

REVIEW

Prevalence and incidence of hand eczema in hairdressers—A systematic review and meta-analysis of the published literature from 2000–2021

Martin S. Havmose¹  | Sanja Kezic²  | Wolfgang Uter³  | Cara Symanzik^{4,5}  | Sarah Hallmann³ | Julia Strahwald³ | Patricia Weinert⁵ | Marija Macan⁶  | Rajka Turk⁶  | Henk F. van der Molen²  | Željka Babić⁶  | Jelena Macan⁶  | Swen M. John^{4,5}  | Jeanne D. Johansen¹ 

¹National Allergy Research Centre, Department of Skin and Allergy, University of Copenhagen, Gentofte Hospital, Copenhagen, Denmark

²Department of Public and Occupational Health, Amsterdam Public Health Research Institute, Amsterdam UMC, University of Amsterdam, Amsterdam, The Netherlands

³Department of Medical Informatics, Biometry and Epidemiology, University of Erlangen, Erlangen, Germany

⁴Department of Dermatology, Environmental Medicine and Health Theory, Osnabrück University, Osnabrück, Germany

⁵Institute for Interdisciplinary Dermatological Prevention and Rehabilitation (iDerm) at Osnabrück University, Osnabrück, Germany

⁶Unit for Occupational and Environmental Medicine, Institute for Medical Research and Occupational Health, Zagreb, Croatia

Correspondence

Dr Martin Havmose, National Allergy Research Centre, Department of Skin and Allergy, Herlev and Gentofte Hospital, Gentofte Hospitalsvej 20A, 2900 Hellerup, Denmark. Email: martin.stibius.havmose@regionh.dk

Abstract

Background: Hairdressers are commonly affected by hand eczema (HE) due to skin hazardous exposure such as irritants and allergens in the work environment.

Objective: To give an overview of the current prevalence, incidence, and severity, as well as the pattern of debut and the contribution of atopic dermatitis on HE in hairdressers.

Methods: A systematic review according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines was performed. Studies published from 2000 to April 2021 that fulfilled predefined eligibility criteria were retrieved.

Results: A pooled lifetime prevalence of 38.2% (95% confidence interval [CI] 32.6–43.8), a pooled 1-year prevalence of 20.3% (95% CI 18.0–22.6), and a pooled point prevalence of 7.7% (95% CI 5.8–9.6) of HE was observed in hairdressers. The lifetime prevalence in fully trained hairdressers and hairdressing apprentices was almost identical. The pooled incidence rate of HE was 51.8 cases/1000 person-years (95% CI 42.6–61.0) and the pooled prevalence of atopic dermatitis was 18.1% (95% CI 13.6–22.5).

Conclusion: HE is common in hairdressers and most hairdressers have debut during apprenticeship. The prevalence of atopic dermatitis in hairdressers is comparable with estimates in the general population, indicating that occupational exposures are the main factor in the increased prevalence of HE in hairdressers. This warrants a strategic and collective effort to prevent HE in hairdressers.

KEYWORDS

dermatosis, hairdressers, hand eczema, incidence, prevalence, severity, skin disease

1 | INTRODUCTION

Hand eczema (HE) is a common and often debilitating occupational disease in hairdressers. This is due to exposure to wet-work and an

array of allergens found in hair dyes, bleaching and waving products, and protective gloves, among others.^{1,2} These exposures begin in apprenticeship, with many hairdressers consequently developing HE early in their career.^{3,4} This has resulted in reports of 31.1% of

hairdressing apprentices and 23.1% of fully trained hairdressers stating skin problems or specifically hand eczema, to be a contributing factor when deciding to leave the trade. Generally occupational hand eczema comes with a range of costs both at a personal and socioeconomic level.^{5,6} It is therefore of great interest to understand the epidemiology of hand eczema in hairdressers, with the aim to prevent HE in hairdressers and to aid in job retention.^{3,7}

Data from epidemiological studies on hairdressers are usually obtained from self-reported questionnaires, structured interviews, or clinical examinations. To ease the comparison between studies, validated assessment tools such as The Nordic Occupational Skin Questionnaire (NOSQ), the Hand Eczema Severity Index (HECSI), and Osnabrück Hand Eczema Severity Index (OHSI) have been developed since the early 2000s.^{8–11} Nevertheless, not all studies incorporate such standardized methods for various reasons, such as publication year or the importance of the particular outcome to the authors. In addition, the often-used UK Working Party (UKWP) criteria in diagnosing a history of atopic dermatitis (AD) in questionnaire studies has been shown to lack sensitivity in populations with other skin comorbidities.¹² Consequently, a high level of heterogeneity in studies reporting on the morbidity of hand eczema and the prevalence of AD, which is the most important endogenous risk factor for HE, is a concern.

Based on the published literature, we aim to give a current estimate of the prevalence and incidence of hand eczema in hairdressers. Additionally, the initial debut and severity of hand eczema, as well as the prevalence of AD in hairdressers will be assessed.

2 | METHODS

This study was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines.¹³ A protocol outlining the objectives, search strategy and criteria for inclusion and exclusion has been published (PROSPERO registration number CRD42021238118).¹⁴

2.1 | Eligibility criteria

Published literature providing information on the prevalence, incidence, debut, or severity of hand eczema in hairdressers or hairdressing apprentices was collected. Only studies with titles and abstracts in English, published from 2000 onward were included in this analysis. No restrictions on study design or number of participants were applied.

2.2 | Literature search

A search was performed in Medline, Web of Science Core Collection, and the Cochrane Library in April 2021. The following search-string combining free-text and MeSH-terms was used: ((*Hairdresser** OR

*Hairdressing apprentice**) AND (“*Dermatitis*”[Mesh] OR *Dermatitis* OR *hand eczema* OR *contact allergy*, OR *allergic contact dermatitis* OR *irritant contact dermatitis* OR *occupational dermatitis* OR “*skin*”[Mesh]) AND (“*Morbidity*” [Mesh] OR “*Risk*” [Mesh] OR *prevalence* OR *incidence* OR *Hazard* OR *consequences* OR *severity*)). Duplicates were removed before two independent reviewers assessed each study by title and abstract. Studies on which an agreement was reached were retrieved for full-text analysis, based on the predefined eligibility criteria. The reference lists of all retrieved studies were screened for relevant titles, not found by the database search.

2.3 | Data extraction

Data on the following outcome variables concerning hand eczema in hairdressers were collected: life-time prevalence, 1-year prevalence, point prevalence, incidence, debut, severity, as well as the proportion of the study population with a history of AD. When possible, the retrieved information was stratified by sex, age, AD, and status as fully trained hairdresser or as hairdressing apprentice. Methods on assessing past or present hand eczema, grading of severity, and a history of AD were recorded.

2.4 | Quality assessment

The Newcastle-Ottawa Scale for cohort studies as well as a modified version for cross-sectional studies (Appendix S1) were used in the quality assessment. Studies were scored in terms of selection, comparability, and exposure. A maximum score of 10 and 9 was possible for cross-sectional and cohort studies, respectively. A total score yielding a proportion >70% was considered of good quality and a total score <70% was considered of fair/poor quality.

2.5 | Statistical analysis

A meta-analysis of proportions was used to estimate the overall prevalence and incidence of hand eczema as well as the prevalence of AD. Tests for heterogeneity were done by an I^2 -test and a Cochrane Q test in order to determine if variability was due to sampling error or other factors and if a random- or fixed-effects meta-analysis were to be used correspondingly.

The Cochrane Q and I^2 were calculated as $Q = \sum (w * ES^2) - \frac{[\sum (w * ES^2)]}{\sum w}$ and $I^2 = \frac{Q - df}{Q} * 100$, where w is the individual study weight, ES is the individual study estimate, and df is degrees of freedom. An I^2 -test >75% or a Cochrane Q with a p -value <0.05 was considered a high level of heterogeneity; hence variability between studies was due to factors other than sampling error why a random-effects meta-analysis was used. An I^2 <25% or a Cochrane Q with a p -value >0.05 was considered a low level of heterogeneity and variability was deemed to be due to sampling error, allowing for a fixed-effects meta-analysis.

A meta-analysis was calculated as the summarized weighted estimates divided by the summarized weights. The inverse variance was used as the weight (W) in both a fixed-effects (FE) and a random-effects (RE) model and was calculated as $w_{FE} = \frac{1}{\text{Standard error}^2}$ and $w_{RE} = \frac{1}{\text{Standard error}^2 + t^2}$, where $t^2 = \frac{Q - df}{\sum w - \frac{(\sum w)^2}{\sum w^2}}$. Statistical calculations were performed in MS office 365 Excel.¹⁵

3 | RESULTS

A total of 233 nonduplicate studies were identified in Medline, Web of Science core collection, and the Cochrane Library. Screening by title and abstract yielded 60 studies for full-text assessment, of which 19 met the eligibility criteria for inclusion (Figure 1). The included studies comprised 15 001 individuals of whom 27.7% (4149/15001) were hairdressing apprentices and 71.6% (10 745/15001) were fully trained hairdressers. Women accounted for 96.1% (11 546/12011) and the

median and average age range was 17 to 37 and 21.1 to 37.4 years, respectively. Eight studies were cohort studies^{7,16-22} and 11 were cross-sectional studies.^{11,23-32} Hand eczema was assessed by a questionnaire in 14 studies,^{7,19-23,25-32} of which 7 used the Nordic Occupational Skin Questionnaire (NOSQ).^{7,20-22,28,31,32} Five studies used clinical examinations in assessing current hand eczema,^{16,26,29,32,33} of which two used standardized scoring systems (one used HECSI¹¹ and one used OHSI³²). A single study used a registry of hairdressers with recognized occupational HE.¹⁸

3.1 | Quantitative analysis

3.1.1 | Prevalence of hand eczema

Studies reporting on the prevalence of hand eczema are summarized in Supplementary Table 2. Nine studies ($n = 10\,952$ participants) reported on the life-time prevalence, yielding an estimate of 38.2% (95% CI 32.6-43.8) (Table 1, Figure 2).^{7,19,22,23,25,28-31} The pooled

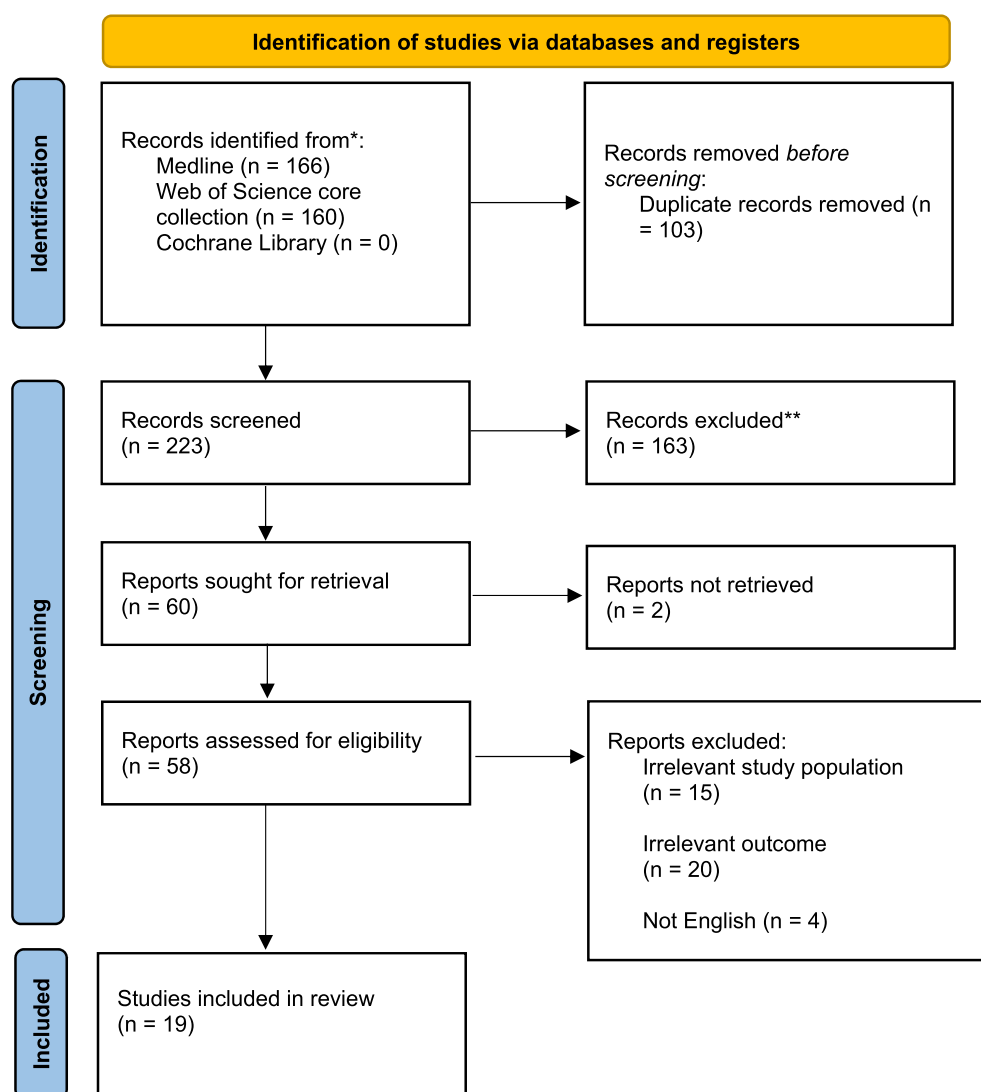


FIGURE 1 Delineation of included studies

TABLE 1 Pooled prevalences and measures of heterogeneity

	N studies	n _{cases} /n _{total}	Pooled prevalence % (95% CI)	I ²	Cochran Q (df)	Level of heterogeneity
Lifetime prevalence of HE (total)						
Total	9	4057/10952	38.2 (32.6–43.8)	93.1	Q (8) = 116.1 p < 0.001	High
Hairdressing apprentices	2	222/613	37.5 (28.9–46.2)	47.8	Q (1) = 1.9 p = 0.25	Medium
Fully trained hairdressers	4	3319/9125	37.0 (27.9–46.1)	96.9	Q (3) = 98.1 p < 0.001	High
NOSQ	5	3899/10564	37.1 (30.2–44.1)	96.4	Q (4) = 109.6 p < 0.001	High
Non-NOSQ	4	158/388	40.2 (31.7–48.6)	43.1	Q (3) = 5.3 p = 0.10	Medium
1-year prevalence of HE						
Total	4	1954/9921	20.3 (18.0–22.6)	76.2	Q (3) = 12.6 p = 0.005	High
Hairdressing apprentices	1	40/136	NA	NA	NA	NA
Fully trained hairdressers	2	1717/8877	19.2 (16.9.4–21.4)	82.9	Q (1) = 5.9 p = 0.03	High
Point prevalence of HE						
Total	9	563/7542	7.7 (5.8–9.6)	77.0	Q (8) = 34.2 p < 0.001	High
Hairdressing apprentices	3	45/438	10.4 (2.6–18.3)	88.3	Q (2) = 17.1 p < 0.001	High
Fully trained hairdressers	4	407/5615	8.8 (5.6–11.9)	57.2	Q (3) = 7.0 0.1	Medium
Self-reported	6	499/6830	7.4 (5.4–9.5)	73.0	18.5 (5) p = 0.005	High
Clinical examination	3	64/712	10.1 (3.8–16.6)	87.6	Q (2) = 16.2 p = 0.001	High
European	6	512/6584	9.9 (6.9–12.9)	80.4	Q (5) = 25.6 p < 0.001	High
Non-European	3	51/958	5.2 (3.7–6.6) ^a	0	Q (2) = 1.6 p = 0.5	Low
Prevalence of atopic dermatitis						
Total	8	2061/10832	18.1 (13.6–22.5)	95.5	Q (7) = 155.3 p < 0.001	High
Hairdressing apprentices	3	128/669	21.3 (3.5–38.9)	95.5	Q (2) = 44.9 p < 0.001	High
Fully trained hairdressers	3	1763/8989	18.3 (13.0–23.6)	95.8	Q (2) = 47.8 p < 0.001	High
UKWP	3	1269/5668	21.7 (9.8–33.7)	96.8	Q (2) = 62.6 p < 0.001	High
Other	5	792/5164	14.8 (13.7–15.8)	86.1	Q (4) = 28.8 p < 0.001	High
Newcastle–Ottawa scale						
<i>Good quality</i>						
Lifetime prevalence of HE	3	3321/9152	35.3 (25.9–45.1)	97.9	Q (2) = 93.3 p < 0.001	High
1-year prevalence of HE	3	1757/9013	19.9 (17.2–22.6)	81.1	Q (2) = 10.6 p = 0.005	High
Point prevalence of HE	3	398/5752	6.9 (6.2–7.6)	0	Q (2) = 0.46 p = 0.5	Low

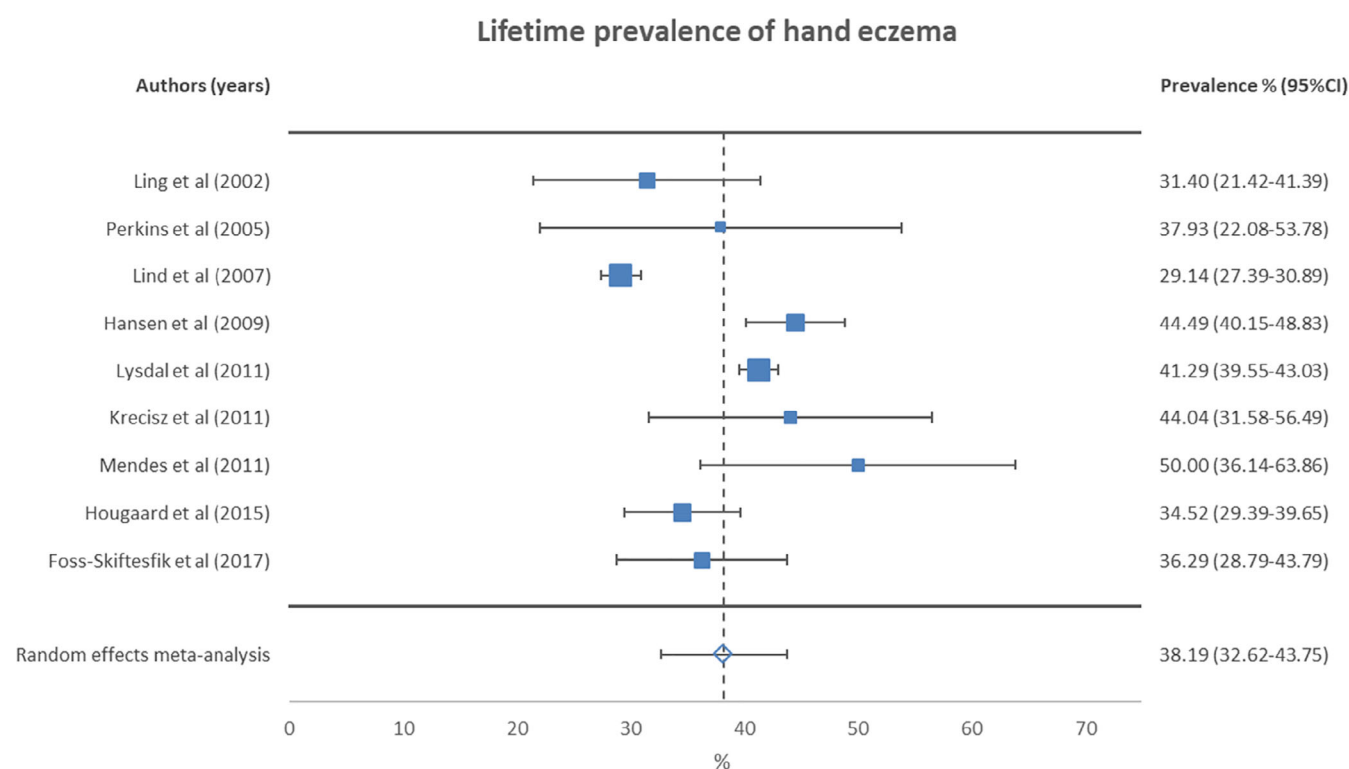
TABLE 1 (Continued)

	N studies	n _{cases} /n _{total}	Pooled prevalence % (95% CI)	I ²	Cochran Q (df)	Level of heterogeneity
A history of atopic dermatitis	5	1927/9694	19.8 (14.6–25.0)	95.4	Q (4) = 98.4 p < 0.001	High
<i>Fair/poor quality</i>						
Lifetime prevalence of HE	6	736/1800	39.9 (34.1–45.7)	63.8	Q (5) = 13.8 p = 0.03	Medium
1-year prevalence of HE	1	908	NA	NA	NA	NA
Point prevalence of HE	6	165/1790	9.8 (5.9–13.7)	85.3	Q (5) = 34.1 p < 0.001	High
A history of atopic dermatitis	3	134/1138	14.3 (8.4–20.4)	70.3	Q (2) = 6.7 p = 0.03	High

Notes: The pooled prevalences were obtained from a random-effects meta-analysis, unless specified.

Abbreviations: HE, hand eczema; NA, not applicable; NOSQ, Nordic Occupational Skin Questionnaire.

^aIndicate use of a fixed-effects meta-analysis.

**FIGURE 2** Meta-analysis estimating the life-time prevalence hand eczema in 10 952 hairdressers/hairdressing apprentices. $I^2 = 93.1$

lifetime prevalence in hairdressing apprentices^{29,31} and fully trained hairdressers^{7,19,23,30} was almost identical, being 37.0% (95% CI 27.9–46.1) and 37.5% (28.9–46.2), respectively. The overall 1-year prevalence was obtained from four studies ($n = 9921$), yielding a pooled estimate of 20.3% (95% CI 18.0–22.6) (Figure 3).^{7,19,20,28} Two studies reporting on the 1-year prevalence in fully trained hairdressers^{7,19} ($n = 8877$) yielded a pooled 1-year prevalence of 19.2% (95% CI 16.9–21.4), whereas a single study ($n = 136$) reporting on the 1-year prevalence in hairdressing apprentices gave an estimate of

29.4%.²⁰ In terms of current hand eczema, nine studies ($n = 7542$) reported on the point prevalence, yielding an estimate of 7.7% (95% CI 5.8–9.6) (Figure 4).^{7,20,21,23,24,26–29} Pooled estimates of 10.4% (95% CI 2.6–18.2) and of 7.7% (95% CI 5.3–10.1) were obtained from studies investigating hairdressing apprentices^{20,26,29} and fully trained hairdressers,^{7,21,23,26} respectively. The point prevalence assessed by clinical examinations^{24,26,29} yielded an estimate of 10.1% (95% CI 3.8–16.6), whereas data from self-reported questionnaires^{7,20,21,23,27,28} yielded an estimate of 7.4% (5.4–9.5).

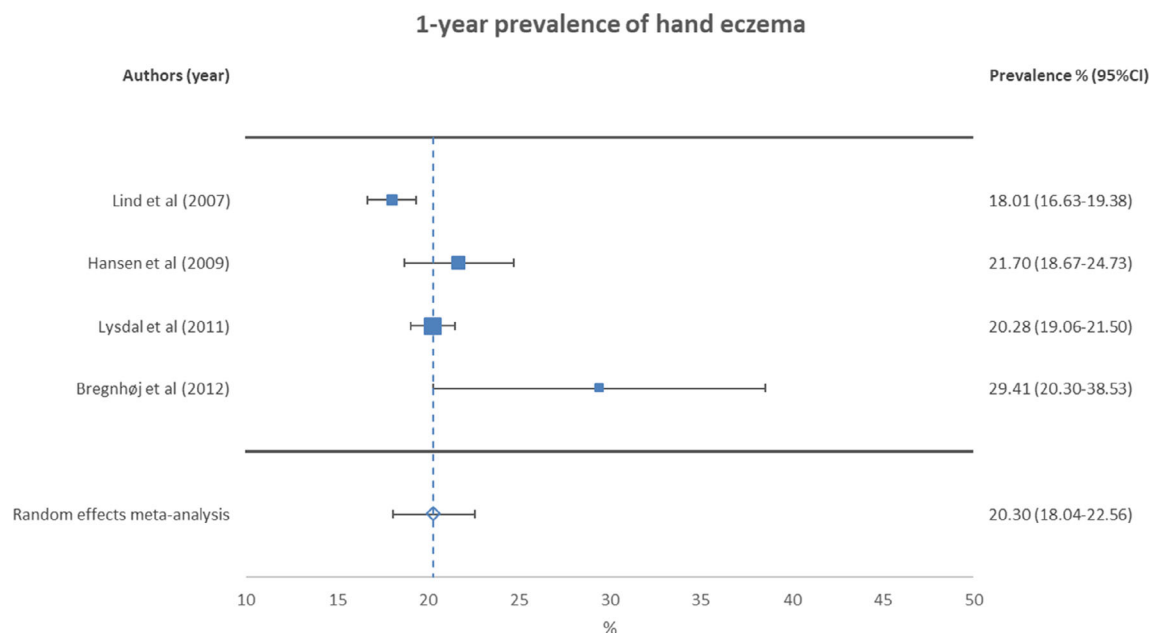


FIGURE 3 Meta-analysis estimating the 1-year prevalence in 9921 hairdressers/hairdressing apprentices. $I^2 = 76.2$

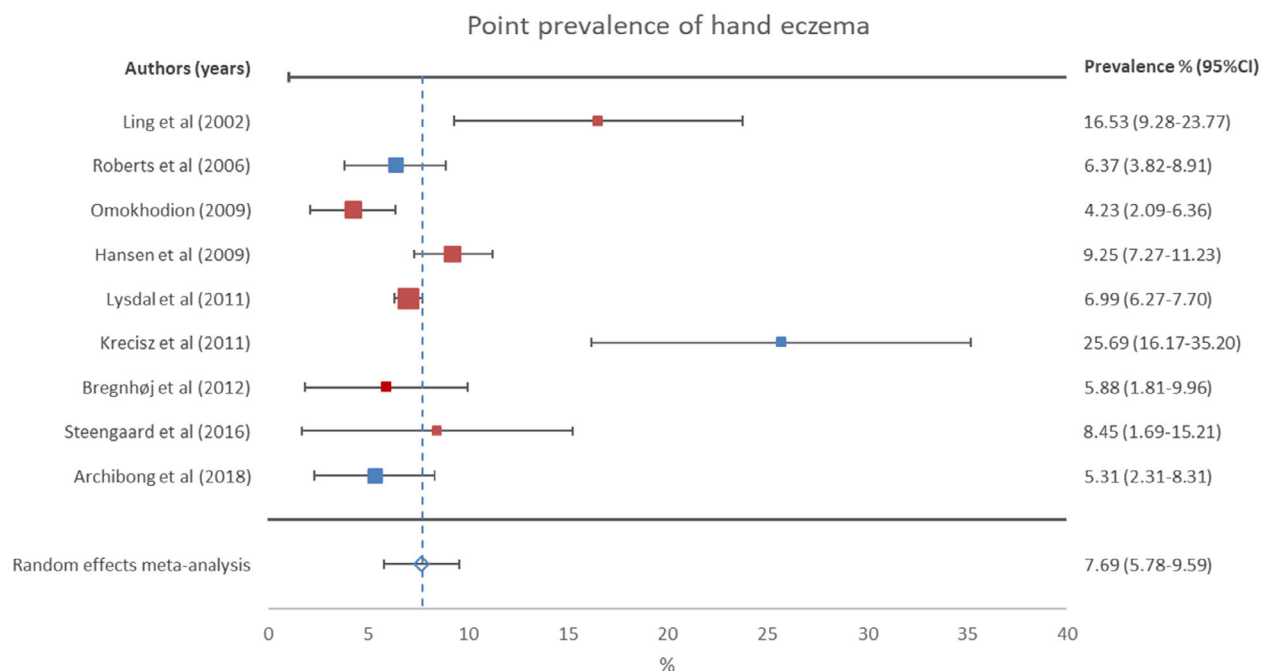


FIGURE 4 Point prevalence of hand eczema in 7542 hairdressers/hairdressing apprentices. Red dot indicates self-reported point prevalence and blue dots indicate point prevalence assessed by clinical examination. $I^2 = 77.0$

All studies reporting on the lifetime and the 1-year prevalence were from Europe (five Danish,^{7,20,22,28,31} two English,^{23,25} one Swedish,¹⁹ one Polish,²⁹ and one Portuguese³⁰). By stratifying studies reporting on the point prevalence by region, estimates of 9.9% (6.9–

12.9) were obtained from European studies and of 5.2% (3.7–6.6) from non-European studies (two Nigerian,^{24,27} one Australian²⁶). No studies stratified the study population with hand eczema by sex, age, or AD, which is why subgroup analysis was not possible.

TABLE 2 Pooled incidence rates of hand eczema and measures of heterogeneity

Incidence rate of hand eczema	N studies	n_{cases} /person-years	Pooled incidence per 1000 person years % (95% CI)	I^2	Cochran Q (df)	Level of heterogeneity
All studies	6	856/32395.9	51.8 (42.6-61.0)	98.6	362.8 (5) $p < 0.001$	High
Hairdressing apprentices	2	225/2017.2	150.9 (40.4-261.4)	92.7	Q (1) = 13.8 $p < 0.001$	High
Trained hairdressers	2	570/23760.3	23.9 (22.0-25.9) ^a	0	Q (1) = 0.9 $p = 0.45$	Low
Newcastle-Ottawa scale						
Good quality	3	626/23691.3	93.7 (22.6-164.9)	96.1	Q (2) = 50.9 $p < 0.001$	High
Fair/poor quality	3	230/8704.6	44.2 (0-95.71)	98.8	Q (2) = 98.8 $p < 0.001$	High

Notes: The pooled incidence rates were obtained from a random-effects meta-analysis, unless specified.

^aIndicate use of a fixed effects meta-analysis.

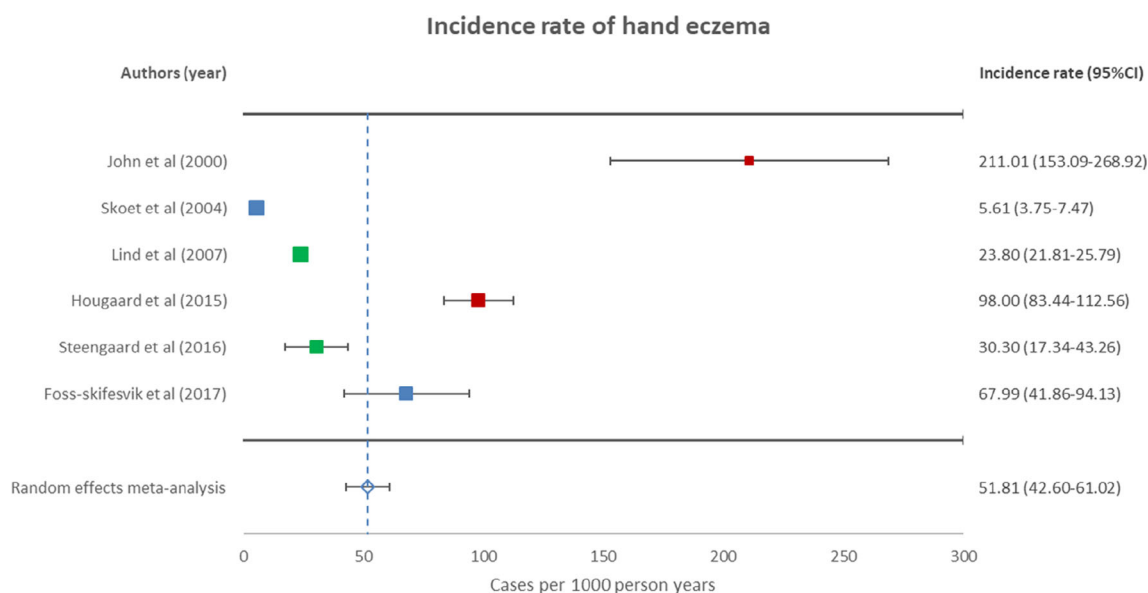


FIGURE 5 Incidence of hand eczema in hairdressers/hairdressing apprentices. $I^2 = 98.6$. Red dots indicate studies including only hairdressing apprentices and green dots, studies including only fully trained hairdressers

3.1.2 | Incidence of hand eczema

Studies reporting on the incidence of hand eczema are summarized in Table S3. Six studies reported on the incidence of hand eczema: Four studies were cohort studies,^{19,21,22,33} one was a cross sectional study,³¹ and one was a study based on registered cases of occupational HE.¹⁸ Three of the cohort studies were prospective, with a median follow-up time of 3 years (ranging from 3 to 4.5 years).^{21,22,33} The remaining cohort study was retrospective with a 26-year study period.¹⁹ A total of 4590 hairdressers with a combined 32,396 person-years in the hairdressing trade were included across the studies, yielding an overall incidence rate of 51.8 cases/1000 person years

(95% CI 42.6-61.0) (Table 2, Figure 5).^{18,19,21,22,31,33} The pooled estimates of the incidence were higher in hairdressing apprentices^{22,33} than in fully trained hairdressers,^{19,21} being 104.7 cases/1000 person-years (95% CI 90.6-118.8) and 23.9 cases/1000 person-years (95% CI 22.0-25.9), respectively.^{19,21,22,33}

3.1.3 | Prevalence of AD

Nine of the included studies, encompassing 10 832 hairdressers, reported on the proportion of the study population with a history of AD, yielding a pooled estimate of 18.1% (95% CI

13.6–22.5).^{7,19,20,22,23,26,28,29} Almost all studies were from Europe (four from Denmark,^{7,20,22,28} one from Sweden,¹⁹ one from England,²³ and one from Poland²⁹), with only a single study being from Australia.²⁶ Three studies used the UKWP criteria in diagnosing AD, yielding a prevalence of 21.3% (95% CI 20.1–22.5).^{7,20,22} The remaining studies either did not describe the method of diagnosis or used a personal interview or a self-reported questionnaire with the item “have you ever had childhood eczema?” obtaining a pooled estimate of 14.8% (95% CI 13.7–15.8).^{19,23,26,28,29} Studies reporting on the prevalence of AD in hairdressing apprentices^{20,22,29} or fully trained hairdressers^{7,19,23} yielded prevalences of 21.3% (95% CI 3.5–38.9) and 18.3 (95% CI 13.0–23.6), respectively.

3.1.4 | Assessment of quality and risk of bias

Six of 18 studies included in the quantitative analysis obtained a Newcastle-Ottawa-scale score >70%, and thus were considered of good quality.^{7,16,19,20,22,33} Three of nine studies used in estimating the lifetime prevalence were of good quality and six were of fair/poor quality, yielding estimates of 35.3% (95% CI 34.1–36.5).^{7,19,22} Three of nine studies reporting on 1-year prevalence were of good quality, yielding an estimate of 19.9% (95% CI 17.2–22.6).^{7,19,20} Three of four studies reporting on point prevalence were of good quality, yielding an estimate of 6.9% (95% CI 6.2–7.6).^{7,20,26} Five of eight studies reporting on a history of AD were of good quality, yielding an estimate of 19.8% (95% CI 14.6–25.0).^{7,19,20,22,26} Studies of fair/poor quality tended to score lower in the items of selection and comparability, hence not being as representative of the average hairdressers and not being transparent about the confounders sex and AD. A high level of heterogeneity ($I^2 > 75\%$) was observed across the studies, apart from non-European studies and studies of good quality reporting on point prevalence, having a low level of heterogeneity (Table S1).

3.2 | Qualitative analysis

3.2.1 | Debut of hand eczema

Two prospective cohort studies of hairdressing apprentices reported on the initial debut.^{16,20} In Germany, 28.2% of hairdressing apprentices clinically examined during their 3-year training period developed interdigital dermatitis.¹⁶ A similar trend was discerned in Danish hairdressing apprentices with 28.3% developing hand eczema within an 18-month observation period. The prevalence of hand eczema at enrollment was 7.0%, which added to the proportion having debut during apprenticeship, approximates the pooled lifetime prevalence of 38.2% found in our study.²⁰ Correspondingly, a 6-year follow-up of the same study population showed that only 29.6% had developed hand eczema since beginning apprenticeship, which is indicative of a drastic decrease in the incidence rate following the end of

apprenticeship.²¹ This was in line with reports of 75% hairdressers and 78.2% of hairdressing apprentices in Denmark reporting to have had debut during apprenticeship and 71% of Swedish hairdressers to have had debut either during apprenticeship or within the first 5 years after graduation.^{7,19,31} Concordantly, the mean age of debut has been reported to be 18 years in hairdressing apprentices. In fully trained hairdressers, retrospective assessment of the age at debut was 20 years for more than half of Swedish hairdressers and between the age of 15 and 24 years for 75% of Danish hairdressers.^{7,19,31}

3.2.2 | Severity of hand eczema

A total of six studies reported on the severity of hand eczema (Table S4). Questionnaire studies used either a visual analogue scale from the NOSQ, ranging from 1 (corresponding to no eczema) to 10 (corresponding to extremely bad eczema) in grading the hand eczema when being most severe, or used a self-reported number of episodes of hand eczema of “once,” “several times,” or “almost all the time.”^{7,11,21,32} Studies using clinical examinations graded the severity by the OHSI, the HECSI, or by using undefined categories such as “mild,” “moderate,” or “severe.”^{26,32,33}

The largest study, comprising 2130 Danish hairdressers with hand eczema assessed 2–24 years after graduation, reported 16.9% to have had hand eczema “once,” 61.9% to have had hand eczema “several times,” and 21.3% to have had hand eczema “almost all the time.”⁷ In another population of Danish hairdressers assessed 7.5 years after commencing vocational school, a mean score of 6, using the VAS from the NOSQ was found.²¹ A similar score, using the same assessment tool, was observed in Croatian hairdressing apprentices in their final year of training.³² Simultaneous clinical examinations in the Croatian apprentices found a rather low average score of 3.0 (of a possible 18 points) using the OHSI, corresponding to mild eczema. Similarly, Danish hairdressing apprentices clinically examined during their second year of training had a median score of 6 (range 2–21) (of 360 possible points) using the HECSI, thus also only having mild eczema.¹¹ In contrast to these low scores, a higher level of severity was observed in German hairdressing apprentices ($n = 92$) clinically examined throughout their training, with 62.7% having minimal skin changes, 21.6% having moderate dermatitis, and 15.7% having severe dermatitis.³³ Likewise, a cross-sectional Australian study found that 14.2% of hairdressing apprentices and 31.9% of hairdressers had moderate to severe dermatitis.²⁶

4 | DISCUSSION

This review confirmed that hand eczema is a frequent disease among hairdressers. Epidemiological studies published from 2000 to 2021 yielded a pooled lifetime prevalence of 38.2%, a pooled 1-year prevalence of 20.3%, and a pooled point prevalence of 7.7% of hand eczema. In comparison, a recently published review estimated the lifetime prevalence of hand eczema in the general population to 14.5%

and specifically in females to 18.9%, illustrating the increased risk of developing hand eczema in hairdressers.³⁴

All studies on the lifetime prevalence were from Europe, with the lowest reported estimate being 31.4%, indicating that hand eczema is common throughout the continent and not limited to exposure patterns specific to certain countries. The few published studies from non-European countries reported on only point prevalence.^{24,26,27} These studies did not appear to be significant outliers to the pooled estimate of the point prevalence, suggesting that hand eczema in hairdressers is not only a European, but a global problem.

A pooled lifetime prevalence of 37.5% and 37.0% was obtained for hairdressing apprentices and fully trained hairdressers, respectively. The similarity of these results indicates that debut in most cases occurs during apprenticeship and less frequently in the later career stages. This pattern was also seen in the pooled incidence rates being 150.9/1000 person years in hairdressing apprentices and of 23.9/1000 person years in fully trained hairdressers, illustrating a 6-fold decrease in the incidence rate from apprenticeship to professional life as a hairdresser. These findings are in line with a recent long-term follow-up study of hairdressers that reported >90% to have had debut of hand eczema by the eighth year in the profession, including apprenticeship.³⁵ A decline in the incidence rate of hand eczema as a function of years in the profession, has also been described in health care workers. Among apprentice nurses, a reduction in the incidence rate from 20.0/1000 person years in first year to 8.5/1000 person years in the second and third years of apprenticeship has been reported and a recent systematic review even found prospective studies to yield a 100-fold decrease in incidence rate when comparing apprentices and fully trained health care workers.^{36,37} Thus, the early debut of hand eczema is not unique to the hairdressing profession, although the high incidence rate in hairdressing apprentices compared to apprentice nurses is noteworthy. This difference may be explained by a particularly high exposure to wet-work and a vaster array of allergens in the hairdressing profession.³⁸

The proportion with mild, moderate, and severe hand eczema has been estimated to 61.8%, 26.1%, and 10.2%, respectively, when using self-reported data from the general population. Corresponding proportions from clinical examinations in the general population has been estimated to be 53.4, 29.1%, and 13.6%, respectively.³⁴ One study ($n = 5219$) included in this review gave estimates of the self-reported hand eczema with 16.9%, 61.9%, and 21.3% reporting to have had hand eczema “once,” “several times,” and “almost all the time,” respectively.⁷ Although somewhat arbitrary as a measurement of severity, this finding indicates that hairdressers have worse hand eczema than the general population, assuming having hand eczema “almost all the time” accounts for severe hand eczema. The remaining studies all used clinical examination in assessing severity, with two cross-sectional studies ($n = 284$ and $n = 128$) reporting hairdressing apprentices on average to have mild eczema.^{11,32} On the other hand, a cohort study of German hairdressing apprentices ($n = 92$) found 21.6% having moderate dermatitis and 15.7% having severe dermatitis, by carrying out clinical examinations 6 times throughout their training, thus being more likely to detect severe hand eczema in cases

of fluctuating severity.³³ Of interest, this estimate is similar to the estimates obtained from clinical examinations in the general population. Conversely, estimates obtained from self-reported data from fully trained hairdressers indicate that hairdressers have more severe hand eczema than the general population. An Australian cross-sectional study ($n = 377$) found 14.2% of hairdressing apprentices and 31.9% of fully trained hairdressers to have moderate or severe hand eczema.²⁶ Hence, the observed difference in the estimates from self-reported data and clinical examinations may be explained by a difference in risk time as the study populations were fully trained hairdressers and hairdressing apprentices, respectively.

Career guidance of individuals with AD seems to have a beneficial effect.^{39,40} Studies in Danish and German hairdressing apprentices report that they have less AD than controls from the general population and office workers.^{41,42} We found the prevalence with a history of AD to be 18.1% overall and 21.3% in hairdressing apprentices. These estimates lie within the range of reported prevalences from the general population, being 15.6–23.6% with a history of AD.^{43–45} Hence, a healthy worker effect or avoidance of the hairdressing profession is not apparent from our findings. A possible explanation could be the high proportion of women in the hairdressing trade, as AD is more prevalent among females.⁴⁶ In addition, the prevalence of AD in the aforementioned Danish study was also about 20%, with the healthy worker effect only being visible in direct comparison with matched controls. Therefore, if a healthy worker effect is present among hairdressing apprentices, it may not be sufficiently large to be evident from prevalence estimates in epidemiological studies, if no comparison to matched controls is available. Thus the excess prevalence of hand eczema in hairdressers (38.2%), compared to the general population (14.5%) cannot be explained by a history of AD. Furthermore, the attributable fraction of AD in hairdressers with hand eczema has been estimated to be 9.6%, supporting this observation.¹⁹ The management of occupational exposures seems therefore to be the most important factor to prevent HE in hairdressers. Although exposure to wet-work and chemicals is a common cause of hand eczema in hairdressers, nickel and cobalt release from hairdressers' working tools have been shown in some countries, further highlighting the complexity of occupational exposure to allergens.⁴⁷

A lifetime prevalence of 37.1% and 40.2% was obtained from studies using the NOSQ and other non-specified methods, respectively. The NOSQ has been validated previously in hairdressing apprentices and found to have a sensitivity of 70.3% and a specificity of 99.8% in estimating the lifetime prevalence.⁴¹ The discrepancy observed between studies using the NOSQ and studies using other non-specified methods may be due to the NOSQ's inherent tendency to underestimate the prevalence by not being completely sensitive, if a higher level of sensitivity in the nonspecified methods is assumed. Of interest, a high and a medium level of heterogeneity was observed in the studies using the NOSQ and other non-specified methods, respectively; hence the variation in the observed estimates from the NOSQ tending more often to be due to factors other than sampling error. This could be explained by the previous validation of the NOSQ being done on hairdressing apprentices observed over 18 months.

Thereby, this validation might not be applicable in settings where hairdressers are asked to retrospectively assess the presence of hand eczema in a period much longer than 18 months. Validation studies of self-reported hand eczema have, however, generally demonstrated to have a high specificity, as shown in the hairdressing apprentices. In addition, specificity levels of 96–99% for self-reported 1-year prevalence and 99% for self-reported current hand eczema have been obtained in other settings not related to hairdressers.^{48,49} Thus the reported pooled estimates in our study may be regarded as reliable approximations of the minimal overall prevalence. Better validation and reporting of applied methods in questionnaire studies are desirable to optimize transparency and precision in estimates of the prevalence of hand eczema.

This systematic review and meta-analysis benefits from limited selection bias, as 17 of the 19 included studies obtain a score ≥ 2 in the item selection of the Newcastle-Ottawa Scale (Table S1) as well as the largest studies all being of good quality and had good response rates ranging from 56% to 92%.^{7,16,19} A high level of heterogeneity was observed across the studies, probably due to a variety of factors, such as variation in patterns of exposure as well as in methods to assess past or present hand eczema. The decision to include studies from 2000 onward may reduce the precision of the estimates. However, as our findings should provide a current approximation of the disease burden of hand eczema in hairdressers, this time constraint was deemed important. It should be noted that the comparisons of estimates from different subgroups are nonrandomized and should be interpreted with caution.

In conclusion, hand eczema is common in hairdressers and begins during apprenticeship for the vast majority. The prevalence of AD in hairdressers is comparable with estimates in the general population, indicating that occupational exposure is the main factor in the increased prevalence of HE in hairdressers. This warrants a strategic and collective preventive effort across Europe to alleviate the negative personal and social consequences of HE in hairdressers. In Europe, minimum standards for prevention of occupational skin diseases have been developed, which may be useful for this endeavor.⁵⁰

ACKNOWLEDGMENT

In the preprint document there is a mention of funding in the form of a picture of the logo of the European Union with added text.

AUTHOR CONTRIBUTIONS

Martin S. Havmose: Conceptualization (equal); data curation (lead); formal analysis (lead); investigation (lead); methodology (lead); visualization (lead); writing - original draft (lead); writing - review and editing (equal). **Sanja Kezic:** Conceptualization (equal); data curation (lead); formal analysis (lead); investigation (lead); methodology (lead); writing - review and editing (equal). **Wolfgang Uter:** Conceptualization (lead); formal analysis (lead); methodology (lead); validation (lead); writing - review and editing (equal). **Cara Symanzik:** Conceptualization (equal); methodology (equal); writing - review and editing (equal). **Sarah Hallmann:** Conceptualization (equal); methodology (equal); writing -

review and editing (equal). **Julia Strahwald:** Conceptualization (equal); methodology (equal); writing - review and editing (equal). **Patricia Weinert:** Conceptualization (equal); methodology (equal); writing - review and editing (equal). **Marija Macan:** Conceptualization (equal); methodology (equal); writing - review and editing (equal). **Rajka Turk:** Conceptualization (equal); methodology (equal); writing - review and editing (equal). **Henk F. van der Molen:** Conceptualization (equal); methodology (equal); writing - review and editing (equal). **Željka Babić:** Conceptualization (equal); methodology (equal); writing - review and editing (equal). **Jelena Macan:** Conceptualization (equal); methodology (equal); writing - review and editing (equal). **Swen M. John:** Conceptualization (lead); funding acquisition (lead); methodology (lead); project administration (lead); writing - review and editing (equal). **Jeanne D. Johansen:** Conceptualization (lead); formal analysis (lead); methodology (lead); visualization (lead).

DATA AVAILABILITY STATEMENT

Data available in article supplementary material

ORCID

Martin S. Havmose  <https://orcid.org/0000-0003-2147-016X>
 Sanja Kezic  <https://orcid.org/0000-0002-1063-4547>
 Wolfgang Uter  <https://orcid.org/0000-0002-4498-3710>
 Cara Symanzik  <https://orcid.org/0000-0002-4090-6726>
 Marija Macan  <https://orcid.org/0000-0001-8415-7571>
 Rajka Turk  <https://orcid.org/0000-0002-5876-8923>
 Henk F. van der Molen  <https://orcid.org/0000-0002-0719-2020>
 Željka Babić  <https://orcid.org/0000-0002-5335-9522>
 Jelena Macan  <https://orcid.org/0000-0001-6269-5475>
 Swen M. John  <https://orcid.org/0000-0001-5406-9458>
 Jeanne D. Johansen  <https://orcid.org/0000-0002-3537-8463>

REFERENCES

- Schwensen JF, Friis UF, Menné T, Johansen JD. One thousand cases of severe occupational contact dermatitis. *Contact Dermatitis*. 2013; 68(5):259–268. doi:10.1111/cod.12045
- Uter W, Bensefa-Colas L, Frosch P, et al. Patch testing with hair cosmetic series in Europe: a critical review and recommendation. *Contact Dermatitis*. 2015;73(2):69–81. doi:10.1111/cod.12424
- Uter W, Pfahlberg A, Gefeller O, Schwanitz HJ. Hand dermatitis in a prospectively-followed cohort of hairdressing apprentices: final results of the POSH study. *Contact Dermatitis*. 1999;41(5):280–286.
- Schwensen JF, Johansen JD, Veien NK, et al. Occupational contact dermatitis in hairdressers: an analysis of patch test data from the Danish Contact Dermatitis Group, 2002–2011. *Contact Dermatitis*. 2014; 70(4):233–237.
- Politeiek K, Oosterhaven JAF, Vermeulen KM, Schutelaar MLA. Systematic review of cost-of-illness studies in hand eczema. *Contact Dermatitis*. 2016;75(2):67–76. doi:10.1111/cod.12590
- Agner T, Andersen KE, Brandao FM, Bruynzeel DP, Bruze M, Frosch P. Hand eczema severity and quality of life: a cross-sectional, multicentre study of hand eczema patients. *Contact Dermatitis*. 2008; 59(1):43–47.
- Lysdal SH, Sørensen H, Andersen KE, Johansen JD. Hand eczema in hairdressers: a Danish register-based study of the prevalence of hand eczema and its career consequences. *Contact Dermatitis*. 2011;65(3): 151–158.

8. Held E, Skoet R, Johansen JD, Agner T. The hand eczema severity index (HECSI): a scoring system for clinical assessment of hand eczema. A study of inter- and intraobserver reliability. *Br J Dermatol*. 2005;152(2):302-307. doi:10.1111/j.1365-2133.2004.06305.x
9. Dulon M, Skudlik C, Nübling M, John SM, Nienhaus A. Validity and responsiveness of the Osnabrück Hand Eczema Severity Index (OHSI): a methodological study. *Br J Dermatol*. 2009;160(1):137-142. doi:10.1111/j.1365-2133.2008.08870.x
10. Susitaival P, Flyvholm MA, Meding B, et al. Nordic Occupational Skin Questionnaire (NOSQ-2002): a new tool for surveying occupational skin diseases and exposure. *Contact Dermatitis*. 2003;49(2):70-76. doi:10.1111/j.0105-1873.2003.00159.x
11. Bregnhøj A, Søsted H, Menné T, Johansen JD. Validation of self-reporting of hand eczema among Danish hairdressing apprentices. *Contact Dermatitis*. 2011;65(3):146-150. doi:10.1111/j.1600-0536.2011.01908.x
12. Thyssen JP, Andersen Y, Halling A-S, Williams HC, Egeberg A. Strengths and limitations of the United Kingdom working party criteria for atopic dermatitis in adults. *J Eur Acad Dermatol Venereol*. 2020;34(8):1764-1772. doi:10.1111/jdv.16364
13. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. *BMJ*. 2009;339:b2700. doi:10.1136/bmj.b2700
14. Uter W, Johansen JD, Havmose M, et al. *Protocol for a Systematic Review on Systemic and Skin Toxicity of Important Hazardous Hair and Nail Cosmetic Ingredients in Hairdressers*. *BMJ Open*. Published online; 2021.
15. Neyeloff JL, Fuchs SC, Moreira LB. Meta-analyses and forest plots using a microsoft excel spreadsheet: step-by-step guide focusing on descriptive data analysis. *BMC Res Notes*. 2012;5:52. doi:10.1186/1756-0500-5-52
16. Schwanitz HJ, Uter W. Interdigital dermatitis: sentinel skin damage in hairdressers. *Br J Dermatol*. 2000;142(5):1011-1012. doi:10.1046/j.1365-2133.2000.03487.x
17. Schubert S, Geier J, Skudlik C, et al. Relevance of contact sensitizations in occupational dermatitis patients with special focus on patch testing of workplace materials. *Contact Dermatitis*. 2020;83(6):475-486. doi:10.1111/cod.13688
18. Skoet R, Olsen J, Mathiesen B, Iversen L, Johansen JD, Agner T. A survey of occupational hand eczema in Denmark. *Contact Dermatitis*. 2004;51(4):159-166. doi:10.1111/j.0105-1873.2004.00423.x
19. Lind M-L, Albin M, Brisman J, et al. Incidence of hand eczema in female Swedish hairdressers. *Occup Environ Med*. 2007;64(3):191-195. doi:10.1136/oem.2005.026211
20. Bregnhøj A, Menné T, Johansen JD, Søsted H. Prevention of hand eczema among Danish hairdressing apprentices: an intervention study. *Occup Environ Med*. 2012;69(5):310-316. doi:10.1136/oemed-2011-100294
21. Steengaard SS, Bregnhøj A, Johansen JD. Hand eczema among hairdressing apprentices in Denmark following a nationwide prospective intervention programme: 6-year follow-up. *Contact Dermatitis*. 2016;75(1):32-40. doi:10.1111/cod.12588
22. Foss-skiftesvik MH, Winther L, Johnsen CR, Zachariae C, Johansen JD. Incidence of skin and respiratory diseases among Danish hairdressing apprentices. *Contact Dermatitis*. 2017;76(3):160-166.
23. Ling TC, Coulson IH. What do trainee hairdressers know about hand dermatitis? *Contact Dermatitis*. 2002;47(4):227-231. doi:10.1034/j.1600-0536.2002.470407.x
24. Archibong J, Henshaw E, Ogunbiyi A, George A. Occupational skin disorders in a subset of Nigerian hairdressers. *Pan Afr Med J*. 2018;31(100). doi:10.11604/pamj.2018.31.100.16499
25. Perkins JB, Farrow A. Prevalence of occupational hand dermatitis in U.K. hairdressers. *Int J Occup Environ Health*. 2005;11(3):289-293. doi:10.1179/107735205800245920
26. Roberts H, Frowen K, Sim M, Nixon R. Prevalence of atopy in a population of hairdressing students and practising hairdressers in Melbourne, Australia. *Australas J Dermatol*. 2006;47(3):172-177. doi:10.1111/j.1440-0960.2006.00266.x
27. Omokhodion FO, Balogun MO, Ola-Olorun FM. Reported occupational hazards and illnesses among hairdressers in Ibadan, Southwest Nigeria. *West Afr J Med*. 2009;28(1):20-23. doi:10.4314/wajm.v28i1.48419
28. Hansen HS, Søsted H. Hand eczema in Copenhagen hairdressers--prevalence and under-reporting to occupational registers. *Contact Dermatitis*. 2009;61(6):361-363. doi:10.1111/j.1600-0536.2009.01649.x
29. Krecisz B, Kiec-Swierczynska M, Chomiczewska D. Dermatological screening and results of patch testing among polish apprentice hairdressers. *Contact Dermatitis*. 2011;64(2):90-95. doi:10.1111/j.1600-0536.2010.01844.x
30. Mendes A, Madureira J, Neves P, Carvalhais C, Laffon B, Teixeira JP. Chemical exposure and occupational symptoms among Portuguese hairdressers. *J Toxicol Environ Health A*. 2011;74(15-16):993-1000. doi:10.1080/15287394.2011.582027
31. Hougaard MG, Winther L, Søsted H, Zachariae C, Johansen JD. Occupational skin diseases in hairdressing apprentices - has anything changed? *Contact Dermatitis*. 2015;72(1):40-46. doi:10.1111/cod.12315
32. Samardžić T, Varnai VM, Bakotić M, et al. Skin health and safety at work in Croatian hairdressing apprentices. *Contact Dermatitis*. 2016;75(1):25-31. doi:10.1111/cod.12603
33. John SM, Uter W, Schwanitz HJ. Relevance of multiparametric skin bioengineering in a prospectively-followed cohort of junior hairdressers. *Contact Dermatitis*. 2000;43(3):161-168. doi:10.1034/j.1600-0536.2000.043003161.x
34. Quaade AS, Simonsen AB, Halling AS, Thyssen JP, Johansen JD. Prevalence, incidence, and severity of hand eczema in the general population - a systematic review and meta-analysis. *Contact Dermatitis*. 2021;84(6):361-374. doi:10.1111/cod.13804
35. Havmose M, Thyssen JP, Zachariae C & Johansen JD Long-term follow-up of hand eczema in hairdressers - a prospective cohort study of Danish hairdressers graduating from 1985-2007. Published online 2021.
36. Visser MJ, Verberk MM, Van Dijk FJH, Bakker JG, Bos JD, Kezic S. Wet work and hand eczema in apprentice nurses; part i of a prospective cohort study. *Contact Dermatitis*. 2014;70(1):44-55. doi:10.1111/cod.12131
37. Larese Filon F, Pesce M, Paulo MS, et al. Incidence of occupational contact dermatitis in healthcare workers: a systematic review. *J Eur Acad Dermatol Venereol*. 2021;35(6):1285-1289. doi:10.1111/jdv.17096
38. Lysdal SH, Johansen JD, Flyvholm M-A, Søsted H. A quantification of occupational skin exposures and the use of protective gloves among hairdressers in Denmark. *Contact Dermatitis*. 2012;66(6):323-334. doi:10.1111/j.1600-0536.2012.02050.x
39. Meding B, Swanbeck G. Predictive factors for hand eczema. *Contact Dermatitis*. 1990;23(3):154-161. doi:10.1111/j.1600-0536.1990.tb04776.x
40. Wilkinson DS. Careers advice to youths with atopic dermatitis. *Contact Dermatitis*. 1975;1(1):11-12. doi:10.1111/j.1600-0536.1975.tb05303.x
41. Bregnhøj A, Søsted H, Menné T, Johansen JD. Healthy worker effect in hairdressing apprentices. *Contact Dermatitis*. 2011;64(2):80-84. doi:10.1111/j.1600-0536.2010.01831.x
42. Uter W, Pfahlberg A, Gefeller O, Schwanitz HJ. Risk of hand dermatitis among hairdressers versus office workers. *Scand J Work Environ Health*. 1999;25(5):450-456. doi:10.5271/sjweh.459
43. Larsen FS, Diepgen T, Svensson Å. The occurrence of atopic dermatitis in North Europe: An international questionnaire study. *J Am Acad Dermatol*. 1996;34(5 Pt 1):760-764. doi:10.1016/S0190-9622(96)90009-2

44. Gawkrödger DJ, Mortimer MJ, Jaron AG. The prevalence of childhood atopic eczema in a general population. *J Am Acad Dermatol*. 1994;30(1):35-39. doi:10.1016/S0190-9622(94)70004-4
45. Dotterud LK, Kvammen B, Bolle R, Falk ES. A survey of atopic diseases among school children in Sør-Varanger community. Possible effects of subarctic climate and industrial pollution from Russia. *Acta Derm Venereol*. 1994;74(2):124-128. doi:10.2340/0001555574124128
46. Van De Ven MOM, Van Den Eijnden RJJM, Engels RCME. Atopic diseases and related risk factors among Dutch adolescents. *Eur J Public Health*. 2006;16(5):549-558. doi:10.1093/eurpub/ckl022
47. Symanzik C, Skudlik C, John SM. Experimental evaluation of nickel and cobalt release from tools and self-reported prevalence of nickel and cobalt allergy in the German hairdressing trade. *J Eur Acad Dermatol Venereol*. 2021;35(4):965-972. doi:10.1111/jdv.17058
48. Meding B, Barregård L. Validity of self-reports of hand eczema. *Contact Dermatitis*. 2001;45(2):99-103. doi:10.1034/j.1600-0536.2001.045002099.x
49. Yngveson M, Svensson Å, Isacson Å. Evaluation of a self-reported questionnaire on hand dermatosis in secondary school children. *Acta Derm Venereol*. 1997;77(6):455-457. doi:10.2340/0001555577455457
50. Alfonso JH, Bauer A, Bensefa-Colas L, et al. Minimum standards on prevention, diagnosis and treatment of occupational and work-related skin diseases in Europe – position paper of the COST action StanDerm (TD 1206). *J Eur Acad Dermatol Venereol*. 2017;31(Suppl 4):31-43. doi:10.1111/jdv.14319

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

How to cite this article: Havmose MS, Kezic S, Uter W, et al. Prevalence and incidence of hand eczema in hairdressers—A systematic review and meta-analysis of the published literature from 2000–2021. *Contact Dermatitis*. 2022;1-12. doi:10.1111/cod.14048