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The prevalence of contact dermatitis and skin diseases in dental professionals: a global systematic review and meta-analysis

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Abstract

Background As there has not been a comprehensive systematic review on the prevalence of contact dermatitis in dental professionals, the aim of this study is to determine the global prevalence of occupational contact dermatitis (OCD) and occupational skin diseases (OSD) in dental professionals.

Methods In this meta-analysis, a search in databases including web of sciences, PubMed and Scopus was conducted until June 14, 2024. Google Scholar was examined to find relevant studies. The retrieved articles were screened and the necessary data were extracted from related articles and entered into the analysis. To evaluate the methodological quality of the included studies (risk of bias), the Newcastle–Ottawa Quality Assessment Scale, adapted for cross-sectional and cohort studies was used.

Results In conducting a meta-analysis of articles related to OSD and OCD, heterogeneity and publication bias were observed. The results showed that the prevalence of OCD among dental professionals is 34% (95%CI = 28–41%, chi square = 1859, df = 32, I-square = 98.3%, $p < 0.001$). The results of meta-analysis showed that the prevalence of OSD is 30% (95%CI = 27–33%, chi square = 1286, df = 44, I-square = 96.6%, $p < 0.001$).

Conclusion The results revealed that the global prevalence of OCD and OSD in the dental staff is over 30%, which is a relatively high. Among different subgroups, the highest prevalence was observed among dental technicians, followed by dental assistants. Dentists and dental hygienists had a lower-than-average prevalence in OCD and OSD. Routine screening of skin problems in dental professionals are recommended.

Keywords Dermatitis, contact, Dermatitis venenata, Contact eczema, Skin problem, Dentists, Occupational contact dermatitis, Occupational skin diseases

1 Introduction

Contact dermatitis is a type of eczema that is caused by contact with a certain substance. Eczema is a group of skin diseases that cause dryness, redness, itching, cracking, swelling and irritation of the skin [1–3]. These skin reactions may be caused by chemical



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substances or metal ions that leave their destructive effects without causing a response in T cells of the immune system (contact stimuli) or may be caused by reactive chemical substances that change the proteins and induce the role of contact allergens [2, 4].

Dentists and dental technicians are more prone to dermatitis on the skin of their hands. Many materials used in dentistry are biologically irritating. The use of protective gloves, which have been determined as the standard of care, increases the exposure of dental workers to potential allergens in latex. Symptoms from latex exposure can range from a mild skin irritation such as itching to anaphylactic shock [5]. In addition to that, hands are constantly exposed to abrasive washing with antimicrobial substances and other substances used in dentistry. Common sensitizing materials in dentistry include: latex, rosin, methacrylate, dental metal alloys, eugenol, disinfectants, local anesthetics, some dental molding materials, and mercury [6].

The increase in the number of patients visiting dentists in recent years has led to an increase in reports of dermatitis and various allergies in patients and dentists. However, due to the changes that have been made in dental materials since the past, the allergy and contact reactions of people involved with new allergens have also increased [7]. Important underlying factors of allergy are atopy, hand dermatitis, history of repeated surgery and food allergy. In addition, family history of allergies, race and smoking have listed among these factors [8].

So far, there has not been a comprehensive study on the prevalence of occupational contact dermatitis (OCD) in dental professionals. Evaluating the prevalence of this type of dermatitis can play a significant role in prevention and planning to deal with this type of skin disease for dentists and dental personnel. Paying attention to this point reduces the amount of skin damage and provides the necessary measures to manage it for dentists and other dental workers, so the aim of this study is to determine the prevalence of OCD and occupational skin diseases (OSD) in dental professionals (dentists, dental technicians and dental assistants) as a systematic review and meta-analysis.

2 Methods

2.1 Study design

To conduct this systematic review, the PRISMA guidelines were used. This study is a systematic review and is considered as a secondary study, and all published studies in the field of contact dermatitis and allergic skin reactions in dental professionals have been searched.

2.2 Protocol and registration

The protocol was registered on the PROSPERO (ID: CRD42024562106).

2.3 Eligibility criteria

In this research, the inclusion criteria include original human studies and articles in English and the exclusion criteria include lack of access to the full text of the article and articles other than original articles. The studies that reported the prevalence of skin allergies, and contact dermatitis among dentists, dental technicians, and dental assistants were included in our study. In terms of design, any study that reported the prevalence of contact dermatitis were included. Case reports, editorials, commentary, animal studies, and interventional studies were not included.

2.4 Information sources

A comprehensive search of published studies in international databases including web of sciences, PubMed and Scopus was conducted until June 14, 2024. In addition, Google Scholar was examined to find additional relevant studies. Also, the references of included full-text in the meta-analysis was also manually searched in order to find all related articles.

2.5 Searches

The search was conducted by two authors independently (AAH and MKC). Different keywords were used to search for studies including dentists, periodontist, dental technician, dental technologist, dermatitis venenata, contact dermatitis, contact eczema, contact sensitivity, contact hypersensitivity, skin sensitivity, occupational skin damage, and skin problem. The details of searching articles in the mentioned databases in Table 1 are shown.

2.6 Study selection

Relevant articles were searched and retrieved articles were entered into EndNote software for review. Then first, duplicate articles were removed using the software. In the next step, the title and abstract of the articles were screened and irrelevant articles and articles that did not meet the inclusion criteria were removed. After that, the full text of the remaining articles was downloaded and evaluated, and at this stage irrelevant articles were also removed. Finally, the required data were extracted from the remaining related articles. The process of screening and study selection was evaluated and reviewed by two authors (MKC, FG), and in case of inconsistencies between the two authors, the cases were reviewed by the third author (MB).

2.7 Data collection process and data items

To extract data from the remaining articles, a checklist was designed in Excel software and the extracted information was entered into it. The data included the first author, year of publication, country, study design, average age of participants, characteristics of participants, sample size, sampling method, type of skin disorder, prevalence of contact dermatitis (total cases, positive cases and 95% confidence interval (CI)), and diagnosis method of contact dermatitis.

Table 1 The details of the search strategy in three databases

Databases	Search query	Results
PubMed	(("Dermatitis, Contact"[Mesh] OR "Dermatitis Venenata"[all] OR "Contact Dermatit*" [all] OR "Contact Eczema"[all] OR "Contact Sensitiv*" [all] OR "Contact Hypersensitiv*" [all] OR ("Skin sensitiv*" [all] OR "occupational skin damag*" [all] OR "Skin problem*") AND ("Dentists"[Mesh] OR "Periodontist*" [all] OR "Dentist*" [all] OR "dental technic*" [all] OR "Dental technologist*" [all])	630
Scopus	(("Dentists") OR ("Periodontist*") OR ("Dentist*") OR ("dental technic*") OR ("Dental technologist*")) AND (("Dermatitis Venenata") OR ("Contact Dermatit*") OR ("Contact Eczema") OR ("Contact Sensitiv*") OR ("Contact Hypersensitiv*") OR ("Skin sensitiv*") OR ("occupational skin damag*") OR ("Skin problem*")) AND (LIMIT-TO (LANGUAGE, "English"))	282
Web of sciences	"Dentists" (Topic) or "Periodontist*" (Topic) or "Dentist*" (Topic) or "dental technic*" (Topic) or "Dental technologist*" (Topic) AND "Dermatitis Venenata" (Topic) or "Contact Dermatit*" (Topic) or "Contact Eczema" (Topic) or "Contact Sensitiv*" (Topic) or "Contact Hypersensitiv*" (Topic) or "Skin sensitiv*" (Topic) or "occupational skin damag*" (Topic) and "Skin problem*" (Topic)	162

2.8 Risk of bias in individual studies

To assess the methodological quality of the studies (risk of bias), the Newcastle–Ottawa Quality Assessment Scale (NOS), adapted for cross-sectional and cohort studies was used. This tool evaluates studies in three sections including selection, comparability and outcome. The maximum score of this tool is 9, which is a maximum of 5 points for selection, 1 point for comparability and 3 points for outcome. In this tool, a score of 7–9 was considered as low risk, a score of 4–6 as medium risk and a score of 3 or less as high risk. NOS is a public tool for assessing the quality of observational studies (cohort and case–control), which are common in occupational health research, including studies on OCD and OSD among dental professionals and provides a simple, easy-to-use checklist and widely recognized and accepted checklist.

2.9 Summary measures and synthesis of results

The extracted data were entered into Stata software. Heterogeneity between articles was checked using chi-square test and I-square statistic, and if there was no significant heterogeneity between studies, fixed-effects model was used, otherwise, random-effects model was used. The prevalence of OCD and OSD with 95% confidence interval (95%CI) was calculated. A forest plot was used to show the data synthesis. To check the possibility of publication bias, funnel plot and Begg and Egger tests were used. Also, sensitivity analysis was used to examine the effect of each study in the overall prevalence. Subgroup analysis was also performed by the profession of the participants, country and study design. Analyzes were performed using Stata version 17.

3 Results

3.1 Study selection

Based on the information presented in Fig. 1, a total of 1108 articles were retrieved by searching the databases (630 articles from PubMed, 162 articles from web of sciences, 282 articles from Scopus and 34 articles from Google Scholar and manual search). After eliminating duplicate articles, titles and abstracts of 779 articles were screened, of which 667 articles were excluded, and the full text of the remaining 112 articles was evaluated, and 48 articles were excluded. Finally, the data required for meta-analysis was obtained from 25 relevant studies to OCD [9–33] and 32 studies [6, 24, 34–63] related to OSD were included in the meta-analysis.

3.2 Study characterization

In the synthesis of OCD studies, 25 studies were included, the oldest of which was published in 1985 [13] and the most recent of which was published in 2024 [31]. The lowest sample size was in Wrangsjö et al. [32] with 8 samples and the largest sample size was 1603 samples in Hamann et al. [15]. These studies were conducted on dental technicians, dentists, dental personnel, dental assistants, dental hygienist, and dental students, and the most studies were conducted on dentists (10 studies) and the least studies were conducted on dental students (one study). More details about the included studies are shown in Table 2.

Also, 32 studies were included in the OSD meta-analysis, the oldest study was published in 1985 [57] and the most recent in 2024 [6]. The lowest sample size was in Hill

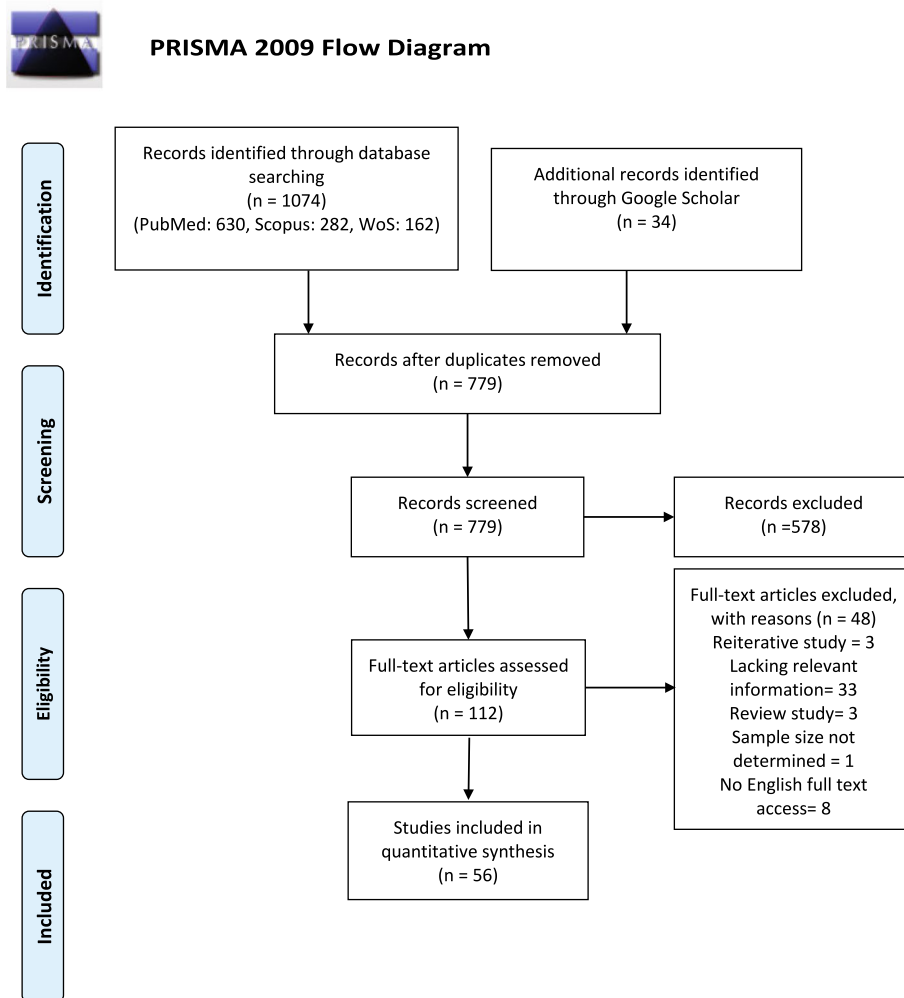


Fig. 1 Flowchart of the study selection process

et al. [34] with 13 samples and the highest in Stoeva et al. [60] with 4675 samples. More details about the included studies are shown in Table 3.

3.3 Risk of bias within studies

The review of the methodology quality of the included studies was checked using the NOS checklist, the results of which are reported in Table 4. In OCD studies, there were 11 low-risk studies, and 14 medium-risk studies. In the OSD study, 3 studies with low risk, and 29 studies with medium risk of bias were identified. There is no high risk of bias study.

4 Occupational contact dermatitis

4.1 Heterogeneity

In the synthesis of the findings of OCD studies, the evaluation of heterogeneity between the articles showed that there is significant heterogeneity between the studies (chi square = 1859, df = 32, I-square = 98.3%, $p < 0.001$), for this reason two approaches including the use of random-effects model and subgroup analysis based on the type of study participants were performed.

Table 2 The summary of included studies in the meta-analysis of OCD

Author	Year	Country	Participants	Diagnostic method	Sampling	Sample size	CD+	Quality score	Study Design	Details
Wiechens [31]	2024	Germany	Dentists	Questionnaire	Random	208	36	5(9)	Cross Sectional	
Jaber [17]	2023	UAE	Dental Personnel	Questionnaire	Random	434	41	5(9)	Cross Sectional	
Alzaid [10]	2023	Saudi Arabia	Dentists	Questionnaire + Clinical	Non random	90	37	7(9)	Cross Sectional	
Alzaid [10]	2023	Saudi Arabia	Dental student	Questionnaire + Clinical	Non random	100	33	7(9)	Cross Sectional	
Warshaw [30]	2022	North America	Dental Personnel	Patch Test	Random	585	387	7(9)	Cohort	
Japundžić I [18]	2018	Croatia	Dental Personnel	Questionnaire + Patch	Random	104	5	7(9)	Cross Sectional	ACD
Heratzadeh [16]	2018	Germany	Dental Technicians	Recorded Data	Random	399	226	7(9)	Cohort	
Minamoto [24]	2016	Japan	Dental Personnel	Questionnaire + Patch	Random	54	29	8(9)	Cross Sectional	ACD
Kocak O [21]	2014	Turkey	Dental Personnel	Clinical finding	Non random	461	198	8(9)	Cross Sectional	
Yusoff [33]	2013	Malaysia	Dental Personnel	Questionnaire	Random	357	90	6(9)	Cross Sectional	
Cristaudo [12]	2012	Italy	Dental Technicians	Patch Test	Non random	81	47	7(9)	Cross Sectional	
Al-Ali [9]	2012	UAE	Dentists	Questionnaire	Random	733	135	6(9)	Cross Sectional	
Scott [27]	2003	UK	Dentists	Questionnaire + Clinical	Random	46	23	6(9)	Cross Sectional	
Scott [27]	2003	UK	Dental Assistants	Questionnaire + Clinical	Random	18	5	6(9)	Cross Sectional	
Ravis [25]	2003	USA	Dental Assistants	Questionnaire + Patch	Random	101	13	7(9)	Cohort	ACD
Kiec-Swierczyńska [20]	2002	Poland	Dentists	Patch Test	Random	79	56	6(9)	Cross Sectional	ACD
Kiec-Swierczyńska [20]	2002	Poland	Dental Assistants	Patch Test	Random	46	34	6(9)	Cross Sectional	ACD
Wrangsjö [32]	2001	Sweden	Dentists	Patch Test	Random	79	44	7(9)	Cross Sectional	
Wrangsjö [32]	2001	Sweden	Dental Assistants	Patch Test	Random	85	62	7(9)	Cross Sectional	
Wrangsjö [32]	2001	Sweden	Dental Hygienist	Patch Test	Random	8	3	7(9)	Cross Sectional	
Lee [22]	2001	South Korea	Dental Technicians	Patch Test	Random	49	22	6(9)	Cross Sectional	
Wallenhammar [29]	2000	Sweden	Dentists	Questionnaire + Patch	Random	1287	141	8(9)	Cross Sectional	
Lindberg [23]	2000	Sweden	Dentists	Questionnaire + Patch	Random	192	15	8(9)	Cross Sectional	ACD
Lindberg [23]	2000	Sweden	Dental Assistants	Questionnaire + Patch	Random	269	25	8(9)	Cross Sectional	ACD
Lindberg [23]	2000	Sweden	Dental Hygienist	Questionnaire + Patch	Random	64	1	8(9)	Cross Sectional	ACD
Chowanadisai [11]	2000	Thailand	Dentists	Questionnaire	Random	178	39	5(9)	Cross Sectional	
Hamann [15]	1998	USA	Dental Personnel	Questionnaire + skin prick test	Non random	1603	382	6(9)	Cross Sectional	
Katalaris [19]	1996	Australia	Dental Personnel	Questionnaire	Non random	177	32	5(9)	Cross Sectional	

Table 2 (continued)

Author	Year	Country	Participants	Diagnostic method	Sampling	Sample size	CD+	Quality score	Study Design	Details
Gebhart [14]	1996	Germany	Dental Technicians	Patch Test	Non random	59	37	6(9)	Cohort	
Uveges [28]	1995	USA	Dental Personnel	Questionnaire + Patch	Non random	449	120	6(9)	Cross Sectional	
Rudzki [26]	1989	Poland	Dentists	Patch Test	Random	92	36	6(9)	Cross Sectional	ACD
Estlander [13]	1985	Finland	Dental Technicians	Questionnaire + Patch	Random	107	21	6(9)	Cross Sectional	

Table 3 The summary of included studies in the meta-analysis of OSD

Author	Year	Country	Participants	Diagnostic method	Sampling	Sample size	SD +	Study Design	Details
Slodownik [6]	2024	Israel	Dental Personnel	Questionnaire	Random	312	60	Cross Sectional	OSD
Japundžić [47]	2023	Croatia	Dentists	Clinical + Patch	Random	74	38	Cross Sectional	Hand eczema
Stoeva [60]	2020	Bulgaria	Dentists	Questionnaire	Random	4675	1477	Cross Sectional	OSD
Stoeva [59]	2019	Bulgaria	Dental Students	Questionnaire	Random	467	99	Cross Sectional	OSD
Vodanović [61]	2016	Croatia	Dentists	Questionnaire	Random	494	144	Cross Sectional	OSD
Minamoto [24]	2016	Japan	Dentists	Questionnaire	Random	103	15	Cross Sectional	OSD
Minamoto [24]	2016	Japan	Dental Technicians	Questionnaire	Random	21	5	Cross Sectional	OSD
Minamoto [24]	2016	Japan	Dental Hygienist	Questionnaire	Random	266	55	Cross Sectional	OSD
Minamoto [24]	2016	Japan	Dental Assistants	Questionnaire	Random	75	10	Cross Sectional	OSD
Zarra [63]	2015	Greece	Dentists	Questionnaire	Non-Random	120	39	Cross Sectional	OSD
Arheim [38]	2015	Libya	Dentists	Questionnaire	Non-Random	340	120	Cross Sectional	OSD
Agrawa [35]	2010	India	Dentists	Questionnaire	Random	163	26	Cross Sectional	OSD
Ayers [39]	2009	New Zealand	Dentists	Questionnaire	Random	566	266	Cross Sectional	OSD
Leggat P.A [51]	2006	Australia	Dentists	Questionnaire	Random	285	33	Cross Sectional	Hand eczema
Rao [58]	2004	India	Dental Personnel	Questionnaire	Non-Random	52	9	Cross Sectional	OSD
Jacobsen [45]	2003	Norway	Dentists	Questionnaire	Random	121	21	Cross Sectional	OSD
Wrangsjö [62]	2001	Sweden	Dentists	Questionnaire	Random	3083	417	Cross Sectional	Hand eczema
Meding B [52]	2001	Sweden	Dentists	Questionnaire + Patch	Random	1286	311	Cross Sectional	Hand eczema
Andreasson [37]	2001	Sweden	Dentists	Questionnaire	Random	3024	665	Cross Sectional	OSD
Kerosuo [49]	2000	Finland	General Dentists	Questionnaire	Random	147	62	Cross Sectional	Hand eczema
Kerosuo [49]	2000	Finland	Orthodontist	Questionnaire	Random	81	34	Cross Sectional	Hand eczema
Kerosuo [49]	2000	Finland	Office Employee	Questionnaire	Random	91	24	Cross Sectional	Hand eczema
Ortengren U [56]	1999	Sweden	Dentists	Questionnaire	Random	3082	416	Cross Sectional	Hand eczema
Hill [34]	1998	USA	Dentists	Questionnaire	Non-Random	131	19	Cross Sectional	Hand eczema
Hill [34]	1998	USA	Dental Nurses	Questionnaire	Non-Random	212	36	Cross Sectional	Hand eczema
Hill [34]	1998	USA	Dental Hygienist	Questionnaire	Non-Random	13	5	Cross Sectional	Hand eczema
Hill [34]	1998	USA	Dental Technicians	Questionnaire	Non-Random	34	15	Cross Sectional	Hand eczema
Munksgaard [53]	1996	Denmark	Dentists	Questionnaire + Telep	Random	2208	601	Cross Sectional	OSD

Table 3 (continued)

Author	Year	Country	Participants	Diagnostic method	Sampling	Sample size	SD+	Study Design	Details
Jacobsen [43]	1996	Sweden	Dental Technicians	Questionnaire	Random	731	248	Cross Sectional	OSD
Murer [55]	1995	Denmark	Dental Technicians	Questionnaire	Random	192	102	Cross Sectional	OSD
Burke [40]	1995	England and wales	Dental practitioner	Questionnaire	Random	1200	348	Cross Sectional	OSD
Mürer [54]	1995	Denmark	Dental Technicians	Questionnaire	Random	39	12	Cross Sectional	OSD (methacrylate)
Jacobsen [46]	1993	Norway	Dental Technicians	Questionnaire	Random	201	56	Cross Sectional	OSD
Knudsen [50]	1992	Denmark	Dentists	Questionnaire	Random	87	51	Cross Sectional	OSD
Jacobsen [42]	1991	Norway	Dentists	Questionnaire	Random	104	47	Cross Sectional	OSD (1988)
Jacobsen [42]	1991	Norway	Dental Assistants	Questionnaire	Random	127	57	Cross Sectional	OSD (1988)
Jacobsen [42]	1991	Norway	Dentists	Questionnaire	Random	120	48	Cross Sectional	OSD (1979)
Jacobsen [42]	1991	Norway	Dental Assistants	Questionnaire	Random	162	72	Cross Sectional	OSD (1979)
Hensten-Pettersen [41]	1991	Norway	Dentists(prosthodontists)	Questionnaire	Random	115	48	Cross Sectional	OSD
Altuna G [36]	1991	Canada	Dentists	Questionnaire	Random	213	42	Cross Sectional	OSD
Jokstad [48]	1989	Norway	Dentists	Questionnaire	Random	259	82	Cross Sectional	OSD
Jacobsen [44]	1989	Norway	Dentists(periodontists)	Questionnaire	Random	85	31	Cross Sectional	OSD
Jacobsen [44]	1989	Norway	Dental Hygienist	Questionnaire	Random	44	19	Cross Sectional	OSD
Jacobsen [44]	1989	Norway	Dental Assistants	Questionnaire	Random	64	19	Cross Sectional	OSD
Rajaniemi [57]	1985	Finland	Dental Technicians	Questionnaire	Random	202	69	Cross Sectional	OSD

Table 4 The results of risk of bias assessment of included studies

Studies	Author	Year	Study design	Selection	Comparability	Outcome	Overall Rating (9)
Studies included in OCD	Wiechens [31]	2024	Cross Sectional	**	*	**	5(9)
	Jaber [17]	2023	Cross Sectional	**	*	**	5(9)
	Alzaid [10]	2023	Cross Sectional	****	*	**	7(9)
	Warsaw [30]	2022	Cohort	**	**	***	7(9)
	Japundžić I [18]	2018	Cross Sectional	***	*	***	7(9)
	Heratizadeh [16]	2018	Cohort	**	**	***	7(9)
	Minamoto [24]	2016	Cross Sectional	****	*	***	8(9)
	Kocak [21]	2014	Cross Sectional	****	*	***	8(9)
	Yusoff [33]	2013	Cross Sectional	***	*	**	6(9)
	Cristaudo [12]	2012	Cross Sectional	***	*	***	7(9)
	Al-Ali [9]	2012	Cross Sectional	***	*	**	6(9)
	Scott [27]	2003	Cross Sectional	***	*	**	6(9)
	Ravis [25]	2003	Cohort	**	**	***	7(9)
	Kiec-Swierczyńska [20]	2002	Cross Sectional	***	*	**	6(9)
	Wrangsjö [32]	2001	Cross Sectional	***	*	***	7(9)
	Lee [22]	2001	Cross Sectional	***	*	**	6(9)
	Wallenhammar [29]	2000	Cross Sectional	****	*	***	8(9)
	Lindberg [23]	2000	Cross Sectional	****	*	***	8(9)
	Chowanadisai [11]	2000	Cross Sectional	**	*	**	5(9)
	Hamann [15]	1998	Cross Sectional	***	*	**	6(9)
Katellaris [19]	1996	Cross Sectional	**	*	**	5(9)	
Gebhart [14]	1996	Cohort	**	**	**	6(9)	
Uveges [28]	1995	Cross Sectional	***	*	**	6(9)	
Rudzki [26]	1989	Cross Sectional	***	*	**	6(9)	
Estlander [13]	1984	Cross Sectional	***	*	**	6(9)	

4.2 Synthesis of results and subgroups analysis

According to Fig. 2, the results showed that the prevalence of OCD among dental professionals is 34% (95%CI=28–41%). The total number of participants in this analysis was 8594 cases, of which 2375 cases had OCD. As shown in Fig. 3, the results of the subgroup analysis also showed that the prevalence of OCD among dental technicians is 48% (95%CI=31–65%, I-square=94.7%), among dentists is 32% (95%CI=23–40%, I-square=96.9%), among dental personnel is 30% (95%CI=18–42%, I-square=98.9%), among dental assistants is 39 (95%CI=12–66%, I-square=98.3%), among dental hygienists 15% (95%CI=0–50%, I-square=77.1%) and among dental students is 33% (95%CI=24–42%).

According to Fig. 4, the prevalence of OCD is 37% (95%CI=28–47%, I-square=98.4%) in Europe, 29% (95%CI=21–37%, I-square=94.2%) in Asia, and 32% (95%CI=11–54%, I-square=99.3%) in America. Also, the results in Fig. 5 are reported based on the study design, which was obtained in cross-sectional studies by 31% (95%CI=26–37%, I-square=97.3%) and in cohort studies by 50% (95%CI=26–73%, I-square=98.5%).

Table 4 (continued)

Studies	Author	Year	Study design	Selection	Comparability	Outcome	Overall Rating (9)
Studies included in OSD	Slodownik [6]	2024	Cross Sectional	**	*	**	5(9)
	Japundžić [47]	2023	Cross Sectional	***	*	***	7(9)
	Stoeva [60]	2020	Cross Sectional	***	*	**	6(9)
	Stoeva [59]	2019	Cross Sectional	***	*	**	6(9)
	Vodanović [61]	2016	Cross Sectional	***	*	**	6(9)
	Minamoto [24]	2016	Cross Sectional	****	*	***	8(9)
	Zarra [63]	2015	Cross Sectional	**	*	**	5(9)
	Arheiam [38]	2015	Cross Sectional	***	*	**	6(9)
	Agrawal [35]	2010	Cross Sectional	**	*	**	5(9)
	Ayers [39]	2009	Cross Sectional	***	*	**	6(9)
	Leggat [51]	2006	Cross Sectional	**	*	**	5(9)
	Rao [58]	2004	Cross Sectional	**	*	*	4(9)
	Jacobsen [45]	2003	Cross Sectional	**	*	**	5(9)
	Wrangsjö [62]	2001	Cross Sectional	***	*	**	6(9)
	Meding [52]	2001	Cross Sectional	****	*	***	8(9)
	Andreasson [37]	2001	Cross Sectional	***	*	**	6(9)
	Kerosuo [49]	2000	Cross Sectional	**	*	**	5(9)
	Ortengren [56]	1999	Cross Sectional	***	*	**	6(9)
	Hill [34]	1998	Cross Sectional	***	*	**	6(9)
	Munksgaard [53]	1996	Cross Sectional	***	*	**	6(9)
	Jacobsen [43]	1996	Cross Sectional	***	*	**	6(9)
	Murer [55]	1995	Cross Sectional	**	*	**	5(9)
	Burke [40]	1995	Cross Sectional	***	*	**	6(9)
	Mürer [54]	1995	Cross Sectional	**	*	**	5(9)
	Jacobsen [46]	1993	Cross Sectional	**	*	**	5(9)
	Knudsen [50]	1992	Cross Sectional	**	*	**	5(9)
	Jacobsen [42]	1991	Cross Sectional	***	*	**	6(9)
	Hensten-Petersen [41]	1991	Cross Sectional	**	*	**	5(9)
	Altuna [36]	1991	Cross Sectional	**	*	**	5(9)
	Jokstad [48]	1989	Cross Sectional	**	*	**	5(9)
Jacobsen [44]	1989	Cross Sectional	**	*	**	5(9)	
Rajaniemi [57]	1985	Cross Sectional	**	*	**	5(9)	

4.3 Publication bias

Regarding the results of the publication bias, evidence was found in support of the presence of publication bias. Figure 6 showed an obvious asymmetry, and in addition, the results of Egger ($p = 0.003$) and Begg's test ($p = 0.009$) also significantly showed that there is a publication bias.

4.4 Sensitivity analysis

The results of the sensitivity analysis showed that the lowest prevalence proportion was obtained after excluding the Wrangsjö et al. [32] study (33.1%, 95%CI 25.5–40.7%) and

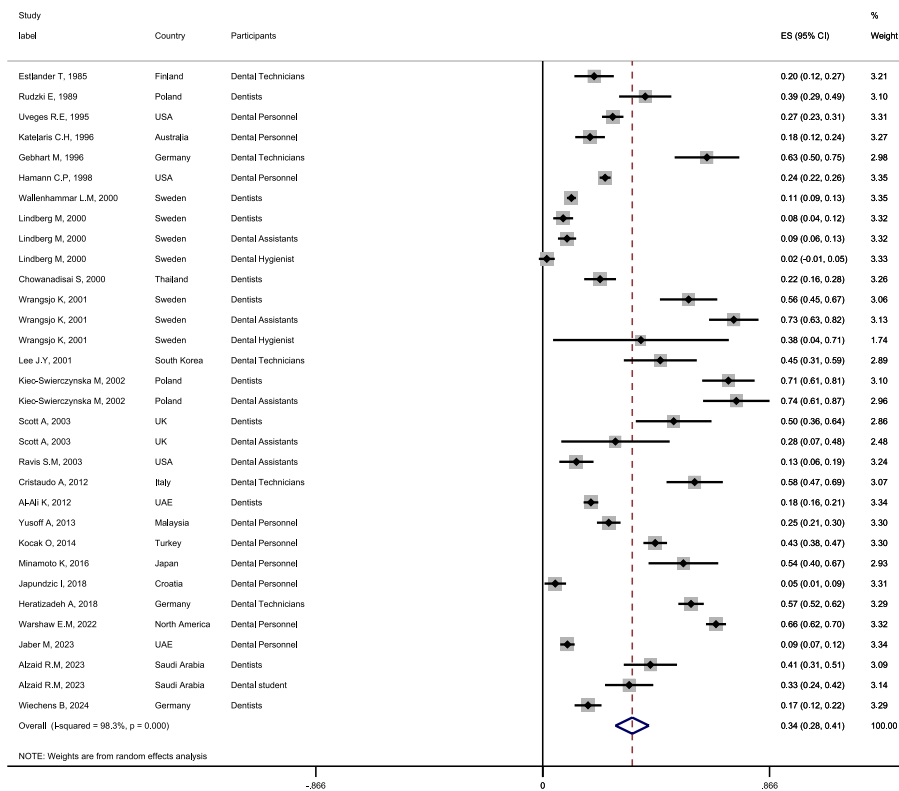


Fig. 2 The meta-analysis of OCD prevalence among dental professionals

the highest prevalence proportion was obtained after excluding the study of Lindberg M. et al. [23] (35.5%, 95%CI 27.8—43.2%).

5 Occupational skin diseases

5.1 Heterogeneity

In the OSD prevalence studies, a significant heterogeneity was observed between the studies (chi square = 1286, df = 44, I-squared = 96.6%, $p < 0.001$), and for the synthesis of these results, the random-effects model and subgroup analysis were used.

In addition to subgroup analysis, meta-regression was conducted to identify potential sources of heterogeneity. The results showed that in the analysis of OCD, variables such as the country of study ($P = 0.658$), type of participants ($P = 0.954$), sample size ($P = 0.278$), and year of study ($P = 0.798$) did not play a significant role in generating heterogeneity. However, in the analysis of OSD, the year of study was identified as one of the sources of heterogeneity ($P = 0.014$). In contrast, type of participants ($P = 0.703$), sample size ($P = 0.201$), and country of study ($P = 0.054$) did not have a significant effect on heterogeneity in this analysis.

5.2 Synthesis of results

In the study of the prevalence of OSD, 25,471 dental-related professionals were included in the analysis, of which 6,373 cases were suffering from OSD. The results of meta-analysis with the random-effects model approach showed that the prevalence of OSD in this group of health workers is 30% (95%CI = 27–33%) (Fig. 7). Based on the subgroups analysis, the results suggested that the prevalence of OSD among

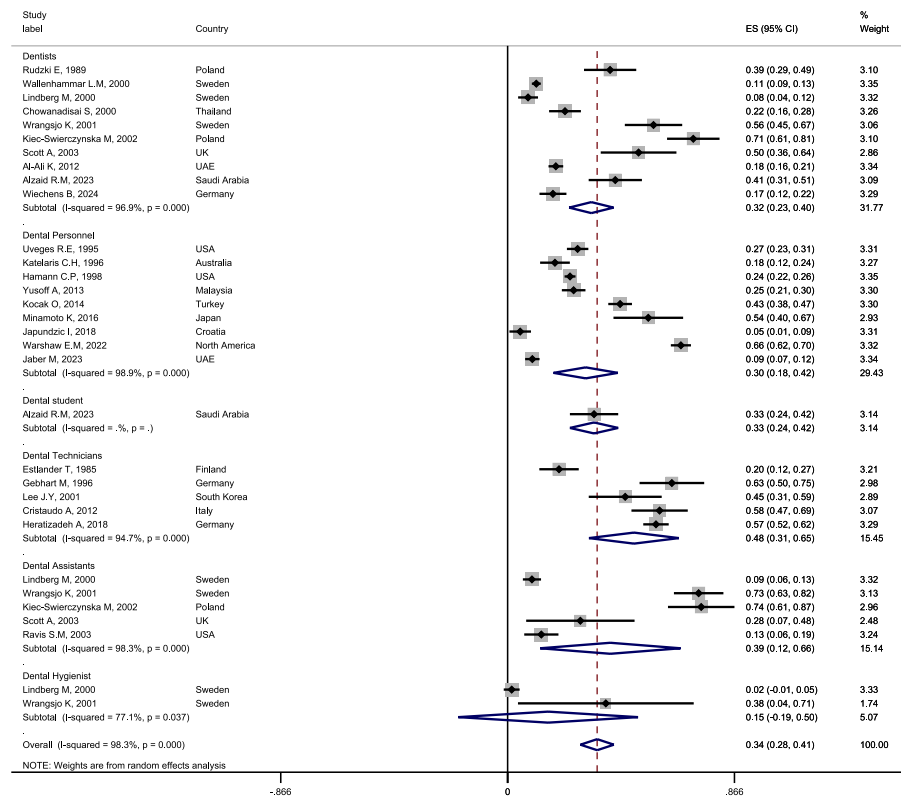


Fig. 3 The meta-analysis of OCD prevalence by dental staffs

dental technicians is 35.9% (95%CI 28.8–43.0%, I-square = 82.2%), among dentists is 29.5 (95%CI 25.6–33.3, I-square = 97.6%), among dental assistants is 33.1% (95%CI 17.1–49.1%, I-square = 92.7%), among dental hygienist is 32.3% (14.8–49.9%, I-square = 78.9%). According to Fig. 8, the prevalence of OSD is 33% (95%CI = 29–37%, I-square = 97.4%) in Europe, 18% (95%CI = 16–21%) in Asia, and 21% (95%CI = 15–28%, I-square = 70.3%) in America. All studies of OSD were cross-sectional and subgroup analysis was not performed based on study design.

5.3 Publication bias

In examining the publication bias in this analysis, the funnel plot (Fig. 9) showed that there is a significant publication bias because of asymmetry in the funnel, which was confirmed by the result of the Egger test ($p = 0.003$), although the result of Begg’s test was not significant ($p = 0.493$).

5.4 Sensitivity analysis

The results of sensitivity analysis in OSD meta-analysis showed that the lowest prevalence of OSD was 29.2% (95%CI = 25.8–32.7%) after excluding Knudsen B.B. et al. study [50] and the highest value was 30.3% (95%CI = 26.7–33.9%) after excluding Rao R. et al. study [58].

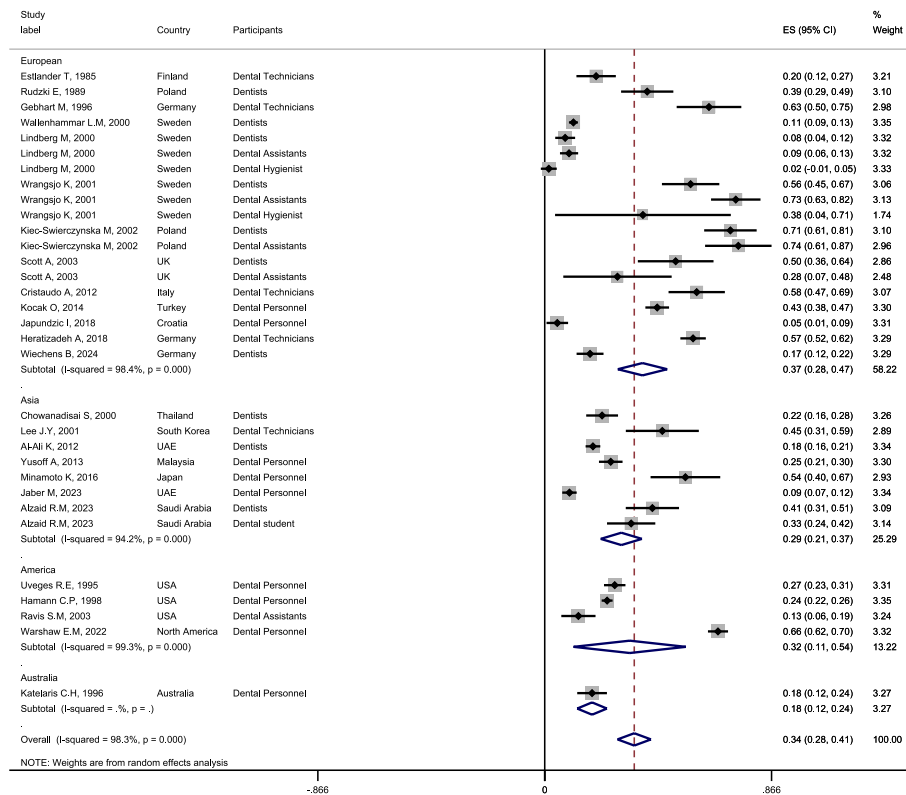


Fig. 4 The meta-analysis of OCD prevalence by country

6 Discussion

The key results of this study displayed that the global prevalence of OCD and OSD in the dental staff is over 30%, which is a relatively high prevalence. Among different subgroups, the prevalence of both OCD and OSD had a similar pattern, and the highest prevalence was observed among dental technicians, followed by dental assistants. Dentists and dental hygienists had a lower-than-average prevalence in OCD and OSD. According to the study country, in both OCD and OSD outcomes, the highest prevalence was related to European countries, followed by American and Asian countries.

In most of the analyses, there was a significant heterogeneity between the results of the studies, which can be influenced by various factors, such as work history, exposure to different allergens, the year of the study, and the country of the study. Therefore, random-effects model was used for data synthesis, and subgroup analysis was also performed to reduce heterogeneity due to the occupation of the participants.

Improving OCD and OSD among dental professionals requires a multifaceted approach that includes prevention, early detection, education, and workplace modifications. Some of key strategies to address OCD and OSD in dental professionals are risk identification, protective measures and personal protective equipment optimization, skin care protocols, education and training, workplace modifications, early detection, and dermatological consultations.

Also, the results of sensitivity analysis suggested that in both OCD and OSD, with the exclusion of individual studies, the overall estimate did not change significantly, and in fact, the effect of each study on the overall estimate was almost the same.

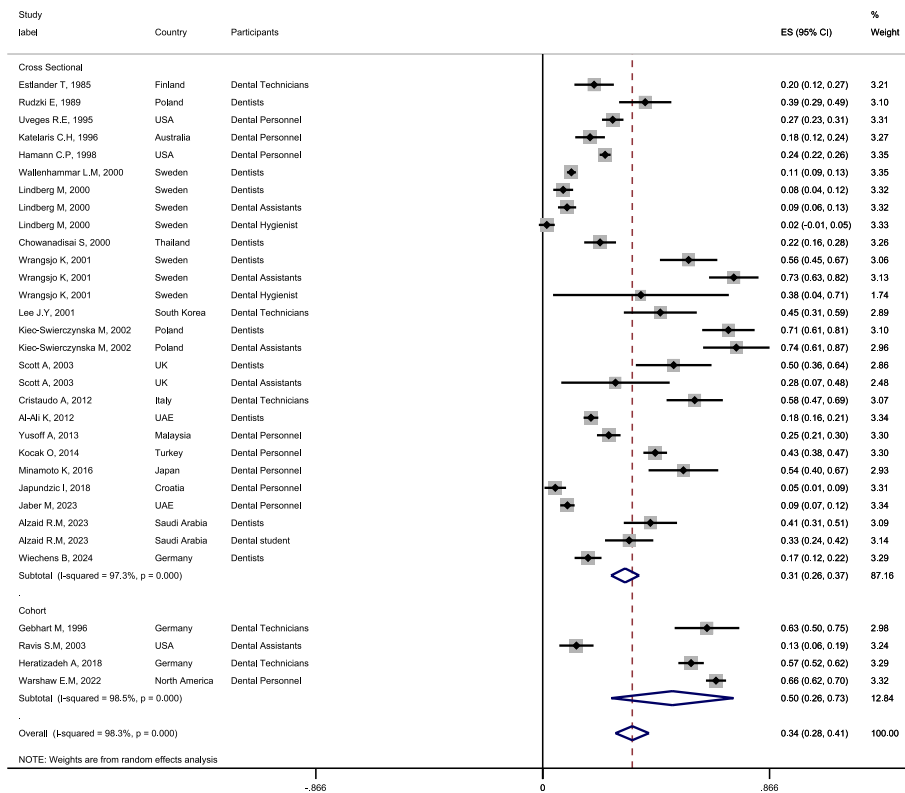


Fig. 5 The meta-analysis of OCD prevalence by study design

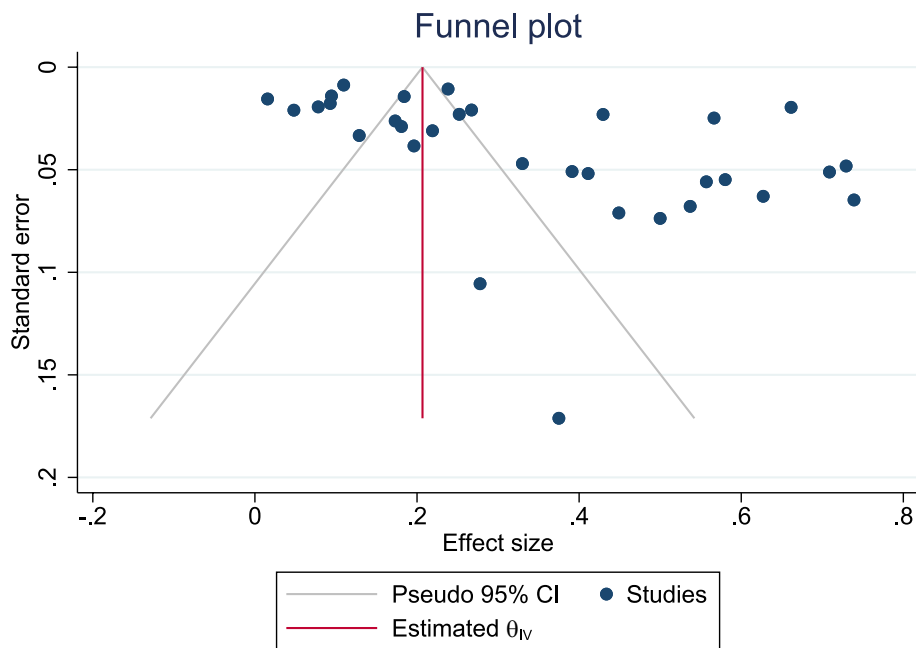


Fig. 6 The funnel plot to assess the publication bias among OCD studies

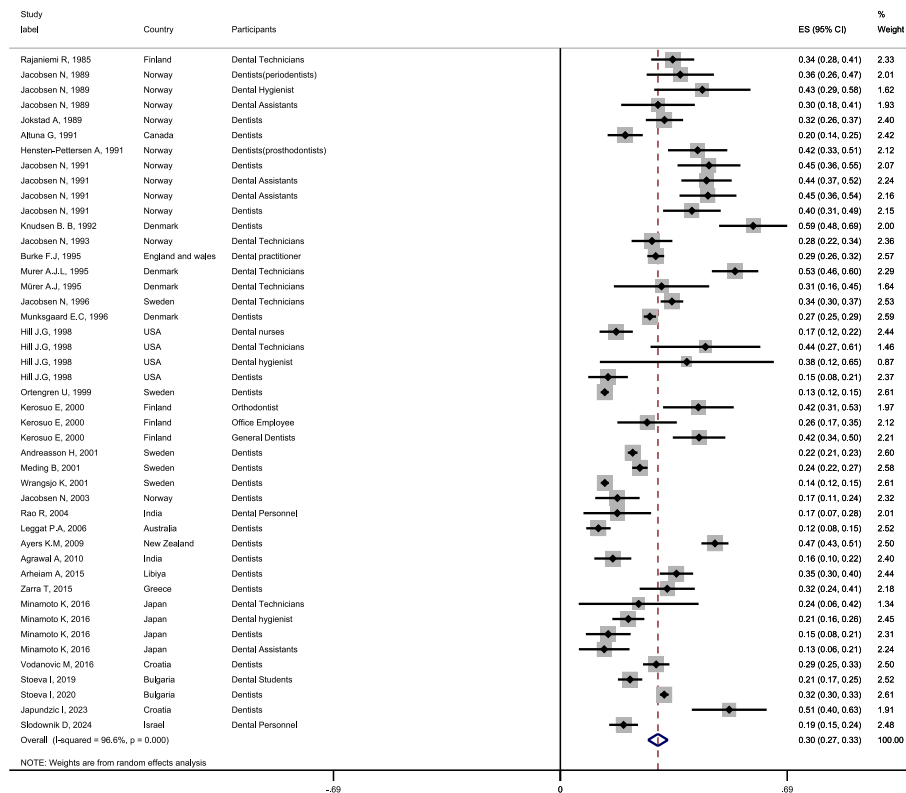


Fig. 7 The meta-analysis of OSD prevalence among dental professionals

Kiec-Swierczyńska et al. [20] conducted a study to assess the incidence of allergic contact dermatitis in dentists and dental nurses using positive patch test. The researchers found that dental personnel were primarily sensitive to components of disinfectants, metals, rubber, and fragrances, but acrylates caused allergies only in dentists. They concluded that acrylates in dentists and disinfectant aldehydes in nurses are the main source of allergy among dental personnel. Type 1 allergy to natural latex was diagnosed in 6.3% of dentists and 8.7% of dental nurses.

In another study, Warsaw et al. [30] conducted a study from 2001 to 2018. Of the 41,109 patients, 585 (1.4%) were dental personnel. More than a quarter of dental personnel had one or more work-related allergic patch test reaction. Occupational contact dermatitis was detected in 22.2% (n = 130) of dental personnel, which was mostly due to non-skin soaps, detergents and disinfectants (32.0%). In line with the results of the present study, the findings showed that occupational contact dermatitis is common among dental personnel who refer for patch testing.

Allergic contact dermatitis in dentistry may affect dentists, technicians, nurses, and patients. Changes in dental activities in recent years have changed the frequency of allergens causing allergic contact dermatitis among dental personnel and patients. Medicines, metals and glutaraldehyde were common allergens causing contact dermatitis in dentistry in the past. However, the widespread use of rubber gloves by staff has led to a significant increase in allergic contact dermatitis to glove allergens in dental staff, while providing protection against former allergens. More concerns about the possible toxicity of metals in oral restorations and, in addition, the greater demand for cosmetic dentistry,

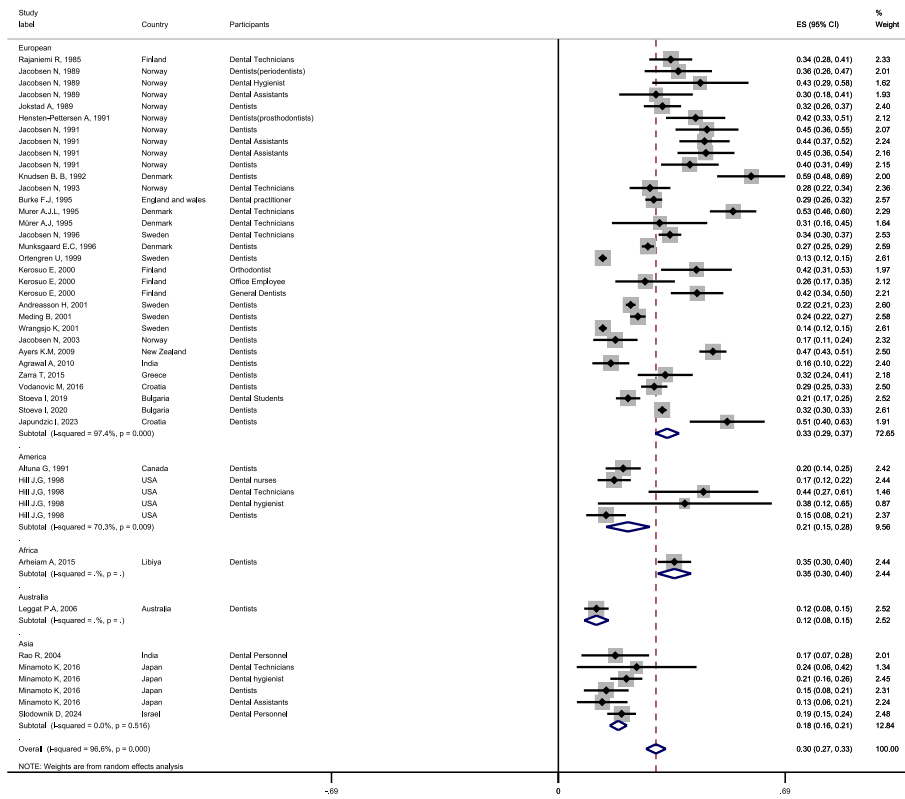


Fig. 8 The meta-analysis of OSD prevalence by country

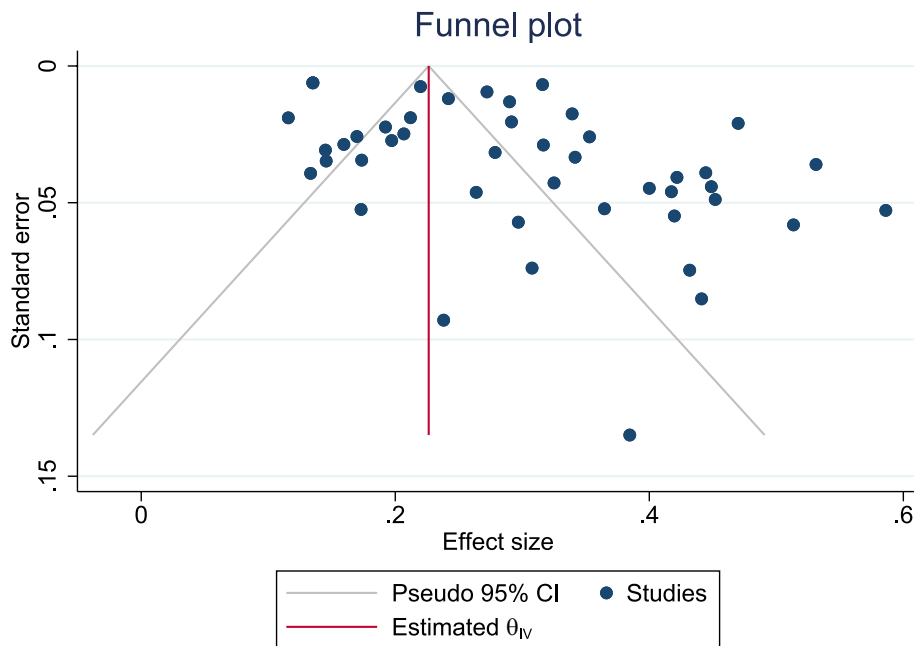


Fig. 9 The funnel plot to assess the publication bias among OSD studies

have led to the greater use of acrylics and expose dental staff to many allergenic substances [64].

A review of the existing literature reveals that dental professionals are particularly vulnerable to OSD, especially OCD. This vulnerability is largely linked to repeated exposure to various irritants and allergens commonly found in dental settings, including disinfectants, latex gloves, and certain dental materials such as acrylates. That said, reported prevalence rates vary significantly, raising concerns about the consistency of findings and the methodological soundness of the studies involved.

While various studies suggest practical interventions such as replacing latex gloves with nitrile alternatives or adopting regular skincare routines, there is a noticeable lack of evidence evaluating the long-term effectiveness of these measures. Most of the available literature is descriptive and cross-sectional, with few studies taking a longitudinal or interventional approach to assess outcomes over time.

The significance of study year as a source of heterogeneity in OSD analysis may be explained by changes in diagnostic criteria and disease classification, advances in pharmacological and non-pharmacological interventions, improvements in study design and research methodologies in more recent studies, as well as changes in population characteristics and access to healthcare services over time. These factors could potentially lead to variations in study outcomes and contribute to heterogeneity.

The prevalence of work-related hand dermatitis depends on frequent hand washing, exposure to potential allergens, and the use of latex gloves [34]. Having the knowledge of dermatologists about the materials used in dentistry, as well as the characteristics of protective equipment such as the materials used in latex gloves and dental materials, can help in better diagnosis and treatment and even prevention of contact dermatitis or other related diseases in dentistry.

One of the strengths of this study is that, to the best of our knowledge, this was a comprehensive and review study that searched three international databases to find relevant studies on the global prevalence of OCD and OSD. One of the limitations of this study is that the studies included in the meta-analysis were limited to the English language full text, which can contribute to the possibility of publication bias. In addition, this review does not search grey literature databases such as OpenGrey or ProQuest dissertations and theses. This omission may increase the risk of publication bias because studies with negative or non-significant findings are less likely to be published in peer-reviewed journals but might exist in grey literature sources.

7 Conclusion

The results exhibited that the prevalence of OCD and OSD in the dental staff is over 30%, which is a relatively high prevalence. Among different subgroups, the highest prevalence was observed among dental technicians, followed by dental assistants. Dentists and dental hygienists had a lower-than-average prevalence in OCD and OSD. Routine screening of skin problems of this group and substitution of less sensitizing materials and protective equipment are recommended.

Abbreviations

NOS	Newcastle–Ottawa assessment scale
OCD	Occupational contact dermatitis
OSD	Occupational skin diseases
NACDG	North American Contact Dermatitis Group

CI Confidence interval

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Author contributions

MKC, MB, FG, and AAH conceived the study design. MKC, MB and FG contributed to the title, abstract and full-text screening. Data extraction was done by MKC, MB and FG. All authors contributed equally to the initial draft of the manuscript. AAH analyzed the data and all authors have read and approved the final version of the manuscript.

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Data availability

All data generated or analyzed during this study are included in the article.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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