

# Dental fear and dental anxiety: bibliometric analysis of the 100 most frequently cited papers

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## ABSTRACT

Dental fear and anxiety are feelings that are often present at dental appointments and have been studied for a long time. **Aim:** To identify and critically review the 100 most frequently cited papers on dental fear and dental anxiety (DFA). **Materials and Method:** The 100 most frequently cited papers on DFA were retrieved from Web of Sciences (All databases) using a combined search strategy. Key bibliometric indicators were extracted. The methodological quality of the studies was assessed by the Mixed Methods Appraisal Tool (MMAT) except for reviews and systematic reviews, which were evaluated by the Joanna Briggs Institute (JBI) tool. **Results:** Citations for the 100 most frequently cited papers ranged from 81 to 882. The largest number of papers was from the United States of America (22 papers; 3850 citations). Community Dentistry and Oral Epidemiology was the journal with highest number of papers (27 papers; 3153 citations). The most frequently cited author was Corah NL (1390 citations). Cross-sectional study design was the most common (67 studies). The topics covered by the studies were diverse, highlighting studies on the development and validation of assessment tools. There were 17 validated assessment tools, of which The Dental Anxiety Scale was the most often used (28 studies). There were five terms used to refer to DFA. Most papers were of intermediate quality. **Conclusion:** This bibliometric analysis identified the 100 most frequently cited papers on DFA and the topics covered. "Dental anxiety" was the term most often used, although more recent research includes both "fear" and "anxiety". The Dental Anxiety scale was the most frequently used assessment tool. Higher quality papers are encouraged to improve knowledge on DFA.

**Keywords:** bibliometrics - citations - dental anxiety - dental fear - dentistry

## Medo e ansiedade odontológicos: revisão bibliométrica dos 100 artigos mais citados

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## RESUMO

O medo e a ansiedade odontológicos são sentimentos que estão frequentemente presentes nas consultas odontológicas e são estudados há muito tempo. **Objetivo:** identificar e revisar criticamente os 100 artigos mais citados sobre medo e ansiedade odontológicos (MAO). **Materiais e Método:** Os 100 artigos mais citados do MAO foram recuperados da Web of Sciences – All databases. Foram extraídos indicadores bibliométricos. A qualidade metodológica dos estudos foi avaliada pelo Mixed Methods Appraisal Tool (MMAT), exceto para revisões e revisões sistemáticas que foram avaliadas pelo instrumento do Joanna Briggs Institute (JBI). **Resultados:** As citações para os 100 artigos mais citados variaram de 81 a 882. O maior número de artigos foi originado nos Estados Unidos da América (22 artigos; 3850 citações). Community Dentistry and Oral Epidemiology foi o periódico com maior número de artigos (27 artigos; 3153 citações). O autor mais citado foi Corah NL (1390 citações). O desenho de estudo transversal foi o mais comum (67 estudos). Os temas abordados pelos estudos foram diversos, destacando-se estudos voltados para o desenvolvimento e validação de instrumentos de avaliação. Foram 17 instrumentos de avaliação validados, dos quais a Dental Anxiety Scale foi o mais utilizado (28 estudos). Havia cinco termos usados para se referir ao MAO. A maioria dos artigos era de qualidade intermediária. **Conclusão:** Esta análise bibliométrica elucidou as citações e os temas abordados. Ansiedade odontológica foi o termo mais usado, no entanto, pesquisas mais recentes incluem o termo medo e ansiedade. A Dental Anxiety Scale foi o instrumento de avaliação mais utilizado. Artigos de maior qualidade são incentivados para melhorar o conhecimento sobre medo e ansiedade odontológicos.

**Palavras-chave:** bibliométrica - citação - ansiedade ao tratamento odontológico - medo ao tratamento odontológico - odontologia

## INTRODUCTION

Dental fear and dental anxiety, which are feelings often induced by dental appointments, have been studied for a long time through research on various aspects such as definition, prevalence, aetiology and management<sup>1-4</sup>.

Dental anxiety refers to a state of apprehension that something terrible will happen in relation to dental treatment, with a sense of loss of control<sup>3</sup>. Anxiety is characterised as “the anticipation of future threats and is more associated with muscle tension and vigilance”<sup>5</sup>. Dental fear is a type of anxiety in the face of well-known situations such as injections or dental situations in general<sup>3</sup>. The American Psychological Association (APA) describes fear as “an emotional response to real or perceived threats, usually associated with reactions of excitability preparing for fight or flight”<sup>5</sup>. Dental fear causes a series of effects in the body, generating emotional, physiological and behavioural responses such as defence reactions<sup>3</sup>. A severe, persistent type of dental fear is known as dental phobia<sup>3</sup>, since phobia is defined as a “persistent fear of situation, object or activity resulting in huge necessity of avoidance”<sup>5</sup>. Seeking dental care is important in order to support oral health<sup>6</sup>; nevertheless, fear and anxiety often create barriers that prevent people from doing so<sup>7</sup>. Even when patients attend a dental appointment, they may still have feelings and reactions to it<sup>8</sup>. “Dental fear and dental anxiety” (DFA) may be used as a composite term to refer to strong negative feelings related to dental settings<sup>3,9</sup>.

DFA can be measured by many different instruments with different names<sup>10-13</sup>, which vary regarding the number of questions and the appropriate time at which to assess the feeling<sup>10,11</sup>. Some of them are used for epidemiological studies, and others to measure DFA in the dental office<sup>12-15</sup>. Another difference among assessment tools is what they measure: whether state anxiety, related to how the person feels at the time of the appointment, or trait anxiety, which is assessed outside the dental setting and measures dental anxiety across different procedures or contexts related to dental care<sup>16</sup>.

Bibliometric analysis is a scientific method that can be useful to examine academic productivity in different fields such as medicine, dentistry and business<sup>17-19</sup>. It consists of a review of papers published on the topic of interest, and includes all study designs such as descriptive, observational,

experimental, qualitative and reviews, to account for all the evidence<sup>20</sup>. Bibliometric reviews differ from systematic reviews. While a systematic review aims to respond to a clear question based on the quality of the evidence<sup>21</sup>, a bibliometric review is an enumeration of evidence such as main authors, most impactful papers, collaborations, and countries of the first author in a particular field of existing literature<sup>20,21</sup>, enabling the study of publication and collaboration patterns, and exploration of the intellectual structure of a research field or a journal<sup>18</sup>. Moreover, a bibliometric review can build a foundation for advancing research on a certain topic in a new way<sup>18,21</sup>. Recent bibliometric reviews have been conducted on child oral health and outcomes<sup>4,17,22</sup>, but there is no equivalent evidence on DFA. While a distinction between fear and anxiety may be made in theory, in epidemiological and clinical settings the definition of these constructs remains subjective.

Citations indicate the level of interest that a scientific study has received from the scientific community, even though they are not a perfect measure of quality. Furthermore, finding a pattern in the use of terminology helps avoid confusion in its use. Thus, the objective of this study is to identify and review critically the 100 most frequently cited papers on the topic of DFA in order to understand and describe aspects related to it.

## MATERIALS AND METHOD

This bibliometric study, taking a qualitative approach, retrieved and analysed the papers on DFA. The search was conducted using Web of Science - All Databases (WoS-AD)<sup>17,21</sup>. The search strategy was prepared based on other reviews of DFA with the following terms: (“dental anxiety” OR “dental fear” OR “dental phobia” OR “odontophobia”) AND (“pediatric dentistry”) AND (child\*) OR (“adolescent\*”) AND (“oral health problem”)<sup>9,23,24</sup>. Papers published up to April 2024 were searched with no language restriction. Research papers for which the main outcome was any aspect of DFA were included. Conference papers were excluded. One researcher (ACP) selected the papers to identify the 100 most frequently cited papers<sup>17,21,25</sup>. The list of the 100 most frequently cited papers on DFA is displayed in descending order, based on the number of citations in WoS-AD. In the event of a draw, the

ranking is based on the number of citations per year (citation density). Citation counts for each paper in Google Scholar and Scopus databases were also collected<sup>17,21,22</sup>.

A spreadsheet was created with the following data: title, authors, journal, number of citations, citation density, study design, year of publication, country (first author affiliation), terminology used, assessment tool and sample age. Study designs were classified as follow: clinical trial (randomized or not), cross-sectional, longitudinal, non-systematic review, systematic review, and validation. Papers were grouped into assessment tool development, assessment tool validation, DFA acquisition, DFA management, review of assessment tools, and epidemiological surveys on factors associated to DFA. Spearman's rank correlation coefficient test was performed at the Statistical Package for Social Sciences (SPSS for Windows, version 24.0; IBM Corp) for citations.

The review followed the BIBLIO guideline for bibliometric reviews to enhance transparency<sup>20</sup>. The methodological quality of the validation, cross-sectional, cohort and clinical trials studies was assessed according to the Mixed Methods Appraisal Tool (MMAT)<sup>26</sup>. The MMAT provides a methodological quality criterion for different study designs in a single tool, thereby allowing a direct comparison of quality of evidence in the different types of studies included<sup>26,27,28</sup>. This tool supports critical presentation of quality, rather than an overall score<sup>29</sup>. Systematic and other reviews were evaluated using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Systematic Reviews and Research Synthesis<sup>30</sup>.

## RESULTS

The search strategy recovered 3,857 references from WoS-AD. Thirty-eight papers were excluded because they did not focus on DFA. The included studies covered all age groups (children, adolescents, adults and elderly people) ([Supplementary file 1](#)). Whilst most papers reported local studies (n=64), eleven were national and six were multi-centre.

The 100 most frequently cited papers on DFA were cited 13,957 times altogether (median: 113.5; minimum: 81 citations; maximum: 882 citations) in WoS-AD. Papers were more often cited in Google Scholar than in other databases (median: 280.5; minimum: 117 citations; maximum: 1,990 citations).

Positive correlations were found between the number of citations in WoS-AD and Scopus ( $r = .995$ ) and WoS-AD and Google Scholar ( $r = .975$ ). The most frequently cited paper on DFA was "Development of a dental anxiety scale" first-authored by Corah NL (1969), which is also the oldest paper published. Corah NL was the most frequently cited author of all publications, with 2 papers and 1,390 citations. The most recent papers were published in 2017 and were authored by Cianetti et al. in Italy, Seligman et al. in the USA and by Lin et al. in Taiwan. The *Community Dentistry and Oral Epidemiology* (27 papers; 3,153 citations) and the *Journal of the American Dental Association* (10 papers; 2,056 citations) published the most papers included in the list of the 100 most frequently cited papers on DFA ([Supplementary file 1](#)).

Europe was the continent with most papers (54 papers; 7,208 citations) followed by Anglo-Saxon America (30 papers; 4,807 citations). Latin America had only one paper, published in Brazil (84 citations), and the African continent had no paper on the list. At country level, USA had the highest number of both papers and citations (22 papers; 3,850 citations). Papers from the England (11 papers; 1,513 citations), Netherlands (10 papers; 1,265 citations), Sweden (9 papers; 1,586 citations) and Australia (8 papers; 1,046 citations) were cited more than one thousand times. (Fig. 1).

Table 1 presents summary data on the authors with at least two papers included in the list of the 100 most frequently cited papers on DFA. These authors published between 6 and 447 papers and were cited between 425 and 34,899 times in WoS-AD. Armfield JM and Locker D were the authors with the most papers on the list of the 100 most frequently cited papers on DFA.

Most of the papers on the list were epidemiological surveys (67 cross-sectional; 1 cohort, and 3 randomized clinical trials), followed by 18 reviews (4 systematic reviews) and 11 validation studies (4 assessment tool development). Most papers were classified as epidemiological surveys on DFA associated factors. Eight studies were designed to review assessment tools. Different terminologies were found, with "dental anxiety" being the most frequently used term (61 studies), followed by "dental fear" (25 studies), "dental fear and anxiety" (11 studies), "dental phobia" (2 studies) and "dental fear and dental phobia" (1 study) (Table 2). "Dental

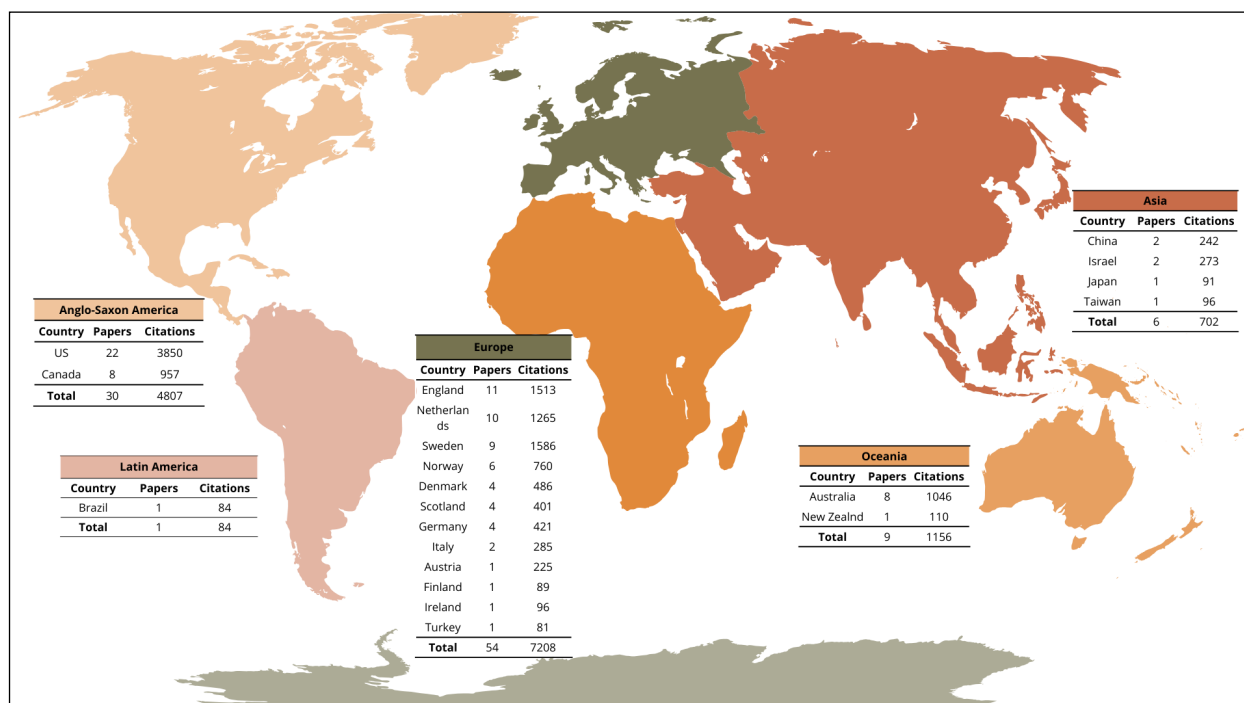


Fig. 1: Global distribution of 100 most frequently cited papers on dental fear and dental anxiety.

**Table 1. Bibliometric indicator of authors with at least 2 publications included in the 100 most frequently cited papers on dental fear and dental anxiety.**

Author	Number of citations in WoS-AD	Total papers in WoS-AD	h-index WoS	Number of citations in top 100 DFA	Number of papers in top 100 DFA
Milgrom P	34,899	447	63	588	3
Locker D	17,436	415	74	610	5
Humphris G	11,195	360	57	334	3
Berggren U	5,668	195	41	428	2
De Jongh A	5,850	235	42	190	2
Corah NL	2,940	79	26	1390	2
Kleinknecht RA	2,739	54	28	296	2
Armfield JM	2,653	92	26	850	6
Klingberg G	1,930	79	21	599	2
Skaret E	1,382	40	22	182	2
Ten Berge M	1,315	42	20	244	2
McNeil DW	693	65	13	191	2
Moore R	512	14	9	391	3
Oosterink F	425	6	6	312	2

fear and anxiety” as a composite term has been more often accepted in recent papers ([Supplementary file 1](#)).

The 100 most frequently cited papers on DFA used 31 different assessment tools, including single instruments or combinations of instruments. The

Dental Anxiety Scale was the most often used instrument in the 82 primary research papers (alone in 28 studies; combined with other instruments in 13), followed by the Dental Fear Scale (alone in 5 studies, combined with other instruments in 5) (Table 3). Table 3 also shows the categorization of

**Table 2. Characteristics of the 100 most frequently cited papers on dental fear and dental anxiety.**

	Number of papers	Number of citations	Citation ratio <sup>a</sup>
<b>Study Design</b>			
Cross-sectional	67	8672	129,4
Longitudinal	1	110	110
Clinical trial (randomized)	3	323	107,6
Non-systematic review	14	2406	171,8
Systematic review	4	412	310
Validation	11	2034	184,9
<b>Topic</b>			
Assessment tools validation	7	801	114
Assessment tools development	4	1233	308
DFA acquisition	14	1867	133,3
DFA management	9	1574	174,8
Epidemiological survey	58	7236	124,7
Review of assessment tools.	8	1246	155,7
<b>Terminology</b>			
Dental anxiety	61	8421	138,0
Dental fear	25	3404	136,1
Dental fear and anxiety	11	1664	151,2
Dental fear and dental phobia	1	191	191,0
Dental phobia	2	277	138,5

the studies regarding assessment tool development, assessment tool validation, cross-sectional epidemiological surveys, longitudinal surveys and clinical trials. Seventeen validated instruments were found across the primary research papers, the oldest being from 1952. The Dental Anxiety Scale was the oldest used in the papers on the list. Table 4 presents the evolution of these scales, indicating their year of development and the period of use, according to the studies.

The quality appraisal is presented as a supplementary file (S2 and S3). Most of the studies are classified as having medium quality. The aspect that contributed the most to the lower quality of the papers relates to poor evidence on sample selection. The inclusion and exclusion criteria were unclear in most of the papers. Additionally, incomplete outcome data (<80%), was observed in many studies. Otherwise, almost all studies had appropriate indicators related to the variable measurement. The review papers were classified as medium and low quality. Most of them were not systematic reviews, and there were limitations relating to inclusion criteria, search strategy and analysis.

## DISCUSSION

The results of this review show that the 100 most frequently cited papers on DFA were published over a 58-year period (1969 and 2017) and are of intermediate quality. Most of them were conducted in Anglo-Saxon America and Europe, involving primary research exploring factors associated with DFA. “Dental anxiety” was the most common term, followed by “dental fear”, whilst the term “dental phobia” appeared in a few studies. The Dental Anxiety scale was the assessment tool with most citations in the review.

A higher total number of citations was observed in the Google Scholar and Scopus databases than in the WoS-AD. Although the number of citations in the different databases assessed were positively correlated, showing agreement, Google Scholar had a higher number of citations because it retrieves citations from open-access online journal papers, books and non-academic sources.

The 100 most frequently cited papers on DFA were written over a considerable number of years, beginning in 1969. Interestingly, another review showed that the first papers on aspects of DFA date

**Table 3. Description of assessment tools used in the studies regarding of number of papers, citation and first authors\***

Assessment tool	Number of papers	Citation on WoS-AD	Authors
Dental Anxiety Scale	28	4678	Corah NL (1) <sup>a</sup> , Corah NL (2) <sup>b</sup> , Berggren U (4) <sup>c</sup> , Schuller AA (14) <sup>c</sup> , Reisine ST (21) <sup>c</sup> , Kent G (24) <sup>c</sup> , Winocur E (27) <sup>c</sup> , McGrath C (28) <sup>c</sup> , Lidell A (33) <sup>c</sup> , Towned E (34) <sup>c</sup> , Sohn W (35) <sup>c</sup> , Eitner S (38) <sup>c</sup> , Locker D (41) <sup>c</sup> , Oosterink FMD (43) <sup>c</sup> , Maggrias J (47) <sup>c</sup> , Moore R (48) <sup>c</sup> , Thomson WM (56) <sup>c</sup> , Auerbach SM (57) <sup>c</sup> , Moore R (58) <sup>c</sup> , DeJongh A (61) <sup>c</sup> , Doerr PA (64) <sup>c</sup> , Blomqvist M (65) <sup>c</sup> , Sullivan MJL (72) <sup>c</sup> , Berggren U (80) <sup>c</sup> , Hagglin C (89) <sup>c</sup> , Locker D (94) <sup>c</sup> , Goettems ML (95) <sup>c</sup> , Abrahamsson KH (97) <sup>c</sup>
Modified Dental Anxiety Scale	6	777	Cohen SM (19) <sup>c</sup> , Humphris GM (25) <sup>b</sup> , Hill KB (29) <sup>c</sup> , Kritsidima M (37) <sup>d</sup> , Buchanan H (71) <sup>c</sup> , Humphris G (78) <sup>b</sup>
CFSS-DS	5	690	Klingberg G (11) <sup>c</sup> , Migrom P (18) <sup>c</sup> , Ten Berge M (41) <sup>c</sup> , Ten Berge M (44) <sup>c</sup> , Wogelius P (73) <sup>c</sup>
Structured questionnaire	5	777	Milgrom P (6) <sup>c</sup> , Lautch H (12) <sup>c</sup> , Davey GCL (22) <sup>c</sup> , Gatchel RJ (50) <sup>c</sup> , Wong M (99) <sup>c</sup>
Dental Fear Scale	5	569	Kleinknecht G (23) <sup>a</sup> , Kleinknecht G (30) <sup>b</sup> , McNeil DW (63) <sup>c</sup> , Mcneil DW (91) <sup>c</sup> , Bradley MM (98) <sup>c</sup>
Dental Anxiety Scale, Structured questionnaire	3	538	Hakeberg M (10) <sup>c</sup> , Milgrom P (13) <sup>c</sup> , Vassend O (17) <sup>c</sup>
Dental Fear Scale, Dental Belief Scale, Geer Fear Scale	2	182	Skaret E (75) <sup>c</sup> , Skaret E (86) <sup>c</sup>
Spielberg Trait Anxiety and State anxiety scales	2	331	Lehrner J (7) <sup>c</sup> , Stouthard MEA (62) <sup>c</sup>
Structured Clinical Interview for DSM	2	286	Oosterink FMD (9) <sup>c</sup> , Ost LG (74) <sup>c</sup>
Single question	2	207	Armfield JM (46) <sup>c</sup> , Pohjola V (83) <sup>c</sup>
Dental Anxiety Scale, GATCHEL, Dental Fear Scale	2	292	Locker D (8) <sup>c</sup> , Locker D (93) <sup>c</sup>
Dental Fear Scale, Dental Belief Scale, Dental Anxiety Scale, Geer Fear Scale	1	174	Johnsen BH (15) <sup>c</sup>
Dental Anxiety Question	1	170	Armfield JM (16) <sup>c</sup>
Dental Anxiety Scale, Single question	1	165	Moore R (20) <sup>c</sup>
Visual Analogue Scale	1	149	Facco E (26) <sup>b</sup>
Dental Anxiety Scale, Visual Analogue Scale	1	124	Eli I (39) <sup>c</sup>
Dental Anxiety and Fear IDAC-4C+	1	110	Armfield JM (53) <sup>c</sup>
Visual Analogue Scale, Spielberg Trait Anxiety and State anxiety scale	1	110	Karst M (54) <sup>d</sup>
Dental Anxiety Scale, GATCHEL, Single question	1	110	Locker D (55) <sup>c</sup>
Dental Anxiety Question, Dental Anxiety Scale	1	107	Neverlien PO (60) <sup>a</sup>
Dental Anxiety Scale, Dental Fear Scale	1	101	Mehrstedt M (66) <sup>c</sup>
Dental Anxiety Scale, Modified Dental Anxiety Scale	1	96	Howard KE (70) <sup>b</sup>
The Dental Anxiety Inventory - Short form	1	93	Ng SLW (76) <sup>c</sup>
Modified version of Geer's Fear Survey Schedule	1	93	Bernstein DA (77) <sup>c</sup>
CFSS-DS, Frankl Scale	1	91	Nakai Y (81) <sup>b</sup>
Modified Dental Anxiety Scale, LEO-DEQ	1	89	Humphris G (82) <sup>c</sup>
Venham Anxiety Rating Scale	1	87	Isong IA (87) <sup>d</sup>
Dental Anxiety Scale, Index of Dental Anxiety and Fear	1	87	Armfield JM (88) <sup>a</sup>
Hierarchical Anxiety Scale	1	86	Enkling N (90) <sup>c</sup>
Dental Anxiety Scale, Spielberg Trait Anxiety and State anxiety scales	1	86	Weisenberg M (92) <sup>c</sup>
Modified Dental Anxiety Scale, Dental Fear Scale	1	81	Tunc EP (100) <sup>c</sup>

WoS-AD: Web of Science – All databases; \*Review studies were not considered.

<sup>a</sup>Assessment tools development; <sup>b</sup>Assessment tools validation; <sup>c</sup>Cross-sectional epidemiological surveys; <sup>d</sup>Clinical trial surveys; <sup>e</sup>Longitudinal surveys



**Table 4. Description of key validated instruments used in the studies regarding development dates, authors and range dates of presentation in the review**

Assessment tool	Author of the original scale	Year of publication of the original scale	Range of dates of use in the review
Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders (DSM)	American Psychiatric Association	1952	1985-2009
Frankl Scale,	Frankl SN et al	1962	2005
Geer Fear Scale/ Modified Geer Fear Scale	Geer JH	1965	1998-2003
Dental Anxiety Scale	Corah NL	1969	1969-2012
Hierarchical Anxiety Scale	Gale EN	1972	2006
Dental Fear Scale	Kleinknecht RA et al	1973	1978-2008
Visual Analogue Scale	Hornblow AR and Kidson MA	1976	2013
Venham Anxiety Rating Scale	Venham LL et al	1980	2014
Children Fear Survey Scale-Dental Subscale	Cuthbert MI and Melamed BG	1982	1995-2005
Spielberg Trait Anxiety and State Anxiety Scales	Spielberg CD et al.	1983	1990-2000
Dental Fear Belief	Smith T	1987	1998-2003
Gatchel Fear Scale	Gatchel R	1989	1999-2003
Dental Anxiety Question	Neverlien O	1990	1990-2006
Modified Dental Anxiety Scale	Humphris G et al	1995	2000-2013
The Dental Anxiety Inventory - Short form	Aartman IH	1998	2008
Level of Exposure-Dental Experiences Questionnaire (LEO-DEQ)	Oosterink FMD	2008	2011
Dental Anxiety and Fear IDAC-4C+	Armfield JM	2010	2010-2013

from the late 1800s and early 1900s<sup>4</sup>. Other research topics, such as oral health-related quality of life and non-pharmacological behaviour management techniques have shorter publication intervals for the most frequently cited papers<sup>17,31</sup>, demonstrating that DFA has been important to dental clinical practice for over a century.

The fact that most papers in this study were from Anglo-Saxon America and Europe agrees with other bibliometric reviews in dentistry<sup>31,32</sup>. The papers were published in four of the five continents, with none from Africa and only one from Latin America. Funding for research has a significant impact on publication, with low-income countries participating less in scientific research due to some barriers, including lack of funding<sup>33,34</sup>. This indicates the importance of sharing resources and building collaborations to improve the number of studies published in developing countries.

Most of the papers retrieved in this review were cross-sectional studies (n=67), a similar result to bibliometric reviews<sup>17,32</sup>. Cross-sectional research is important, although some gaps in science will only be filled with different study designs, including randomized controlled trials and cohort studies that

follow all the relevant guidelines. Consequently, systematic reviews will help to build up evidence-based science and practice<sup>35</sup>.

Studies on DFA use different terms to describe the feeling. The most common is “dental anxiety”, followed by “dental fear”, and in third place the unique term, “dental fear and anxiety”, used in 11 papers, most of which were published after the year 2000, suggesting that the combined term appears to be becoming accepted in recent publications<sup>3,8,9</sup>. “Dental phobia” refers to exacerbated dental fear which is persistent and unreasonable, but was not a common expression<sup>3</sup>, having been used in only three studies.

Different assessment tools can be used to measure DFA, which can be self-reported or proxy-reported<sup>16,36</sup>. This review also looked at the development of the assessment tools over the years, and how they are used in the 100 most frequently cited papers on DFA. The most frequently used assessment tool was the Dental Anxiety Scale. Although it is not the first one to have been developed, it was the first one made specifically for dental situations<sup>10</sup>. The Dental Fear Survey was the 23<sup>rd</sup> most cited paper<sup>11</sup>. The Dental Anxiety Scale

and the Dental Fear Scale are the most frequently used scales in epidemiological surveys nowadays, which accounts for the presence of both on this list<sup>36</sup>. Seven papers on the list referred to validation processes. Validation processes are important to guarantee that an assessment tool has good psychometric properties on the target population, which accounts for the number of citations of the papers on development of assessment tools<sup>21</sup>. The paucity of validation studies compared to tools in this citation list may simply be due to the fact that such studies may not be cited as much as papers reporting the creation and use of an instrument.

A bibliometric review is important to describe how the literature on a specific topic has been covered, by examining publications and the research constituents<sup>21</sup>. Several aspects of DFA were covered by the papers in the 100 most frequently cited list, reflecting the different advances in knowledge that have taken place over the years. Thus, the aim of this review was not to answer a specific clinical question, but to provide an overview of the topic and the gaps in knowledge that need to be covered by future research. This bibliometric review was conducted following the most recent guidelines<sup>18,20,25</sup>, and evaluated the quality of the 100 most frequently cited papers on DFA, finding medium to high quality overall. Thus, it may be considered a reliable source of evidence-based information for clinical practice, policy-making or future research. This study provides a guide to help authors develop new research, identify the most

significant associations and find opportunities to establish new collaborations, mainly in countries with higher barriers for research. In addition, identifying the authors and research groups that have had the greatest impact may guide clinicians and policymakers to choose the best evidence on which to base their decisions.

The limitations of the study are that (1) a bibliometric review cannot provide conclusive summary of the effect of interventions or robust evidence related to a research question (which is a known limitation of this type of study)<sup>20,21</sup>; (2) the quality of the studies was intermediate overall, suggesting that greater effort is needed to guarantee higher quality research; and (3) important recent papers in the field will take time to achieve the volume of citations that would enable them to be selected, and they thus remain unrepresented.

In conclusion, this bibliometric analysis identified the 100 most frequently cited papers on DFA found in the WoS-AD. The citations of these papers range from 81 to 882 over a 58-year period. They were mainly published by countries in the Global North, and cover different aspects of DFA. Whilst “dental anxiety” is the most common term, there appears to be more emphasis on “dental fear and anxiety” in more recent studies. The Dental Anxiety Scale was the most frequently used assessment tool in this list. The methodological quality assessment suggests the need for higher quality research in this field. Longitudinal and randomized clinical trials should be encouraged in order to produce further evidence.

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## CONFLICT OF INTERESTS

The authors declare no potential conflicts of interest regarding the research, authorship, and/or publication of this article.

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