finland	Home	777	18	Adolescents	---	7.6%	≥19
Carrillo-Diaz 2013	Spain	School	161 (M 84)	7-14	Children Adolescents	10.95 (SD 4.7)	8.70%	≥19
Modified Child Dental Anxiety Scale (MCDAS) 8 item.range of scale: 8-40								
Paryab 2013	India	Clinic	150 (M 66)	6-12	Children	8 item 20.81 (SD6.97)	29.3%	≥26
Wong 1998	England	School	277	8-15	Children/ Adolescents	8 item 18.2 (SD 7.14)	13.3%	≥26
DFS 20 item. range of scale : 20-100								
Skaret 2007 Vika 2008	Norway	School	1385 (M 615)	18	Adolescents	44.2 (SD 17.6)	19.8%	≥62-
Stenebrand_a 2013 Stenebrand_b 2013	Sweden	School	216(M115)	15	Adolescents	34.2 (SD 14.9)	6.5%	≥60
Taani 2002 Taani 2005d	Jordan	School	1021 (M 460)	12-15	Adolescents	---	10%	Unclear-
DFSS-SF 8 item; range of scale : 8-40								
Folayan 2003	Nigeria	Clinic	81 (M40)	8-13	Children	15•32. (SD 5•07)	14.8%	1 st. dev.t. above mean)
Foloyan 2004_c	Nigeria	Clinic	69 (M 39)	8-13	Children	15.68 (SD 5.62)	26.1%	≥20
Olak 2013	Estonia	School	344 (M 188)	8-10	Children	15.4 (SD 4.6)	16.5%.	≥20(1 st. dev above mean)

TABLE 4B Characteristics of the included studies.

2006]. The median number of subjects included was 340, with an IQR ranged from 258 to 678. Age varied from 6 to 19 years with a mean of 13.4 years. The cut-off threshold for fear or anxiety was 15 for 3 studies and 13 for 2 studies. The pooled prevalence among the included studies was 10.0% (95% CI 5.8-16.6) with substantial heterogeneity (I2=94%). The mean score of the dental fear measured with the DAS was reported only in 3 studies studies [Dogan et al., 2006; Abu-Ghazaleh et al., 2011; Jaakkola et al., 2013]. The pooled average score was 8.8 (95% CI 7.2-10.5; I2=95%) among the studies.

Modified Corah Dental Anxiety Scale (MDAS)

Four studies evaluating the prevalence of DFA in children, using the Modified Corah Dental Anxiety Scale (MDAS), were identified [Wong et al., 1998; Skaret, 2007; Carrillo-Diaz et al., 2013; Paryab and Hosseinbor, 2013]. The studies were conducted in Spain (n=2), Finland (n=1), and Jordan (n=1). Two studies were performed in a school, one in a general dental clinic and one at home. The median number of included children was 469, with an IQR ranged from 154 to 1096. The age ranged from 7 to 16 years across the studies and the mean age in the four studies was 12.6 years. The pooled prevalence of the DFA among the studies was 12.2% (95% CI 6.0-23.0; I2=96%).The mean score of DFA was 12.5 (95% CI 10.6-14.4; I2=97%).

Modified Child Dental Anxiety Scale (MCDAS)

Two studies evaluating the prevalence of DFA in children, using the Modified Child Dental Anxiety Scale (MCDAS), were identified [Paryab and Hosseinbor, 2013; Wong et al., 1998]. One study was conducted in India (n=1) in a school and one in England in a general dental clinic. The number of the children varied from 150 to 277. The age ranged from 6 to 15 years across the studies. The prevalence of the DFA among the studies varied from 13,3% to 29,3%. The mean score of DFA ranged from 18.1 to 20,81.

Dental Fear Survey (DFS)

Three studies, in 6 publications, that used the DFS, for dental fear assessment, were identified [Stenebrand a et al., 2013; Stenebrand b et al., 2013; Taani, 2002; Taani et al., 2005; Skaret et al., 2007; Vika et al., 2008]. All the studies were cross-sectional in design and were performed in the same setting (school), but in different countries (Norway, Sweden, Jordan). The median number of the included subjects was 1021 with an IQR ranged from 216 to 1385. In one study, in two publications [Skaret et al., 2007; Vika et al., 2008], the subjects were 18 years old. In the second study, the subjects were 15 years old [Stenebrand a et al., 2013; Stenebrand b et al., 2013], and in the third study, the age ranged from 12 to 15 years. The threshold anxiety cut-off was 60 and 62 for two studies and was unclear in one. The pooled prevalence of the DFA was 11.0% (95% CI 6.0-20.0; I2=96%). The mean score was 34.2 and 44.2 in the two studies, but it was not reported in one study.

Dental Fear Schedule Subscale-Short Form (DFSS-SF)

Three studies used the DFSS-SF to assess DFA. Two

Type of Variable		Prevalence	Studies (n.)	Patients (n.)
Geographical areas	Nord Europe	11.1%	8	996
	Sud-Center Europe	21.9%	3	7145
	Asia	19.2%	5	4842
	Usa	20.2%	1	421
Age	--	Decrease with increase of age	5	6575
		Increase with increase of age	1	200
		Non linear trend of DFA with age	1	725
Sex	Male	19.6%	5	2008
	Female	24.5%		1882
Setting	Clinic	13.1%	9	7001
	School	16.9%	7	6156
Type of informant	Children/adolescent	13.7%	6	3597
	Parents	12.9%	10	7522
Cut off	≥ 38	13.2	11	10400
	<38	19.9	5	2757

TABLE 5 Variation of the Prevalence of DFA based on Geographica areas, demographic and other variables in the studies that used CFSS-DS.

Type of Variable		Prevalence	Studies (n.)	Patients (n.)
Geographical areas	Nord Europe	23.4	7	5199
	Sud-Center Europe	g	1	183
	Asia	29.4	5	4842
	Usa	29.6	1	421
Age	--	Decrease with increase of age	2	1556
		Increase with increase of age	0	0
		Non linear trend of DFA with age	1	2144
Sex	Male	19.6	9	2008
	Female	24.5		1882
Setting	Clinic	24.6	7	4967
	School	27.6	6	5431
Type of informant	Children/adolescent	24.6	5	1560
	Parents	26.7	8	5488
Cut off	≥ 38	26.5	10	9675
	<38	21.2	3	723

TABLE 6 Variation of the Mean Score of DFA based on Geographica areas, demographic and other variables in the studies that used CFSS-DS.

studies were performed in Nigeria, one in a pediatric dental setting [Foloyan et al., 2003; Folayan a et al., 2004], and the other in a general dental clinic clinic [Olak et al., 2013]. The third study was performed in Estonia in a school 26. The median number of children included was 81, with an IQR ranged from 69 to 333. The age ranged from 8 to 13 years among the studies, with a mean age of 9.3 years in Olak 2013 and 10.9 years in the other two studies [Folayan et al., 2003; Folayan a et al., 2004]. The threshold anxiety cut off was 18 in one study and 20 in two studies. The pooled prevalence across the studies was 20% (95% CI 15.1-26.9; I2=51.2). The mean score of dental fear using the DFFS-SF was 15.4 (95% CI 15-15.9; I2=0%).

Discussion

In this review, we performed a comprehensive systematic search of studies that reported the prevalence of dental fear in children and adolescents younger than 19 years old. We identified 34 studies, in 36 publications, that measured dental fear and anxiety employing the most frequently used questionnaires, as suggested by Porrit [2013]. The main conclusion is that dental fear is a common problem in children and adolescents among several countries in Europe, Asia, Africa and North America. The pooled prevalence varied between 10% and 20%.

The studies utilised different types of questionnaires. In the studies that used DFSS-SF, DFS, DAS, MDAS, MCDAS and CFSS-DS questionnaires, the prevalence rates were similar, ranging from 10% to almost 13%. Three studies used the DFSS-SF questionnaire, which when combined, led to a pooled prevalence of 20%. In the studies that used MCDAS Dental fear prevalence rates were very heterogeneous varying from 13.3% to 29.3%. The complete data synthesis of either Dental Fear prevalence and mean score and its related variables was reported in Table 4. The results were highly heterogeneous, most probably due to the study design, the sampling methods, the setting and the application of the questionnaire, as well as cultural attitudes and socio-economical variations.

Variation in prevalence and mean score

The assessment of variations in DFA prevalence, measured with different scales, and the factors, such as the gender and the age of children/adolescents, the country, the setting, the questionnaire respondent (parents or child), and the threshold anxiety score (cut off), that may explain the variability, was reported in almost all studies. We will limit the discussion to those studies that used the CFSS-DS, given that it was the most utilized scale. The synthesis of data measured with CFSS-DS were reported in Table

5 and Table 6. The CFSS-DS was used in 17 studies from 13 countries in 4 geographical areas. The results permit several considerations on issues related to prevalence and the characteristics of the subjects and the setting in which prevention and dental treatment were provided. The prevalence and mean scores of DFA in Northern European populations were less than that observed in the other geographical areas, namely Southern Europe (Italy, Greece, Spain), Asia (India, Iran, Taiwan, Turkey), and the USA. Unfortunately, the DFA mean score was not reported in the studies performed in Greece and Italy. We are unable to identify the cause of these differences, but cultural factors may influence dental fear [Folayan b et al., 2004]. Of the 17 studies that used the CFSS-DS, only 12 studies reported data regarding DFA related to age. Of the latter twelve, 7 studies showed that the frequency of DFA decreased with increasing age. Five studies used prevalence data [Baier et al., 2004; Majstorovic and Veerkamp, 2005; Lee et al., 2007; Kyritsi et al., 2009; Chhabra et al., 2012] and two reported mean scores [Wogelius et al., 2003; Olak, 2013]. Two studies reported a nonlinear trend in DFA values. Ten Berg 43 reported a decrease of the mean score between 4 and 9 years of age and an increase between 10 and 11 years of age. Conversely, Caprioglio [2009] reported an increase of the prevalence of DFA in children between 6–8 years and a decrease between 9 and 10 years. Finally, Salem 2010 showed an increase in the prevalence of dental fear with increasing age. Overall DFA seemed to be related with the younger children age in most of the included studies. This can be explained with the maladaptive trait that characterises childhood [De Clercq et al., 2009]. Only 12 studies reported DFA data in relation to gender. Overall, there were 5042 males and 4685 females included in these studies. Nine studies [Raadal et al., 2002; Ten Berge et al., 2002; Wogelius et al., 2003; Versloot et al., 2004; Akbay Oba et al., 2009; Chhabra et al., 2012; Lara et al., 2012; Salem et al., 2012; Krikken a et al., 2013] provided mean scores based on gender: in males the mean score was 19.6, whereas the mean score was 24.5 in females. In five studies that reported prevalence data [Baier et al., 2004; Majstorovic and Veerkamp, 2005; Akbay Oba et al., 2009; Caprioglio et al., 2009; Chhabra, 2012], the DFA values were lower in males: the pooled prevalence rate was 17.4% in males and 22% in females. Two studies [Akbay Oba et al., 2009; Chhabra et al., 2012] reported both gender-related prevalence and mean score data. There was a substantial agreement among studies in defining girls with higher level of DFA than boys. These results could be better understood when compared with those of other similar internalising emotions as well as the general anxiety or sadness for which the gender differences among children were clearly demonstrated Chaplin [Chaplin and Aldao, 2013]. No substantial differences in the prevalence, and the mean scores, of DFA were observed among the six studies [Raadal et al, 2002; Versloot et al, 2004; Akbay Oba et al., 2009; Caprioglio et al., 2009; Lara et al., 2012; Krikken et al., 2013a] that used psychometric measures based on children's self-reports and the ten studies [Ten Berge et al., 2002; Wogelius et al., 2003; Baier et al., 2004; Majstorovic and Veerkamp, 2005; Klaassen et al., 2008; Lee et al., 2008; Kyritsi et al., 2009; Salem et al,. 2009; Chhabra et al, 2012; Krikken et al., 2013b] in which the psychometric measures were reported by their parent/guardian proxies. In terms of setting, seven studies [Versloot et al., 2004; Lee et al., 2007; Caprioglio et al., 2008; Akbay Oba et al., 2009; Lara et al., 2012; Krikken et al., 2013a; Krikken et al, 2013b] were conducted in schools and nine [Raadal et al., 2002; Ten Berge et al., 2002; Wogelius et al., 2003; Baier et al., 2004; Majstorovic and Veerkamp, 2005; Klaassen et al., 2008; Kyritsi et al., 2009; Salem et al., 2009; Chhabra, 2012] in dental clinics, whereas one study [Lee et al., 2008] did not specify the setting. The prevalence and mean scores of DFA measured in the studies carried out in a dental service was lower than in schools. Therefore, a clinical setting was not anxiety inducing compared to schools, differently from what might be assumed. The studies that employed CFSS-DS, did not use the same cut-off to determine the presence of anxiety in the population. After evaluating the spread of the threshold used among the studies, we classified the studies based on a cut-off value of 38. Eleven studies [Ten Berge et al., 2002; Wogelius et al., 2003; Baier et al., 2004; Versloot et al., 2004; Lee et al., 2007; Akbay Oba et al., 2009; Caprioglio et al., 2009; Chhabra et al., 2012; Lara et al, 2012; Salem et al., 2012; Krikken et al., 2013b] used a threshold equal to or greater than 38, which led to an average prevalence of 13.2%. Conversely, five studies [Alvesalo et al., 1993; Radal et al., 2002; Majstorovic and Veerkamp, 2005; Klaassen et al., 2008; Krikken et al., 2013a] used a cut-off below 38, which produced a pooled prevalence of 21.2%. In one study the threshold value of anxiety was unclear [Lee et al., 2008]. This analysis suggested that the variability of the prevalence, among the studies, was influenced by the cut-off values used.

Conclusions

The present systematic review showed that the prevalence of DFA in paediatric populations was significant in different settings. At least one child out of ten had a level of DFA that hindered his/her ability to tolerate dental treatment. These data are similar to those reported by Klingberg et al. [2007] in a previous systematic review. In the studies employing the CFSS-DS scale, younger children and female children had higher values of DFA. Northern European children and adolescents had a lower prevalence and lower levels of DFA compared to their peers in other geographical areas. Other population variables, such as the type of questionnaire respondent (children or parent/guardian proxies) and the setting (school or dental clinic) were not significantly related to DFA. The choice of threshold level in each study also affected the prevalence of DFA. Epidemiological data concerning DFA can aid the

understanding of dental fear, stimulate the identification of factors that contribute to its onset and help create prevention programs to reduce its occurrence.

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