



## PhD thesis

# Occupational hand eczema and its career consequences among trained hairdressers: a register based questionnaire study

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RESEARCH CENTRE  
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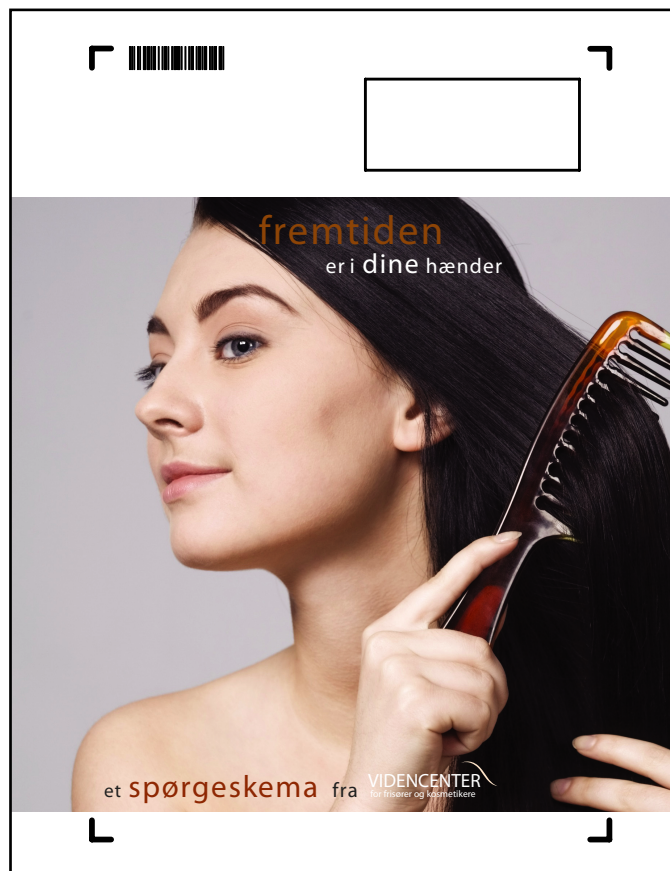


**Gentofte  
Hospital**



# PhD thesis 2011

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*I never thought of hand eczema as an occupational disease. I just thought it was my own fault that I had got it.*

- Questionnaire respondent about not reporting hand eczema as an occupational disease.

**This PhD thesis is based on the following 3 manuscripts:**

- I. **Lysdal SH, Søsted 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**, 151-158.
- II. **Lysdal SH, Søsted H, Johansen JD.** Do hairdressers in Denmark have their hand eczema reported as an occupational disease? Results from a register-based study. *Contact Dermatitis*. 2011 Nov 15. doi: 10.1111/j.1600-0536.2011.01997.x. [Epub ahead of print]
- III. **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. Accepted for publication in *Contact Dermatitis*.

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## **PREFACE**

This thesis was conducted at the Research Centre for Hairdressers and Beauticians, Department of Dermato-Allergology, Copenhagen University Hospital Gentofte, between January 2008 and December 2011. This study received financial support from the Danish Hairdressers' and Beauticians' Union, the Danish Organization for Independent Hairdressers and Cosmeticians, the Danish Working Environment Research Fund, and the Aage Bangs Foundation. All are gratefully acknowledged.

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*Gentofte, December 2011  
Susan Hovmand Lysdal*





## TABLE OF CONTENTS

<b>1 SUMMARIES</b> .....	<b>2</b>
1.1 SUMMARY IN ENGLISH .....	2
1.2 SUMMARY IN DANISH .....	3
<b>2 INTRODUCTION</b> .....	<b>5</b>
2.1 HAIRDRESSERS .....	5
2.2 HAND ECZEMA .....	5
2.3 OCCUPATIONAL HAND ECZEMA .....	6
2.4 HAIRDRESSERS AND OCCUPATIONAL HAND ECZEMA .....	7
2.5 OCCUPATIONAL EXPOSURES AMONG HAIRDRESSERS .....	7
2.6 OTHER OCCUPATIONAL DISEASES AMONG HAIRDRESSERS .....	8
2.7 REPORT OF AN OCCUPATIONAL DISEASE TO THE AUTHORITIES .....	8
<b>3 AIMS OF THE THESIS</b> .....	<b>9</b>
<b>4 OVERVIEW OF STUDIES</b> .....	<b>10</b>
<b>5 MANUSCRIPT I</b> .....	<b>11</b>
<b>6 MANUSCRIPT II</b> .....	<b>20</b>
<b>7 MANUSCRIPT III</b> .....	<b>37</b>
<b>8 COMMENTS AND CONSIDERATIONS ON METHODOLOGY AND VALIDITY</b> .....	<b>59</b>
8.1 STUDY DESIGN .....	59
8.1.1 <i>Comments and considerations on study design</i> .....	59
8.2 DATA FROM REGISTERS .....	59
8.2.1 <i>Comments and considerations on information received from registers</i> .....	60
8.3 STUDY POPULATION .....	60
8.3.1 <i>Delineation of the cohort size</i> .....	60
8.3.2 <i>Characterization of researcher protected individuals</i> .....	61
8.3.3 <i>Comments and considerations on the study population</i> .....	61
8.4 THE QUESTIONNAIRE .....	63
8.4.1 <i>Validation of the questionnaire</i> .....	64
8.4.2 <i>Measures taken to increase response rate</i> .....	64
8.4.3 <i>Comments and considerations</i> .....	64
8.5 DATA ENTERING AND VALIDATION .....	68
8.5.1 <i>Comments and considerations on data entering</i> .....	68
8.6 DEFINITIONS .....	68
8.6.1 <i>Wet work</i> .....	68
8.6.2 <i>Comments and considerations on the definition of wet work</i> .....	69
8.6.3 <i>Hand eczema</i> .....	69
8.6.4 <i>Glove use</i> .....	69
8.6.5 <i>Comments and considerations on the definition of glove use</i> .....	69
8.6.6 <i>Atopic dermatitis</i> .....	69
8.6.7 <i>Comments and considerations on the definition of atopic dermatitis</i> .....	69
<b>9 GENERAL DISCUSSION</b> .....	<b>70</b>
9.1 HAND ECZEMA AND LENGTH OF CAREER .....	70
9.2 PREVENTION OF HAND ECZEMA .....	71
9.3 HAND ECZEMA AND ATOPIC DERMATITIS .....	72
<b>10 CONCLUSION</b> .....	<b>73</b>
<b>11 PERSPECTIVES AND FUTURE STUDIES</b> .....	<b>74</b>
<b>12 REFERENCES</b> .....	<b>75</b>

# 1 SUMMARIES

## 1.1 SUMMARY IN ENGLISH

Hairdressers have a high prevalence of occupational hand eczema due to extensive wet work and skin exposure to both irritant and allergenic substances in hairdressing products. This skin exposure is extensive throughout their careers.

This thesis aimed to estimate the prevalence of hand eczema among hairdressers in Denmark and to quantify their occupational skin exposure and their use of protective gloves. Additionally, the purpose was to delineate whether hairdressers' hand eczema was reported as an occupational disease to the National Board of Industrial Injuries. Lastly, this thesis aimed to estimate the average length of a hairdressing career and to clarify possible health complaints that may have led to a career change.

This thesis was conducted as a register-based questionnaire study among all graduates from hairdressing vocational schools in Denmark from 1985–2007 and whose current postal addresses were available (n=7840). The registers used were the Central Person Registration Office and the Labour Market Supplementary Pension Scheme.

A postal questionnaire was administered in May 2009 and after two reminders, answers were obtained from 5324 persons (67.9%). The questionnaire consisted of 147 questions concerning topics such as hand eczema, the use of protective gloves, working habits, and career change.

The results showed that 42.3% of the respondents had ever had hand eczema; the majority reported either having had hand eczema several times (61.9%) or having it almost all the time (21.3%). Most were apprentices at the time of hand eczema onset.

In only 20.7% of the hairdressers was their hand eczema reported to the relevant authorities as an occupational disease. The main reasons for not reporting were 'I thought it would eventually get better' (40.4%) and 'My doctor did not tell me it was possible to report it' (26.6%).

In all, 44.3% of the trained hairdressers left the trade. Including a 4-year apprenticeship, they had worked an average of 8.4 years in the profession before leaving. Hand eczema was significantly more prevalent among the ex-hairdressers (48.4%) compared with the group of current hairdressers (37.6%). The severity of hand eczema was also significantly increased among ex-hairdressers.

Musculoskeletal pain (41.9%) and hand eczema (23.1%) were the most common health reasons for leaving the trade. Among ex-hairdressers who had ever had hand eczema, however, hand eczema was the predominant reason for career change (45.5%, n=1009). Leaving the trade because of hand eczema was associated with increased severity of hand eczema in this group (OR 50.1; CI (18.3-137.0)).

Wet work was excessive among the current hairdressers, with 86.6% reporting to have wet hands for 2 hours or more a day. The majority of hairdressers always used gloves for full-head hair colouring and bleaching procedures, but glove use was less frequent for high-/lowlighting procedures and permanent waving. Hair washing was rarely performed wearing gloves (10.0%), but gloves were more frequently worn for hair washing after hair colouring procedures. One in five hairdressers re-used their gloves. Of all hairdressers, 8.0% regularly turned their gloves inside out before re-using them.

This study forwards knowledge about occupational hand eczema and its career consequences among hairdressers. It describes a major underreporting of hand eczema as an occupational disease, an inappropriate use of gloves, as well as the excessive occupational skin exposures to both wet work and hairdressing chemicals.

## 1.2 SUMMARY IN DANISH

Frisører har en høj forekomst af arbejdsbetinget håndeksem, fordi deres job indbefatter en omfattende mængde vådt arbejde og hudkontakt med både irritative og allergifremkaldende substanser i frisørprodukter.

Formålet med denne afhandling var at estimere prævalensen af håndeksem, den arbejdsbetingede hudeksponering for vådt arbejde og kemikalier i frisørprodukter samt brugen af handsker blandt frisører i Danmark. Derudover skulle afhandlingen beskrive, i hvilken udstrækning frisører anmeldte deres håndeksem som en arbejdsbetinget lidelse til Arbejdsskadestyrelsen. Endelig var formålet at estimere den gennemsnitlige længde af frisørers tilknytning til branchen og at opklare, om helbredsmæssige faktorer var årsag til karriereskift.

Studiet, der ligger til grund for denne afhandling, var en registerbaseret spørgeskemaundersøgelse blandt alle frisører, der fik et svendebrev fra frisørskolerne i Danmark i perioden 1985-2007 og vis postadresser var gyldige. Der blev endvidere benyttet data fra det Centrale Person Register og Registeret for Arbejdsmarkedets Tillægspension.

I maj 2009 blev spørgeskemaet postomdelt, og efter to påmindelser blev der opnået en svarprocent på 67,9 (5324 personer). Spørgeskemaet bestod af 147 spørgsmål om blandt andet håndeksem, brug af handsker, arbejdsvaner og karriereskift.

Resultaterne viste, at 42,3% af respondenterne havde haft håndeksem; flertallet havde haft håndeksem flere gange (61,9%) eller havde det næsten hele tiden (21,3%). De fleste var frisørelever, da eksemet startede.

Kun 20,7% af frisørerne havde anmeldt deres håndeksem som en arbejdsbetinget lidelse til myndighederne. De vigtigste årsager til manglende anmeldelse var 'Jeg troede, det ville gå over igen' (40,4%) og 'Min læge gjorde mig ikke opmærksom på muligheden' (26,6%).

I alt havde 44,3% af frisørerne forladt branchen. Inklusiv en læretid på 4 år havde de gennemsnitligt arbejdet i faget i 8,4 år, før de forlod frisørfaget. Håndeksem forekom signifikant hyppigere hos ex-frisørerne (48,4%) sammenlignet med gruppen af nuværende frisører (37,6%). Sværhedsgraden af håndeksem var ligeledes signifikant højere blandt ex-frisører.

Muskel- og ledsmerter (41,9%) og håndeksem (23,1%) var de hyppigste helbredsmæssige årsager til at forlade faget. Blandt ex-frisører, der havde haft håndeksem, var håndeksem dog den fremherskende årsag til karriereskift (45,5%, n=1009). At forlade faget pga. håndeksem var signifikant associeret med en øget sværhedsgrad af håndeksem i denne gruppe (OR 50,1; CI (18,3-137,0)).

Mængden af vådt arbejde var omfattende blandt de nuværende frisører, hvor 86,6% angav, at de dagligt havde våde hænder i 2 timer eller mere. Flertallet af frisørerne brugte handsker til helfarvning og blegninger af hele håret, mens handskebrug var mindre udtalt til reflekser og

permanentbehandlinger. Hårvask blev sjældent udført med handsker (10,0%); dog blev der hyppigere brugt handsker til hårvask efter hårfarvninger. En ud af fem frisører svarede, at de genbrugte deres handsker. I alt vendte 8,0% af samtlige nuværende frisører deres handsker på vrangen, før de genbrugte dem.

Dette studie bidrager med viden om arbejdsbetinget håndeksem og dets karrierekonsekvenser blandt frisører. Det beskriver en massiv underrapportering af håndeksem som arbejdsbetinget lidelse, en uhensigtsmæssig brug af handsker så vel som en omfattende arbejdsbetinget udsættelse for vådt arbejde og kemikalier i frisørprodukter.

## 2 INTRODUCTION

### 2.1 HAIRDRESSERS

Hairdressing is an occupation that dates back thousands of years. Today, hairdressers have extensive skin exposure to many hairdressing chemicals of both irritant and allergic nature, and extensive amounts of wet work. In addition, hairdressers stand for most of their working hours and they often work in ergonomically strenuous postures (1). Thus hairdressers are at high risk of developing numerous occupational diseases, such as allergies, irritant and allergic hand eczema, asthma and musculoskeletal disorders (cf. Chapter 2.4 and 2.6).

There are 10 public hairdressing vocational schools in Denmark. Tuition is free and anyone who has completed secondary school can apply for admission. The training takes 4 years and is structured as an apprenticeship with a self-employed hairdresser with planned school periods.

In Denmark, as in many other countries, the hairdressing trade is dominated by women. Today, there are about 12000 hairdressers working in Denmark (2). Of these, approximately 5900 are self-employed (3). The majority of hairdressers work in small salons with few employees; and this makes conventional preventive efforts difficult to implement.

### 2.2 HAND ECZEMA

Hand eczema is an inflammatory skin condition on the hands. The most frequent symptoms of hand eczema are itching and pain, and typical skin manifestations are redness, vesicles, scaling, oedema and fissures (Figure 1).



**Figure 1** The hands of a 23-year-old hairdressing apprentice who gave up a career in hairdressing because of hand eczema.

Hand eczema can be divided into different sub-categories including irritant and allergic contact dermatitis. Although the skin manifestations are indistinguishable, the mechanisms causing either irritant or allergic contact dermatitis differ substantially.

Irritant contact dermatitis is the most common (4) and is a consequence of the skin barrier being destroyed due to a direct physical impact on the epidermis. This could be caused by extensive exposure to water, soap or other irritants and may be either acute or chronic.

Allergic contact dermatitis is caused by skin exposure to a chemical that can act as a skin sensitizer. It is a delayed hypersensitivity reaction and may occur after many years of contact with a substance or after a few exposures. The most frequent allergens that cause contact dermatitis in the general population are nickel, perfume and biocides (5).

However, the aetiology of hand eczema is complex. Atopic dermatitis, female sex, and young age have proven to be risk factors of both occupational and non-occupational hand eczema in previous studies (6-12). In addition, certain genetic factors seem to contribute to the manifestation of hand eczema (13;14).

Hand eczema is relatively common in the general population. Population studies have reported one-year prevalences of hand eczema of 10–14% in Denmark (15;16) and 8–11.8% in Sweden (7;10).

### 2.3 OCCUPATIONAL HAND ECZEMA

Occupational skin diseases are very frequent, and eczema – irritant eczema in particular – is the most commonly recognized occupational disease in Denmark (9;17;18). In 2010, an occupational skin disease was reported to The National Board of Industrial Injuries by 2130 persons: 73% (1696 cases) were recognized as being occupational. Nearly all skin disease cases that have been reported and which receive compensation involve eczematous skin diseases (9). Hand eczema comprises 90–95% of the reported occupational skin diseases (17;19).

Occupational hand eczema is a chronic or acute skin reaction as a result of the skin on the hands being exposed to irritant or allergenic substances, or a combination of both, while working.

Irritant contact dermatitis is most commonly found in wet occupations (17) and it accounts for approximately 2/3 of all reported and recognized cases of occupational eczema (9;17;20).

There are certain high-risk occupations for developing occupational hand eczema and their common denominator is the inclusion of extensive wet work and/or skin exposure to irritant or allergenic substances. Those working as bakers, hairdressers, dental surgery assistants, kitchen workers/cooks and butchers fall into this category (17;19). For women, the majority of cases with occupational hand eczema occur among hairdressers, health-care workers, cleaners, and restaurant workers, whereas for men, construction and cement workers, mechanics, locksmiths and metal-surface processors have a high occurrence of hand eczema (19).

Hand eczema is often a long-lasting disease with relapsing symptoms (10) and leads to an increased risk of disability for the affected individuals. Thus, occupational hand eczema has a high socio-economic impact because of lost working hours; prolonged sick-leave; and costs relating to treatment, retraining and workers' compensation (10;21). The National Board of Health has estimated that the annual costs of occupational contact dermatitis annually exceed 100 million Euros in Denmark alone (22).

## 2.4 HAIRDRESSERS AND OCCUPATIONAL HAND ECZEMA

Hairdressing is listed as one of the occupations that most frequently causes hand eczema (17;20;23) due to extensive wet work and exposure to potentially sensitizing substances in e.g. hair dyes, permanent wave solutions and bleaching products (21;23-27). In previous studies the reported prevalence of occupational hand eczema among hairdressers (17;24;28) and hairdressing apprentices (24;26;27) was between 35% and 49.4%.

Hairdressers are at high risk of developing hand eczema at an early point in their careers; several studies have shown that it frequently occurs during their apprenticeship (17;21;24;27;29;30). This is most likely because hairdressing apprentices handle the majority of wet work tasks in the salons (26). In addition, they are in contact with hair dyes, hair bleaching products and permanent wave solutions early in their careers (26).

Hairdressers develop both irritant and allergic hand eczema. The main cause of irritant hand eczema in hairdressers is the exposure to wet work (20;21;23;26;31). As the irritant hand eczema involves significant skin barrier damage, it often precedes the allergic hand eczema because it facilitates the development of sensitization (20). Hairdressers often develop allergic hand eczema from ammonium persulfate, *para*-phenylenediamine (PPD), toluene-2,5-diamine and glycerol monothioglycolate (32;33). In addition, biocides such as (chloro) methylisothiazolinone are regarded as important allergens among hairdressers (32).

## 2.5 OCCUPATIONAL EXPOSURES AMONG HAIRDRESSERS

On a daily basis, hairdressers are exposed to a mixture of numerous chemical substances (34) used in hairdressing products as well as being exposed to extensive wet work. For hairdressers wet work includes hair washing and hand washing as well as cutting wet hair. In hairdressing, wet work is often combined with exposure to both irritants and allergens in shampoos and conditioners (e.g. detergents, perfume and biocides) and exposure to the sensitizing chemicals from hair dye and permanent wave treatments. Hair dyes contain numerous potent skin sensitizers (e.g. *para*-phenylenediamine and toluene-2,5-diamine (35;36)) and so do permanent waving solutions (e.g. glycerol monothioglycolate (26;32)) and hair bleaching products (e.g. ammonium persulfate (37;38)). The hairdressers are also exposed to these sensitizing substances during the mixing and application procedures as well as from cutting newly coloured hair (39), and from styling procedures.

The hair styling products used usually contain sensitizing substances such as perfume and biocides. Further, both potentially endocrine-disrupting chemicals and organic solvents are found in hairdressing products (34;40-43).

Over the course of time, the exposure in the hairdressing trade has changed and it will continue to change. Products may be replaced, new ones will arrive and the concentrations of the sensitizing substances used in the products may be altered. This explains why the frequency of sensitization among hairdressers may vary over time (32).

In addition to the described skin exposures, it appears possible that on very busy days the total mixture of airborne chemicals can reach significant concentrations in a hairdressing salon (44). However, this airborne exposure is hard to quantify, and as a consequence the total amount of chemicals that hairdressers are exposed to through their occupation is not well described (34;41;43;44).

## 2.6 OTHER OCCUPATIONAL DISEASES AMONG HAIRDRESSERS

Besides hand eczema and contact allergies, hairdressers often have a wide variety of occupational diseases. The most common health complaint among hairdressers is musculoskeletal disorders (Manuscript I;(25;45)). Disorders in the shoulder and neck are commonly reported (1) due to hairdressers' work with the arms in elevated postures (46).

Asthma and respiratory symptoms (rhinitis, nasal congestion, shortness of breath and cough) are also known occupational diseases in hairdressers (47-52) often caused by persulfates in hair bleaching products (53-55).

Several studies show that hairdressers have an increased risk of developing bladder cancer (56-59). Other types of cancer, such as breast-, larynx-, and lung cancer, and specific types of haematopoietic cancers have also been confirmed to be more frequent in hairdressers compared with the general population (59). The increased risk for these cancers is essentially caused by potentially carcinogenic chemicals contained in hair dyes (56;58;59).

Reproduction in female hairdressers may also be influenced by their occupational exposures: outcomes such as infertility and prolonged time to pregnancy (41;60;61), reduced fetal growth in pregnant hairdressers (42;62;63) and a higher risk of congenital malformations in hairdressers' offspring (42;64) have been found in several studies.

## 2.7 REPORT OF AN OCCUPATIONAL DISEASE TO THE AUTHORITIES

An industrial injury covers both accidents at work and occupational diseases. In this thesis, only the occupational diseases are described.

An occupational disease is a disease or disorder caused by the work or working conditions. The disease may develop due to either short-term or long-term exposures. To receive worker's compensation, the disease must be reported to the National Board of Industrial Injuries. In Denmark, this report can be filed by the affected individual or the individual's physician, insurance company, employer or trade union (65). Physicians are, however, legally bound to report any disease that is suspected to be of occupational origin to the authorities (66). This report should be filed within a year of the suspicion.

Upon receiving the report, the board will decide whether the disease is likely to be of occupational origin and whether a financial compensation should be awarded (65).



### **3 AIMS OF THE THESIS**

This thesis is based on a national questionnaire study performed among hairdressers who graduated from public hairdressing vocational schools in Denmark between 1985 and 2007. In this cohort, the purpose of this study was:

- To estimate the prevalence of hand eczema (Manuscript I)
- To quantify the occupational skin exposure by the weekly number of hairdressing tasks performed and the use of protective gloves for these procedures (Manuscript III)
- To estimate the average length of a hairdressing career (Manuscript I)
- To clarify whether hand eczema may have led to career change among hairdressers (Manuscript I)
- To estimate to what extent hand eczema among hairdressers is reported as an occupational disease to the National Board of Industrial Injuries and to assess whether there is significant under-reporting (Manuscript II)
- To characterize the possible reasons for not reporting hand eczema as an occupational disease to the National Board of Industrial Injuries (Manuscript II)

## 4 OVERVIEW OF STUDIES

This PhD thesis is based on the following manuscripts:

- I. **Lysdal SH**, Søsted 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**, 151-158.
- II. **Lysdal SH**, Søsted H, Johansen JD. Do hairdressers in Denmark have their hand eczema reported as an occupational disease? Results from a register-based study. *Contact Dermatitis*. 2011 Nov 15.doi: 10.1111/j.1600-0536.2011.01997.x. [Epub ahead of print]
- III. **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. Accepted for publication in *Contact Dermatitis*.

## 5 MANUSCRIPT I

**Lysdal SH**, Søsted 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**, 151-158.

# Hand eczema in hairdressers: a Danish register-based study of the prevalence of hand eczema and its career consequences

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## Summary

**Background.** Occupational hand eczema is common in hairdressers, owing to wet work and hairdressing chemicals.

**Objectives.** To estimate the prevalence of hand eczema and its career consequences among hairdressers in Denmark.

**Methods.** A register-based study was conducted, comprising all graduates from hairdressing vocational schools from 1985 to 2007 ( $n = 7840$ ). The participants received a self-administered postal questionnaire including questions on hand eczema, atopic dermatitis, and career change. A response rate of 67.9% ( $n = 5324$ ) was obtained.

**Results.** Of the respondents, 44.3% no longer worked as hairdressers and had worked for an average of 8.4 years in the profession before leaving it. Hand eczema was more common among ex-hairdressers (48.4%) than among current hairdressers (37.6%) ( $p < 0.0001$ ), and significantly more ex-hairdressers (26.8%) than current hairdressers (15.7%) had chronic hand eczema ( $p < 0.0001$ ). Of the respondents with hand eczema, 75% were aged 15–24 years at onset, and 45.5% gave hand eczema as a reason for career change. In this group, logistic regression analysis showed that chronic hand eczema contributed the most to the decision to change career (odds ratio 50.12; 95% confidence interval 18.3–137).

**Conclusions.** Hairdressers work an average of 8.4 years in the profession before leaving it, and hand eczema contributes significantly to this career change.

**Key words:** career change; hairdressers; hand eczema; occupational contact dermatitis.

Occupational hand eczema (OHE) is the most frequently recognized work-related disease in Denmark (1).

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Hairdressing is one of the professions in which OHE most commonly occurs (1, 2), and in previous studies the reported prevalence of OHE in hairdressers (1, 3, 4) and hairdresser apprentices (3, 5, 6) was between 35% and 49.4%. Thus, OHE plays a major role in the morbidity of this occupation.

Hand eczema has a multifactorial aetiology with irritant, allergic and endogenous components.

Irritant OHE is a common problem in occupations that involve skin contact with water, soap, cleaning agents, food, metal working fluids, organic solvents, etc. (7). Contact with skin irritants is very frequent in the hairdressing trade. Hairdressers are not only exposed

to irritants in shampoos and conditioners, but they are also intensively exposed to wet work from washing and handling damp hair. Furthermore, hairdressers are exposed to several chemical substances in hair dyes, permanent wave solutions, and bleaching products – all of which are well-known causes of allergic OHE (8, 9).

There are several publications on hand eczema in the general population and the occurrence of occupational hand eczema in hairdressers and other occupational groups (7, 10–13). Leaving a profession is a recognized phenomenon in jobs such as hairdressing (14), but little is known about the reasons for this decision. Only a few studies have been published on hand eczema as the possible reason for leaving the trade (7, 13–16).

This study aimed to clarify the health complaints that may lead to a career change among hairdressers, with hand eczema as the main focal point.

## Materials and Methods

### Design

We conducted a register-based questionnaire study with a self-administered postal questionnaire among hairdressers in Denmark, in collaboration with the Danish Hairdressers' and Beauticians' Union and the Danish Hairdresser Association. The study was approved by the Danish Data Protection Agency.

### Registers

In order to perform this study, we used information on current postal addresses from the Central Person Registration Office. The Labour Market Supplementary Pension Scheme provided information on the annual affiliation to the hairdressing trade for every individual in the cohort.

### Study population

The study population comprised all graduates from hairdressing vocational schools in Denmark between 1985 and 2007 whose current postal addresses were available from the Civil Registration System ( $n = 7840$ ). They received a postal questionnaire in May 2009 and, after two reminders, answers were obtained from 5324 persons (67.9%). In this report, only respondents who provided information on current occupation were included, giving a sample of 5239 individuals aged between 22 and 65 years (Table 1).

### Questionnaire

The respondents completed a questionnaire that consisted of 147 questions concerning topics of both an occupational and a personal nature. Previously validated questions concerning hand eczema from the Nordic Occupational Skin Questionnaire (NOSQ-2002) were used (17). A few of these questions were adapted to match the hairdressing profession. We defined atopic dermatitis according to the UK Working Party's diagnostic criteria (18, 19).

All ex-hairdressers were asked to state whether one or more of the following health complaints caused them to leave the trade: hand eczema, asthma, allergy, musculoskeletal pain, multiple chemical sensitivity (MCS), other disease, or pregnancy. The possible answers were: 'yes', 'no' or 'in doubt' for each health complaint.

The questionnaire was pretested as a peer review among supervisors of the project, the two hairdressing unions, and experts in the fields of smoking and alcohol. The pilot test included 19 hairdressers, who received a postal questionnaire and who were subsequently interviewed by telephone. The questionnaire was corrected accordingly.

**Table 1.** Characteristics of the 5239 trained hairdressers who provided information on current occupation

	Current hairdressers (%)	Ex-hairdressers (%)	Total (%)	<i>p</i> -value
Current occupation ( $n = 5239$ )	2918 (55.7)	2321 (44.3)	5239 (100)	—
Sex ( $n = 5239$ )				0.974
Men	125 (4.3)	99 (4.3)	224 (4.3)	—
Women	2793 (95.7)	2222 (95.7)	5015 (95.7)	—
Age group (years) ( $n = 5239$ )	Mean: 36.4	Mean: 37.7	Mean: 37	<0.0001*
	Median: 36.5	Median: 38	Median: 37	
22–32	867 (29.7)	510 (22.0)	1377 (26.3)	—
33–37	770 (26.4)	528 (22.7)	1298 (24.8)	—
38–41	615 (21.1)	586 (25.3)	1201 (22.9)	—
42+	666 (22.8)	697 (30.0)	1363 (26.0)	—

\**t*-test for equality of means.

### Non-respondents

The questionnaire was not returned by 32.1% ( $n = 2516$ ): 8.8% were men ( $n = 221$ ) and 91.2% were women ( $n = 2295$ ). There were significantly more men in the group of non-respondents than in the group of respondents [ $p < 0.0001$ ; odds ratio (OR) 2.16; 95% confidence interval (CI) 1.78–2.61]. The mean ages were 36.7 and 37 years for the non-respondents and the respondents respectively. There was no significant mean age difference between the two groups ( $p = 0.126$ ; 95% CI for the mean difference  $-0.62$  to  $0.505$ ). Significantly more non-respondents than respondents lived in the Capital Region of Denmark ( $p < 0.001$ ; OR 1.19; 95% CI 1.08–1.32), but the geographical distribution was similar in the two groups. According to data from the Labour Market Supplementary Pension Scheme (ATP) 1768 (73.2%) non-respondents no longer worked in the hairdressing trade. For 7.1% ( $n = 179$ ) of the non-respondents, the addresses were not valid according to the Danish Postal Service.

### Statistics

Characteristics of the groups were compared by use of the two-tailed  $\chi^2$ -test and  $t$ -test. A backward logistic regression was performed among all ex-hairdressers who had ever had hand eczema. In the model, 'I left the trade because of hand eczema' ('yes' versus 'no') was used as the dependent variable, and sex ('men' versus 'women'), debut age of hand eczema (age in years), hand eczema prevalence ('now' versus 'within the past 3 months' versus 'between 3 and 12 months ago' versus 'more than 12 months ago'), hand eczema severity ['only once and for less than 2 weeks' versus 'only once but for 2 weeks or more' versus 'several times' versus '(almost) all the time'] and atopic dermatitis ('yes' versus 'no') were included as the independent variables. An interaction variable between atopic dermatitis and hand eczema severity was also included.

ORs with 95% CIs were calculated to describe the associations.

All statistical analyses were carried out with PASW STATISTICS 18 (SPSS, Chicago, IL, USA) for Windows. A  $p$ -value  $< 0.05$  was considered to be significant.

### Results

Information on current occupation was obtained from 5239 respondents: 2321 (44.3%) did not work as hairdressers anymore (ex-hairdressers), and 2918 (55.7%) still worked in the trade (hairdressers). On average, the ex-hairdressers worked for 8.4 years in the hairdressing profession before leaving it ( $n = 2272$ , range 1–25 years).

Table 1 shows the characteristics of the respondents, divided into two groups. The group of hairdressers was similar to that of ex-hairdressers regarding sex: both groups consisted of 4.3% male and 95.7% female participants. The mean age of the hairdressers was 36.4 years, and they were thus significantly younger than the ex-hairdressers (mean age 37.7 years;  $p < 0.0001$ ; 95% CI for the mean difference  $-1.622$ ;  $-0.977$ ).

### Hand eczema and history of atopic dermatitis

Table 2 shows the results regarding hand eczema in the respondents: 48.4% of the ex-hairdressers and 37.6% of the hairdressers had ever had hand eczema ( $p < 0.0001$ ). Significantly more (22.3%) of the hairdressers than the ex-hairdressers (18.6%) had suffered from hand eczema during the past year ( $p = 0.001$ ). Of the hairdressers, 7.4% had hand eczema when they completed the questionnaire, as compared to 6.9% of the ex-hairdressers ( $p = 0.531$ ). Significantly more ex-hairdressers (26.8%) than current hairdressers (15.7%) had chronic hand eczema ( $p < 0.0001$ ). The initial presentation of hand eczema occurred between the ages of 15 and 24 years for 75% of all respondents with hand eczema. Thus, 68.7% of all respondents with hand eczema were hairdresser apprentices at the time of onset.

Significantly more ex-hairdressers (23.7%) than hairdressers (21.0%) had a history of atopic dermatitis ( $p = 0.017$ ).

### Health complaints as a reason for leaving the trade

Table 3 shows the health reasons for leaving the trade among all ex-hairdressers and among hairdressers who left the profession within the first 5 years (see Appendix for the question asked; multiple answers were possible). Among all ex-hairdressers ( $n = 2321$ ), the primary health complaint causing them to leave the trade was musculoskeletal pain (41.9%), and this was followed by hand eczema (23.1%), other disease (20.8%), and allergy (17.9%); the type of allergy was not specified in this particular question.

Notably, among all ex-hairdressers who gave hand eczema as a health reason for leaving the profession, 24% had no other health complaints. For ex-hairdressers who gave 'musculoskeletal pain', 'other disease', and 'allergy', this was the case for 40.7%, 24.8%, and 4.4%, respectively.

Among ex-hairdressers who left the profession within the first 5 years ( $n = 588$ ), the distribution of health complaints was very similar to that among all hairdressers: with the exception of 'musculoskeletal pain' (OR 1.30;

**Table 2.** The prevalence of hand eczema among 5239 trained hairdressers in Denmark

Hand eczema	Current hairdressers (n = 2918) Total (%)	Ex-hairdressers (n = 2321) Total (%)	Total (%)	p-value
Ever (n = 5112)	1089/2895 (37.6)	1074/2217 (48.4)	2163 (42.3)	<0.0001
One-year prevalence (eczema within the past 12 months) (n = 5112)	645/2895 (22.3)	412/2217 (18.6)	1057 (20.7)	0.001
Point prevalence (current eczema) (n = 5112)	213/2895 (7.4)	153/2217 (6.9)	366 (7.2)	0.531
Onset age (n = 2082) (years)				
Mean	22.0	21.2	21.6	0.001*
Median	20	20	20	—
Onset age in age groups (n = 2082) (years)				
10 and under	18/1048 (1.7)	10/1034 (1.0)	28 (1.3)	—
11–14	15/1048 (1.4)	14/1034 (1.4)	29 (1.4)	—
15–19	392/1048 (37.4)	431/1034 (41.7)	823 (39.5)	—
20–24	352/1048 (33.6)	384/1034 (37.1)	736 (35.4)	—
25–29	144/1048 (13.7)	118/1034 (11.4)	262 (12.6)	—
30–34	73/1048 (7.0)	54/1034 (5.2)	127 (6.1)	—
35–39	35/1048 (3.3)	18/1034 (1.7)	53 (2.5)	—
40 and above	19/1048 (1.8)	5/1034 (0.5)	24 (1.1)	—
Occupation by onset of hand eczema (n = 2109)				
Hair washing assistant	54/1061 (5.1)	42/1048 (4.0)	96 (4.6)	0.233
Hairdresser apprentice	695/1061 (65.5)	753/1048 (71.9)	1448 (68.7)	0.002
Hairdresser	281/1061 (26.5)	207/1048 (19.8)	488 (23.1)	<0.0001
Other	31/1061 (2.9)	46/1048 (4.4)	77 (3.7)	0.072
Severity (how frequently have you had hand eczema?) (n = 2130)				
Only once and for less than 2 weeks	130/1067 (12.2)	60/1063 (5.6)	190 (8.9)	<0.0001
Only once but for 2 weeks or more	115/1067 (10.8)	54/1063 (5.1)	169 (7.9)	<0.0001
Several times	654/1067 (61.3)	664/1063 (62.5)	1318 (61.9)	0.578
(Almost) all the time	168/1067 (15.7)	285/1063 (26.8)	453 (21.3)	<0.0001

The respondents are divided into 'current hairdressers' and 'ex-hairdressers' according to their own information on current occupation at the time of answering the questionnaire. The varying n-values in the subsamples are attributable to missing data for the individual items.

\**t*-test for equality of means.

95% CI 1.06–1.58) and 'other disease' (OR 1.33; 95% CI 1.03–1.71), there was no statistical significant difference between the health complaints resulting in career change for the two groups. Thus, leaving the trade because of 'musculoskeletal pain' and 'other disease' was reported to a lower extent by ex-hairdressers who left the trade within the first 5 years.

Respondents with only a single health complaint causing a change of profession were analysed separately (Table 3). This did not significantly change the mutual distribution of the individual health complaints. With the exception of 'musculoskeletal pain', which was reported more frequently as a reason for leaving the profession in the whole group of ex-hairdressers than by

hairdressers who left within the first 5 years (OR 1.33; 95% CI 1.03–1.71), there were no statistically significant differences between the single health complaints resulting in career change for the two groups.

#### Hand eczema as a reason for leaving the trade

Hand eczema was the predominant reason for career change among ex-hairdressers who had ever had hand eczema, 45.5% (n = 459) stating that it was a reason for leaving the trade. The construction of the question made multiple answers possible, and the other health reasons for career change among these 459 ex-hairdressers are shown in Fig. 1. Notably, 51.4% also gave allergy as a

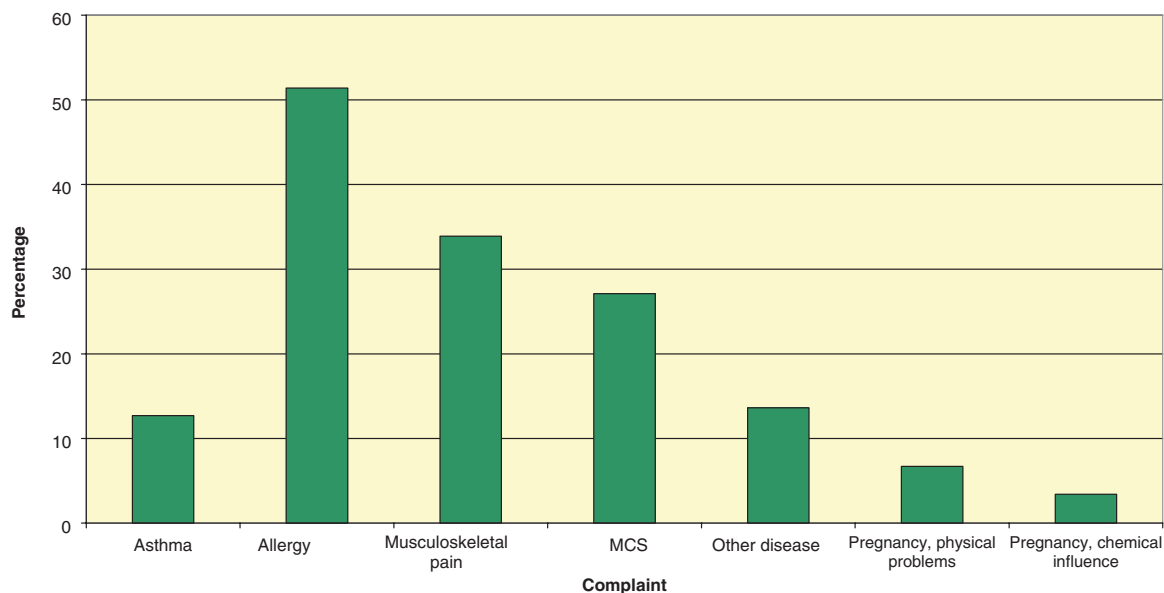
**Table 3.** Health reasons for leaving the hairdressing trade among all ex-hairdressers and ex-hairdressers who left the profession within the first 5 years

	All ex-hairdressers (n = 2321) Total (%)	Ex-hairdressers who left within the first 5 years (n = 588) Total (%)	Crude OR (95% CI)*
Hand eczema	480/2077 (23.1)	141/527 (26.8)	0.82 (0.66–1.02)
- as a single reason	115/2077 (5.5)	36/527 (6.8)	0.80 (0.54–1.18)
Asthma	124/2038 (6.1)	34/510 (6.7)	0.91 (0.61–1.34)
- as a single reason	5/2038 (0.2)	1/510 (0.2)	1.25 (0.15–10.74)
Allergy	366/2040 (17.9)	101/520 (19.4)	0.91 (0.71–1.16)
- as a single reason	16/2040 (0.8)	4/520 (0.8)	1.02 (0.34–3.06)
Musculoskeletal pain	874/2087 (41.9)	188/526 (35.7)	<b>1.30 (1.06–1.58)</b>
- as a single reason	356/2087 (17.1)	69/526 (13.1)	<b>1.36 (1.03–1.80)</b>
Multiple chemical sensitivity	212/2035 (10.4)	49/510 (9.6)	1.09 (0.79–1.52)
- as a single reason	9/2035 (0.4)	4/510 (0.8)	0.56 (0.17–1.83)
Other disease	427/2051 (20.8)	85/514 (16.5)	<b>1.33 (1.03–1.71)</b>
- as a single reason	106/2051 (5.2)	25/514 (4.9)	1.07 (0.68–1.67)
Pregnancy, physical problems	130/2033 (6.4)	31/510 (6.1)	1.06 (0.70–1.58)
- as a single reason	25/2033 (1.2)	7/510 (1.4)	0.89 (0.38–2.08)
Pregnancy, chemical influence	69/2020 (3.4)	17/507 (3.4)	1.02 (0.59–1.75)
- as a single reason	3/2020 (0.2)	1/507 (0.2)	0.75 (0.08–7.25)

CI, confidence interval; OR, odds ratio.

As multiple answers were possible (see Appendix), each health complaint is represented by two lines. The lower of the two illustrates the number of respondents who only had a single health reason for leaving the trade. The varying n-values in the subsamples are attributable to missing data for the individual items. Bold type indicates significant associations.

\*OR (95% CI) comparing the occurrence of the listed health reasons for leaving the hairdressing trade for all ex-hairdressers with that for ex-hairdressers who left the trade within the first 5 years.



**Fig. 1.** Other health reasons for leaving the hairdressing trade among ex-hairdressers who left the trade because of hand eczema, n = 459<sup>†</sup>. Multiple answers were possible (see question asked in Appendix). <sup>†</sup>Cross-checked with a positive answer to 'Have you ever had hand eczema?' MCS, multiple chemical sensitivity.



**Table 4.** Backward logistic regression analysis with the outcome 'I left the trade because of hand eczema' and with different explanatory variables

Explanatory variables	Adjusted OR*	95% CI
Severity of hand eczema		
Only once and for less than 2 weeks	1 (reference)	
Only once but for 2 weeks or more	1.04	0.26–4.19
Several times	<b>4.42</b>	<b>1.71–11.42</b>
(Almost) all the time	<b>50.12</b>	<b>18.34–136.95</b>
Prevalence of hand eczema		
More than 12 months ago	1 (reference)	
Now (point prevalence)	<b>2.63</b>	<b>1.57–4.41</b>
Within the past 3 months	<b>2.51</b>	<b>1.58–3.98</b>
Between 3 and 12 months ago	<b>2.12</b>	<b>1.34–3.36</b>
Atopic dermatitis	<b>1.59</b>	<b>1.16–2.19</b>

CI, confidence interval; OR, odds ratio.

Bold type indicates significant associations.

\*Mutually adjusted for variables shown in the table, sex, and debut age of hand eczema.

Performed in 1009 ex-hairdressers with hand eczema. The model is adjusted for sex and debut age of hand eczema. An interaction variable between atopic dermatitis and severity of hand eczema was included in the model but was insignificant.

reason for leaving the trade, 33.9% gave musculoskeletal pain, and 27.1% gave MCS.

A logistic regression analysis with 'I left the trade because of hand eczema' as the dependent variable was carried out (Table 4). We found that leaving the trade because of hand eczema was associated with increased severity of hand eczema: thus, having had hand eczema several times (OR 4.42; 95% CI 1.71–11.42) and having hand eczema (almost) all the time (OR 50.12; 95% CI 18.34–136.95) were predictors for leaving the trade as compared with only having had hand eczema once, for less than 2 weeks. Having had hand eczema within the past 12 months was also positively associated with leaving the trade because of hand eczema, as compared with having had hand eczema more than 12 months ago (Table 4). Finally, a positive correlation between having atopic dermatitis and leaving the trade because of hand eczema was found (OR 1.59; 95% CI 1.16–2.19). No association with sex and onset age for hand eczema was found, and neither was an association with the interaction variable between atopic dermatitis and hand eczema severity found.

## Discussion

Our study showed a high frequency of career change among hairdressers trained between 1985 and 2007; 44.3% no longer worked in the trade, and the

ex-hairdressers had typically worked for 8.4 years in the profession before leaving it.

Few studies on the reasons for career change among hairdressers have been performed. We wanted to assess whether different health complaints, in particular hand eczema, led hairdressers to leave the trade. Among all ex-hairdressers, musculoskeletal pain and hand eczema were the most frequent health complaints leading to career change (Table 3). Among all ex-hairdressers who had ever had hand eczema, hand eczema was the predominant reason for leaving the trade. The risk of abandoning the profession because of hand eczema increased significantly with severity of hand eczema, but recent outbreaks of hand eczema and atopic dermatitis were also of relevance (Table 4).

Although the literature on hand eczema in hairdressers is abundant, only a few studies have been published on hand eczema and its career consequences for hairdressers (7, 13–16). In their study, Leino et al. showed that the risk of leaving the profession because of hand eczema was 3.5 times as large for hairdressers than for a control group of commercial workers, and that 73% of the hairdressers had left the profession because of work-related diseases (14). Similarly, Meding et al. reported hairdressing to be the occupation that was most frequently abandoned because of hand eczema, with an 18% rate of career change in a study of hand eczema patients from different occupational groups (13). Laing et al. concluded that 66% of hairdressers with positive reactions to the hairdressing series ceased hairdressing because of hand eczema (16). In addition, Holm found that 21% of young hairdressers had left the trade because of health complaints; 6.5% because of hand eczema.

Apart from the study undertaken by Leino et al. (14), the above-mentioned studies were all performed on fairly small populations of hairdressers (range 21–124), some with selected groups of either hand eczema patients or allergic hairdressers. The small sample sizes may explain the variation in the results. Our study comprises the health reasons for leaving the trade for 2321 ex-hairdressers, 1074 of whom had ever had hand eczema, and thus gives a sample of considerable size. Accordingly, it may give a more realistic description.

The findings suggest a healthy-worker effect in the hairdressing trade, as ex-hairdressers had a significantly higher lifetime prevalence of hand eczema than current hairdressers. Furthermore, ex-hairdressers reported chronic hand eczema to a higher extent than did current hairdressers (Table 2). In contrast, the 1-year prevalence of hand eczema was 22.3% in current hairdressers,

and was thus significantly higher than among the ex-hairdressers (18.6%) (Table 2). These findings suggest that individuals with hand eczema of lesser severity, and who tolerate the occupational exposures, continue to work in the profession.

The 1-year prevalence of hand eczema found in this study is comparable to findings in other studies of hand eczema in hairdressers, with a 1-year prevalence varying from 13.8% to 20.2% (2, 3, 20). Nothing suggests that hairdressers overestimate the occurrence of hand eczema. On the other hand, Leino et al. concluded that that hairdressers evidently underrate hand eczema and consider it to be a natural part of their occupation (20). A new validation study of Bregnhøj et al. showed a high degree of consistency between the clinical diagnosis and self-reported hand eczema in hairdresser apprentices (21).

As seen in Table 3, 10.4% of the ex-hairdressers gave MCS as a reason for leaving the trade (see Appendix for question asked). MCS is not a clearly defined medical disorder, but rather a combination of symptoms; it is not commonly recognized by those who have not had particular experience with it. As MCS may be of importance for the morbidity of hairdressers, it was included in the questionnaire, although it may be difficult for respondents to distinguish MCS from asthma and allergy. The reason for this is that, in Danish, 'multiple chemical sensitivity' translates into 'Duft- og kemikalie overfølsomhed', which can be misinterpreted as 'allergy towards fragrances and chemicals'. This may lead to an overlap between these disorders, and might explain the rather high frequency of MCS found in this study. Both MCS and allergy will be the subjects of separate papers.

As this is a questionnaire study, a possible shortcoming might be that hand eczema and other health complaints are self-reported and not clinically diagnosed. This may lead to recall bias. Furthermore, in the question regarding the reasons for career change, multiple answers were possible. Thus, it was impossible to conclude what the primary reason for leaving the trade was, unless the respondent had only a single health complaint. In addition, it would have been desirable for some of the health complaints, for example 'allergy', to have been defined by providing examples of the types of allergy typical for the hairdressing trade.

The relatively high response rate of 67.9% makes it possible for us to assume that the results can be extrapolated to the entire population of hairdressers and ex-hairdressers in Denmark. However; it is possible that we lost valuable information about the ex-hairdressers among the non-respondents: according to the ATP data, 73.2% of the non-respondents no longer worked in the trade, and

this could suggest selection bias, as it is possible that they would be more reluctant to answer a questionnaire regarding something that may no longer be of relevance to them.

Eczema, and irritant eczema in particular, is the most commonly recognized and compensated occupational disease in Denmark (22), and the annual costs of this disease are estimated to be approximately DKK 800 million. Hand eczema occurs most frequently in hairdressers, health-care and dental care workers, machinists, and those engaged in food-related occupations (7, 13). Our study showed that almost 70% of all hairdressers with hand eczema experienced onset during their apprenticeship, and that hand eczema was the predominant reason for leaving the trade among hairdressers who had ever had hand eczema. Thus, as previous studies have shown (23, 24), it is important to implement preventive measures to reduce both the incidence and the prevalence of hand eczema among hairdressers and other high-risk occupational groups. This will include relevant legislation and reduction of exposure to irritant and allergenic hairdressing products, as well as information for and training of both hairdressers and hairdresser apprentices to raise awareness of their occupational exposures and to promote the correct use of suitable gloves and proper skin care.

## Acknowledgements

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## Appendix What caused you to leave the trade?

Please check off one box in every line.

	Yes	No	Don't know
Hand eczema	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Asthma	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Allergy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pain in muscles and joints	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Multiple chemical sensitivity (MCS)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other disease	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pregnancy, physical problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pregnancy, chemical influence	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If 'other disease' caused you to leave the trade, then please state which one: \_\_\_\_\_

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## 6 MANUSCRIPT II

**Lysdal SH**, Søsted H, Johansen JD. Do hairdressers in Denmark have their hand eczema reported as an occupational disease? Results from a register-based study. *Contact Dermatitis*. 2011 Nov 15. doi: 10.1111/j.1600-0536.2011.01997.x. [Epub ahead of print]

## **Do hairdressers in Denmark have their hand eczema reported as an occupational disease? Results from a register based questionnaire study**

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ABSTRACT 200 words

*Background:* Occupational hand eczema is common in hairdressers due to wet work and chemicals.

*Objectives:* To estimate whether hairdressers in Denmark have their hand eczema reported as an occupational disease and to clarify the reasons for not reporting.

*Methods:* A register based study comprising trained hairdressers (n=7840) using a self-administered postal questionnaire including questions on hand eczema and it being reported as an occupational disease. A response rate of 67.9% (n = 5324) was obtained.

*Results:* Overall, 2186 respondents ever had hand eczema; 71.3% were apprentices at hand eczema onset. The majority (61.9%) had had hand eczema several times and 21.3% (almost) all the time; but only 20.7% had reported their hand eczema as being occupational to the National Board of Industrial Injuries (Denmark). A positive association between severity of hand eczema and filing a report was found (OR 19.2; CI (8.18-45.06)). The main reasons for not reporting were 'I thought it would eventually get better' (40.4%) and 'My doctor didn't tell me it was possible to report it' (26.6%).

*Conclusions:*

Hand eczema is considerably under-reported as an occupational disease; the perception of hand eczema among hairdressers and the lack of reporting from doctors being the main reasons.

## **INTRODUCTION**

Eczema, and irritant eczema in particular, is the most commonly recognized occupational disease in Denmark (1-3). However, we are under the impression that there is a massive under reporting to the authorities of hand eczema as an occupational disease (4-8), including those affected by hairdressing (9). This may disguise the true costs of this occupational disease.

Hairdressing is one of the occupations in which occupational hand eczema (OHE) commonly occurs (1;10) and in previous studies the reported prevalence of OHE in hairdressers (1;9;11;12) and apprentice hairdressers (9;13;14) is between 35 and 49.4%. Occupational hand eczema has far-reaching consequences for the affected individual and often leads to change of career among hairdressers (12).

In Denmark, an occupational disease can be reported to the National Board of Industrial Injuries by either the patient, by the patient's trade union, or by the patient's physician. Physicians are, however, obligated by law to report suspected occupational diseases to the board (15). Upon receiving the report, the board will decide whether the disease is likely to be of occupational origin and if a financial compensation should be made. When it is suspected that a disease may be occupational the deadline for reporting it is one year.

All employers in Denmark are obligated to insure their employees against occupational disease (15), and their insurance companies will pay the compensations decided by the National Board of Industrial Injuries (3). Persons, who are self-employed also have the opportunity to insure themselves against occupational diseases, but this is a voluntary scheme. The annual cost of this insurance is approximately 50 Euros per person, but is dependant on the number of employees and the annual turnover of the business (3;16). Roughly estimated, there are approximately 12000 hairdressers working in Denmark (17) of which 5900 are self-employed (18).

The purpose of this study is to estimate to what extent hand eczema among hairdressers is reported as an occupational disease to the National Board of Industrial Injuries and to assess whether a significant under reporting is taking place. Furthermore, this study will clarify the reasons for not reporting hand eczema as an occupational disease among hairdressers.

## **MATERIALS AND METHODS**

### *Design*

We conducted a register based questionnaire study with a self-administered postal questionnaire among hairdressers in Denmark in collaboration with the Danish Hairdressers' and Beauticians' Union and the Danish Hairdresser Association. The study was approved by the Danish Data Protection Agency. The part of the study concerning the prevalence of hand eczema and its career consequences has previously been published (12).

### *Registers*

Information on current postal addresses was provided by the Central Person Registration Office. The Labour Market Supplementary Pension Scheme provided information on the annual affiliation to the hairdressing trade for every individual in the cohort.

### *Study population*

The study population comprised all graduates from hairdressing vocational schools in Denmark between 1985 and 2007 and whose current postal addresses were available from the Civil Registration System (n=7840). They received a postal questionnaire in May 2009 and after two reminders, answers were obtained from 5324 persons (67.9%). In this study only respondents who claimed to have had hand eczema were included giving a sample of 2186 individuals aged between 22 and 69 years, see Table 1. For the results regarding the reporting of hand eczema as an occupational disease only respondents who themselves believed that their hand eczema was caused or worsened by their job were included (n = 1839).

### *Questionnaire*

The respondents completed a questionnaire consisting of 147 questions concerning topics of both occupational and personal nature. Previously validated questions concerning hand eczema from the Nordic Occupational Skin Questionnaire (NOSQ-2002) were used (19). We defined atopic dermatitis by the U.K. Working Party's diagnostic criteria (20;21).

All respondents, who believed that their hand eczema was caused or worsened by their occupation, were asked to state whether their hand eczema was reported as an occupational disease ('yes', 'no'



or ‘I don’t know’). In the event that the respondent did not confirm that a report had been made, the respondent was asked to check off the reasons for not reporting (see Table 4 for question asked).

The questionnaire was pre-tested as a peer review among supervisors of the project, the two hairdressing unions, and experts in the fields of smoking and alcohol. The pilot test included 19 hairdressers, who received a postal questionnaire and who were subsequently interviewed by telephone. The questionnaire was adjusted accordingly.

### *Non-respondents*

32.1% (n=2516) did not return the questionnaire; 8.8% men (n=221) and 91.2% women (n=2295). There were significantly more men in the group of non-respondents compared with the group of respondents ( $p < 0.0001$ ; OR: 2.16; (CI 1.78-2.61)). The mean age was 36.7 years and 37 years for the non-respondents and the respondents respectively. There was no significant mean age difference between the two groups ( $p = 0.126$ ; CI for the mean difference (-0.62-0.505)). The geographic distribution between the five regions in Denmark was virtually similar among respondents and non-respondents. The only exception was that significantly more non-respondents lived in the Capital Region of Denmark compared with the respondents ( $p < 0.001$ ; OR: 1.19; CI (1.08-1.32)).

According to data from the Labour Market Supplementary Pension Scheme (ATP) 1768 (73.2%) non-respondents no longer worked in the hairdressing trade.

7.1% (n=179) of the non-respondents’ addresses were not valid according to the Danish Postal Service.

### *Statistics*

All statistical analyses were carried out using the PASW™ Statistics 18 (SPSS Inc., Chicago, IL, USA) for Windows™. A  $p$ -value of  $< 0.05$  was considered significant.

A backward logistic regression model was performed among all hairdressers, who had ever had hand eczema and who believed it to be caused or worsened by their job. In the model, ‘Is your hand eczema reported as an occupational disease?’ (‘yes’) vs. (‘no’) was used as the dependent variable (respondents who answered ‘I don’t know’ to this question were excluded from the analysis). Sex (‘men’ vs. ‘women’), age when hand eczema first appeared (age in years), year in which hand eczema first occurred (exact year as claimed by the respondent), hand eczema severity (‘only once and for less than 2 weeks’ vs. ‘only once but for 2 weeks or more’ vs. ‘several times’ vs. ‘(almost)

all the time'), atopic dermatitis ('yes' vs. 'no') and whether the respondent was self-employed ('yes' vs. 'no') were included as the independent variables. An interaction variable between age when hand eczema first appeared and hand eczema severity was also included.

Odds ratios (OR's) with 95% confidence intervals (CI's) were calculated to describe the associations.

The  $\chi^2$  trend test (univariate analysis) was used to test for statistically significant differences across the categories of the variable 'number of doctor's visits due to hand eczema' ('1 time' vs. '2 times' vs. '3-4 times' vs. '5-9 times' vs. '10 times or more').

## RESULTS

Of the total number of respondents replying to the question about hand eczema (n = 5187), 42.9% (2128 / 4966) of the women had ever had hand eczema as compared to 26.2% (58 / 221) of the men. The uneven sex distribution among the respondents is due to the fact that the hairdressing trade is dominated by women. In all, 2186 hairdressers (equal to 42.1% of the respondents) had had hand eczema at some point in their lives, and they were the basis of this study. The mean age of the respondents was 36.3 years (Table 1).

### *Hand eczema, history of atopic dermatitis and doctors' consultations*

The mean age of hand eczema onset was 21.5 years (Table 1). The majority of the hairdressers (71.3%) were apprentices at the time of hand eczema onset and nearly one in four hairdressers (24%) had finished their vocational training before developing hand eczema. Furthermore, 61.9% and 21.3% of the hairdressers had had hand eczema several times or (almost) all the time, respectively. Notably, 38.1% of the respondents had a history of atopic dermatitis.

Half of the hairdressers with hand eczema had consulted a physician concerning their hand eczema since they started as an apprentice.

### *Report of hand eczema as an occupational disease*

84.9% (1839/2167) of the respondents believed that their hand eczema was caused or worsened by their occupation. But only 20.7% (380/1836) of these reported their hand eczema as an occupational disease to the authorities. When looking at the two subsets of the respondents, who had either had hand eczema several times or (almost) all the time 12.3% (138/1119) and 51% (221/433), respectively, reported their hand eczema as an occupational disease.

A logistic regression analysis with 'I reported my hand eczema as an occupational disease' as the outcome was carried out (Table 2). We found that reporting hand eczema as an occupational disease was positively associated with increased severity of hand eczema: thus, having had hand eczema several times (OR 2.61; CI (1.12-6.11)) and having hand eczema (almost) all the time (OR 19.20; CI (8.18-45.06)) were predictors for reporting hand eczema as an occupational disease compared to only having had hand eczema once for < 2 weeks. Being self-employed was negatively associated with reporting hand eczema as an occupational disease compared to those respondents, who worked as employees (Table 2). Finally, it showed a positive correlation between age at hand eczema onset and reporting hand eczema as an occupational disease (OR 1.05; CI (1.02-1.07)). This means that for every year the hand eczema debut age increases, the respondent is 1.05 times as likely to have reported it as an occupational disease to the National Board of Industrial Injuries. No association with sex, atopic dermatitis, year for hand eczema onset, or the interaction variable between age at hand eczema onset and hand eczema severity was found.

In a separate univariate analysis a positive association between the number of doctor's visits and report of hand eczema as an occupational disease was observed ( $\chi^2$ ,  $p$ -trend < 0.0001); thus, hand eczema was reported more frequently as an occupational disease among those respondents with 3 or more doctor's visits.

#### *Reasons for not reporting hand eczema as an occupational disease*

In descending order, the **green** column in Table 3 shows the reasons for not reporting hand eczema as an occupational disease the primary being 'I thought it would eventually get better' (40.4%, multiple answers possible). Secondly, 26.6% claimed that their doctor did not inform about the possibility to report hand eczema as an occupational disease. The majority of these respondents had, in fact, seen a doctor regarding their hand eczema (315/373, 84.5%).

Furthermore, 25% of the respondents did not think that they would gain anything from reporting their hand eczema as an occupational disease to the authorities, and 15.5% thought that the process of reporting was too difficult. The category 'other' was checked off by 23.5% and when looking at the written answers attached to this variable the impression is, that this group considers hand eczema to be 'a natural part of the hairdressing trade, 'a side effect of being a hairdresser' and

something that ‘all apprentices had’ and thus never thought of reporting hand eczema as an occupational disease.

Approximately 5% did not report their hand eczema as an occupational disease because they were afraid to lose their job or that it would lead to problems with their employer.

Approximately 3% answered that they were self-employed and not insured as a reason for not reporting. In fact, 27.5% (594/2157) of the respondents in this study were self-employed, and only 12.5% (74/594) of them have reported their hand eczema as an occupational disease.

Respondents who had had hand eczema ‘several times’ (moderate hand eczema) were predominant (Table 3, yellow column). Consequently, the answers given in this group are very similar to that of the whole group. Of the respondents in this group, 46.4% had seen a medical doctor regarding their hand eczema. The pink column describes the reasons for not reporting hand eczema as an occupational disease in the subset of respondents, who had had hand eczema ‘(almost) all the time’ (severe hand eczema). Of the respondents in this group, 81.5% had seen a medical doctor regarding their hand eczema. The reasons for not reporting their hand eczema as an occupational disease do not differ greatly from the before mentioned, apart from 41% claiming that their doctor did not inform them about the possibility to report.

## DISCUSSION

Our study showed a considerable under reporting of hand eczema as an occupational disease to the National Board of Industrial Injuries for hairdressers in Denmark; merely 20.7% of the hairdressers with self reported occupational hand eczema had a report filed. This was true for 12.3% of the hairdressers with moderate hand eczema and 51% of the hairdressers with severe hand eczema.

Occupational hand eczema among hairdressers and other occupational groups is well described in the literature, and it seems that there is a general consensus that the true numbers of occupational skin diseases are considerably higher than reflected by National registers due to under reporting (4-8;22). However, very few studies have quantified this under reporting. In 1988, Taylor estimated the true incidence of all occupational illnesses to be 10-50 times greater than reported (8). With regard to the hairdressing trade, Hansen et al describes a reporting rate as low as 11.6% among trained hairdressers with hand eczema (9).

The lack of literature in this area might be due to the fact that the legislation varies greatly between countries (23), which leads to major differences in the procedure of reporting an occupational disease. Despite these national differences, under reporting is probably not only happening in Denmark but must be viewed as an international problem. This means that statistics from national registers of reported occupational hand eczema only shows a fraction of the true problem. As a consequence, the true impact of hand eczema as an occupational disease is grossly underestimated and this impairs the incentive for preventive action.

As this is a questionnaire study a possible shortcoming might be that hand eczema is self reported and therefore not clinically diagnosed. This may lead to recall bias. However, a recent validation study by Bregnhøj et al shows a high degree of consistence between the clinical diagnosis and self reported hand eczema in apprentice hairdressers (24), and other studies have shown that both hairdressers and other occupational groups are more likely to underrate the occurrence of hand eczema rather than overestimate it (25;26).

The information about the reporting of hand eczema as an occupational disease to the authorities also relies on the answers provided by the respondents. We find these statements reliable, though. It is a very time consuming and comprehensive process to file a report, so it is highly unlikely that this would have taken place without the patient's knowledge. Furthermore, in the question regarding the reasons for not reporting hand eczema as an occupational disease multiple answers were possible. Thus, it was impossible to conclude what the primary reason for not reporting was, unless the respondent only had a single reason for not doing so.

The relatively high response rate of 67.9% makes it possible for us to assume that the results can be extrapolated to the entire population of trained hairdressers in Denmark and maybe even other occupational groups, where hand eczema is prevalent. However, it is possible that we lost valuable information among the non-respondents: according to the data from the Labour Market Supplementary Pension Scheme, 73.2% of the non-respondents no longer worked in the hairdressing trade and this could suggest selection bias since one could speculate that they would be more reluctant to answer a questionnaire regarding something that may not be of relevance to them anymore.

This study illustrates the nature of the under reporting of hand eczema: Denmark has a very well-developed reporting system, free of charge for all employees and inexpensive for the employers. And still only half of the hairdressers with severe hand eczema have filed a report.

We found that some of the main reasons for not reporting hand eczema as an occupational disease were ‘ I thought it would eventually get better’ (Table 2) and that the hairdressers considered hand eczema as a ‘a natural part of the hairdressing trade’. These statements indicate that hairdressers do not think of hand eczema as an occupational disease worthy of being reported. In order to improve the reporting to the registers and the prevention of occupational hand eczema this state of mind would have to be changed. This could be done by making information about the report of hand eczema as an occupational disease a mandatory part of the training in the vocational schools. Further, the Research Centre for Hairdressers and Beauticians hope to increase hairdressers’ knowledge about this subject in the future by giving lectures to hairdressers and writing articles in the magazines published by the Unions.

The statement ‘My doctor didn’t tell me it was possible to report it’ scored very high and interestingly, this was the main reason (41%) for not reporting in the group with severe hand eczema (table 2). In addition a positive association between the number of doctor’s visits and report of hand eczema as an occupational disease was shown ( $\chi^2$ ,  $p$ -trend < 0.0001). This is problematic because physicians in Denmark are obligated by law to report whenever the slightest suspicion of an occupational disease appears, i.e. at the first visit. This rule poses a duality in the role of doctors, though: a doctor is considered to be the patient’s advocate, but at the same time the system imposes on them to report even if it is against the patient’s wish.

Thus, more information to physicians, both general practitioners and dermatologists, about the importance of reporting hand eczema as an occupational disease is needed. The information could be provided through papers published in national medical journals. Also, the Danish National Board of Industrial Injuries could start an information campaign stressing the importance of reporting hand eczema as an occupational disease and reminding medical doctors of their obligation to report.

In conclusion, we find that there is a considerable under reporting of hand eczema as an occupational disease in the hairdressing trade due to factors that are largely preventable. Further information and guidelines about how to handle hand eczema as an occupational disease should be

provided to doctors, hairdressers and other stakeholders in the hairdressing trade, and a change of attitude is needed among all parties.

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**Table 1** Characteristics of the 2186<sup>a</sup> respondents with hand eczema. The varying ‘n’ in the subsamples are due to missing data for the individual items.

	Total (%)
Sex n = 2186	
Men	58 (2.7)
Women	2128 (97.3)
Age (range 22-69) n = 2186	
Mean age (years)	36.3
Median age (years)	37
Mean age at hand eczema onset (years)	21.5
Median age at hand eczema onset (years)	20
Employment by onset of hand eczema n = 2130	
Hair washing assistant	97 (4.7)
Hairdresser apprentice	1463 (71.3)
Hairdresser	493 (24.0)
Other	77 (3.6)
Severity of hand eczema (How frequently have you had hand eczema?) n = 2153	
Only once and for less than two weeks	191 (8.9)
Only once but for two weeks or more	170 (7.9)
Several times	1333 (61.9)
(Almost) all the time	459 (21.3)
Atopic dermatitis	833 (38.1)
Doctor consultations because of hand eczema n = 2167	
Number of respondents who consulted a doctor	1084 (50.0)
Median number of consultations (range 1-500) <sup>b</sup>	3

<sup>a</sup> In all, 2186 out of 5324 respondents (42.1%) had ever had hand eczema, and they were the basis of this study.

<sup>b</sup> The incoming questionnaires were all scanned. Since the range of doctors’ consultations was very wide, all questionnaires with an answer that exceeded 100 doctors’ consultations because of hand eczema were manually checked. The verified values (2 x 200, 1 x 365 and 1 x 500) were allowed in the calculations whereas the non-verified values were denoted ‘missing’.

**Table 2** Backward logistic regression analysis with the outcome 'I reported my hand eczema as an occupational disease' and with different explanatory variables. Performed in 1839 hairdressers with hand eczema, and who believed it to be caused or worsened by their job. The model is adjusted for sex, year for hand eczema debut and atopic dermatitis. An interaction variable between age at hand eczema debut and severity of hand eczema was included in the model but was insignificant.

Explanatory variables	Adjusted OR <sup>a</sup>	95% CI
Severity of hand eczema (How frequently have you had hand eczema?)		
- only once and for less than 2 weeks	1 (reference)	
- only once but for 2 weeks or more	1.389	0.475 – 4.059
- several times	<b>2.614</b>	<b>1.118 – 6.112</b>
- (almost) all the time	<b>19.201</b>	<b>8.183 – 45.055</b>
Self-employed		
- No	1 (reference)	
- Yes	<b>0.714</b>	<b>0.521 – 0.978</b>
Age at hand eczema onset	<b>1.045</b>	<b>1.020 – 1.070</b>

CI, confidence interval; OR, odds ratio. Significant association is shown in bold.

<sup>a</sup> Mutually adjusted for variables shown in table, sex, age at hand eczema onset, and atopic dermatitis. An interaction variable between age at hand eczema debut and severity of hand eczema was included in the model but was insignificant.

**Table 3** Reasons for not reporting hand eczema as an occupational disease to the occupational registers among 1419 hairdressers, who believed their hand eczema was caused or worsened by their job. The green column describes the answers for the whole group, whereas the yellow and pink columns describe the answers for two subsets; the respondents, who have had hand eczema several times and (almost) all the time, respectively. Multiple answers were possible to the question 'Why hasn't your hand eczema been reported as an occupational disease?'

	Hand eczema ever (n = 1419) Total (%)	Several times (n = 980) Total (%)	(Almost) all the time (n = 212) Total (%)
I thought it would eventually get better	573 (40.4)	417 (42.6)	76 (35.9)
My doctor didn't tell me it was possible to report it.	377 (26.6)	256 (26.1)	87 (41.0)
I would probably not gain anything from it anyway	354 (25.0)	244 (24.9)	73 (34.4)
Other*	334 (23.5)	221 (22.6)	36 (17.0)
It seemed difficult	220 (15.5)	158 (16.1)	42 (19.8)
I didn't know that my hand eczema was occupational	176 (12.4)	117 (11.9)	28 (13.2)
I was worried it would lead to problems with my employer.	81 (5.7)	55 (5.6)	23 (10.9)
I was afraid to loose my job	78 (5.5)	56 (5.7)	17 (8.0)
I am self-employed and not insured	41 (2.9)	20 (2.0)	14 (6.6)
I have always had eczema	30 (2.1)	16 (1.6)	12 (5.7)
My doctor didn't think that my hand eczema was occupational	16 (1.1)	9 (0.9)	5 (2.4)
It had gone over the time limit	15 (1.1)	10 (1.0)	3 (1.4)

\* 'Other' served as the last response category in the question asked (see Table 4). Respondents, who checked off this category had the opportunity to add a written comment. The comments mainly expressed an attitude towards hand eczema as 'a natural part of the hairdressing trade, 'a side effect of being a hairdresser' and something that 'all apprentices had'.

**Table 4 Questions.** The four primary questions used for this paper. In all, the postal questionnaire consisted of 147 questions and was administered in May of 2009 to 7840 trained hairdressers in Denmark. After two reminders a response rate of 67.9% was obtained.

Question number 53 is from the Nordic Occupational Skin Questionnaire 2002. The remaining three questions have been developed for this questionnaire. The questions have been translated into English for this publication.

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**53. Have you ever had hand eczema?** Please check off one box only.

- Yes
  - No ➡ please go to question 65
- 

**59. Do you think that your hand eczema is caused or worsened by your job?** Please check off one box only.

- Yes
  - No ➡ please go to question 63
  - I don't know
- 

**61. Has your hand eczema been reported as an occupational disease?** Please check off one box only.

- Yes ➡ please go to question 63
  - No
  - I don't know
- 

**62. Why hasn't your hand eczema been reported as an occupational disease?**

Please check off all statements that are true for you.

- My doctor didn't think that my hand eczema was occupational
- I didn't know that my hand eczema was occupational
- My doctor didn't tell me it was possible to report it
- I was worried it would lead to problems with my employer
- I was afraid to lose my job
- It seemed difficult
- It had gone over the time limit
- I would probably not gain anything from it anyway
- I have always had eczema
- I am self employed and not insured
- I thought it would eventually get better
- Other: \_\_\_\_\_

## **7 MANUSCRIPT III**

**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. Accepted for publication in Contact Dermatitis.

## **A quantification of occupational skin exposures and the use of protective gloves among hairdressers in Denmark**

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## **ABSTRACT:**

*Background:* Occupational hand eczema is common in hairdressers due to excessive exposure to wet work and hairdressing chemicals.

*Objectives:* To quantify occupational skin exposure and the use of protective gloves among hairdressers in Denmark.

*Methods:* A register based study was conducted comprising all graduates from hairdressing vocational schools from 1985–2007 (n=7840). The participants received a self-administered postal questionnaire in May 2009 including questions on performed hairdressing tasks the past week at work and the extent of glove use. A response rate of 67.9 % (n=5324) was obtained.

*Results:* Of the respondents, 55.7% still worked as hairdressers and they were the basis of this study. Daily wet work was excessive; 86.6% had wet hands for 2 hours or more and 54% for 4 hours or more. Glove use was fairly frequent for full head hair colouring and bleaching procedures (93–97.7%), but less frequent for high-/lowlighting procedures (49.7–60.5%) and permanent waving (28.3%). Hair washing was rarely performed wearing gloves (10%); although more frequently after hair colouring procedures (48.9%).

*Conclusions:* Occupational skin exposure was excessive among hairdressers; the extent of wet work and chemical treatments was high and glove use was inconsistent, especially for certain hair colouring procedures and wet work tasks.

## **INTRODUCTION**

Recently we published results showing that hand eczema is reported in more than 42% of hairdressers in Denmark (1), and these findings are coherent with previous studies of both hairdressers (2-4) and hairdresser apprentices (2;5;6). In addition, we found that 84.9% of hairdressers with hand eczema believed that it was caused or worsened by their job (7).

Hairdressing is one of the occupations in which occupational hand eczema commonly occurs (4;8-10). This is due to the intense exposure to wet work from washing and handling damp hair combined with the frequent contact with skin irritants and allergens. Occupations, such as hairdressing, that involve skin contact with water and other irritants are prone to have a high prevalence of irritant occupational hand eczema (11). In addition, hairdressers are exposed to hair dyes, permanent wave solutions, bleaching products, fragrances, and preservatives that are all well known causes of allergic occupational hand eczema (12;13). Very few studies have quantified this skin exposure; in 2006 Anveden et al estimated that hairdressers were exposed to skin irritants 62% of the working day (14), and in 2008 Lind et al concluded that the number of hairdressing tasks involving skin-damaging chemical exposure was high (8). In another study Lind et al found positive hand rinse samples for permanent hair dyes among the majority of hairdressers after application of hair dye and after cutting newly coloured hair (15). If properly used, protective gloves can provide considerable protection against permeation of e.g. hair dye chemicals (16). However, a few studies have been published on the use of protective gloves among hairdressers (15;17) concluding that glove use was infrequent, improper and insufficient to prevent exposure from irritants and allergens.

The aim of this study was to quantify the occupational skin exposure among hairdressers by the weekly number of hairdressing tasks carried out and the use of protective gloves for these procedures.

## **MATERIALS AND METHODS**

### *Design*



We conducted a register based questionnaire study with a self-administered postal questionnaire among hairdressers in Denmark. The study was carried out in collaboration with the Danish Hairdressers' and Beauticians' Union and the Danish Hairdresser Association and was approved by the Danish Data Protection Agency.

### *Registers*

In order to perform this study we used information on current postal addresses from The Central Person Registration Office. The Labour Market Supplementary Pension Scheme provided information on the annual affiliation to the hairdressing trade for every individual in the cohort.

### *Study population*

The study population comprised all graduates from public hairdressing vocational schools in Denmark between 1985 and 2007 and whose current postal addresses were available from the Civil Registration System (n=7840). They received a postal questionnaire in May 2009 and after two reminders, answers were obtained from 5324 persons (67.9%). In this report only respondents currently working as hairdressers were included giving a sample of 2918 individuals aged between 22 and 65 years.

### *Questionnaire*

In May of 2009, the respondents completed a questionnaire that consisted of 147 questions concerning topics of both occupational and personal nature. Previously validated questions concerning self diagnosed hand eczema from the Nordic Occupational Skin Questionnaire (NOSQ-2002) were used (18). We defined atopic dermatitis by the U.K. Working Party's diagnostic criteria (19;20). The results regarding hand eczema have previously been published (1;7).

All hairdressers were asked to state the number of times a particular hairdressing task was carried out the past week of work, to assess the duration of wet work and the extent of glove use. In addition, respondents were asked how often they wore rings and bracelets and/or wrist watches at work and how often they used moisturizer on their hands. The individual questions from the questionnaire used for this publication are stated in the golden boxes in the tables; the rows representing the possible answers.

The questionnaire was pre-tested as a peer review among supervisors of the project and the two hairdressing unions. The pilot test included 19 hairdressers, who received a postal questionnaire and who were subsequently interviewed by telephone. The questionnaire was modified accordingly.

### *Non-respondents*

32.1% (n=2516) did not return the questionnaire; 8.8% men (n=221) and 91.2% women (n=2295). There were significantly more men in the group of non-respondents compared to the respondents ( $p < 0.0001$ ; odds ratio (OR) 2.16; 95% confidence interval (CI) (1.78-2.61)). There was no significant mean age difference between respondents (37 years) and non-respondents (36.7 years) ( $p = 0.126$ ; 95% CI for the mean difference (-0.62 to 0.505)).

The geographic distribution between the five regions in Denmark was virtually similar among respondents and non-respondents. The only exception was that significantly more non-respondents lived in the Capital Region of Denmark compared with the respondents ( $p < 0.001$ ; OR: 1.19; CI (1.08-1.32)).

According to data from the Labour Market Supplementary Pension Scheme (ATP) 1768 (73.2%) non-respondents no longer worked in the hairdressing trade.

7.1% (n=179) of the non-respondents' addresses were not valid according to the Danish Postal Service.

### *Statistics*

Characteristics of the groups were described using plane frequencies, percentages, mean and median values. The groups were compared by using the two-tailed  $\chi^2$  test, t-test or Fischer's exact test.

The  $\chi^2$  trend test (univariate analysis) was used to test for statistically significant differences across the categories of the variable 'age in groups' ('25 years and below' vs. '26-30 years' vs. '31-35 years' vs. '36-40 years' vs. '41-45 years' vs. '46 years and above').

The Fischer's exact test (univariate analysis) was used to test for statistically significant differences between men and women and the number of hairdressing tasks performed. The reason for using this test was that several cells had a cell count of less than 5.

All statistical analyses were carried out using the PASW™ Statistics 18 (SPSS Inc., Chicago, IL, USA) for Windows™. A  $p$ -value of  $< 0.05$  was considered significant.

### *Definitions*

The occupational skin exposure was measured by the question: 'How many times have you carried out the following tasks at work during the past week?' (Table 3) For every task, respondents could indicate the number of times the particular task was performed or tick off 'Did not perform this task'. Respondents who indicated '0' for the number of times the particular task was performed were added to the group of 'Did not perform this task'.

Further, we chose to focus on wet and chemical exposures only. As a consequence, hair styling procedures are not included. It is generally accepted that wet work is defined by (i) having wet hands for two hours or more on a regular work day or (ii) using occlusive gloves for two hours or more per day or (iii) frequent cleaning of hands (>20 times a day) (10;21-23). We defined cutting wet hair, washing hair, dishwashing, cleaning etc. without using gloves as having wet hands.

In Denmark, the rules are quite complex regarding hairdressers and their working hours. According to the agreement between the Danish Hairdresser Association and the Danish Hairdressers' and Beauticians' Union (24) a full time hairdresser should work a maximum of 37 hours a week divided on 5 working days over a period of 16 weeks (the hours/days may vary within this period). In this study we defined 'a week at work' as 5 days when reporting the mean number of times a particular hairdressing task was performed.

In order to investigate the correlation between hand eczema and glove use a variable of 'recent hand eczema' was constructed. This variable is defined by the following answers to the question '*When did you last have hand eczema?*': '*I have hand eczema at the moment*' (N=213) and '*I don't have hand eczema at the moment, but I've had it within the past 3 months*' (N=181). Thus, a total of 394 hairdressers had had recent hand eczema. The analyses were conducted for (i) the group of hairdressers with recent hand eczema (N=394) compared with the rest of the hairdressers (regardless of their hand eczema status) (N=2524) and (ii) the group of hairdressers who had ever had hand eczema (N=1089) compared with the rest of the hairdressers (N=1829) (i.e. hairdressers without hand eczema). This approach was chosen because no information about the time for initiation of glove use was available.

## **RESULTS**

Information on current occupation was obtained from 5239 respondents: 2918 (55.7%) still worked in the hairdressing trade. The trade is dominated by women and 95.7% of the hairdressers were female (Table 1). The mean age of the hairdressers was 36.4 years and on average the hairdressers had worked for 11.3 years in the hairdressing profession when they answered the questionnaire (Table 1). More than half of the hairdressers were self employed (1532/2895 equal to 52.9%).

#### *Wet work*

The majority of both male and female hairdressers reported washing their hands an average of 6-10 times per day at work (38.4% and 41.2%, respectively, Table 2). Washing hands 20 or more times a day was reported by 7.0% of all hairdressers. A total of 78.4% of the male and 86.9% of the female hairdressers (in all 86.6%) reported having wet hands for 2 hours or more on any normal day at work (Table 2). As a whole, 54.0% reported to have wet hands for 4 or more hours per day.

#### *Wearing jewellery and wrist watches*

Less than one fourth of the hairdressers never wore rings to work (Table 2), but 55.2% of the male and 68.9% of the female wore rings to work on a daily basis. The picture is very similar with regard to bracelets and/or wrist watches; a total of 16.1% never wore them whereas 70.8% of the male and 67.7% of the female hairdressers wore them on a daily basis.

#### *Using moisturizer*

Only 7.0% (203/2828) of the hairdressers never used moisturizer on their hands. This was, however, more common among the male hairdressers (21/118 equal to 16.9%) than among the female hairdressers (182/2710 equal to 6.5%). The majority of female hairdressers (1888/2710 equal to 67.8%) used moisturizer on their hands at least once a day; this was true for 51.6% (64/118) of the male hairdressers. There was a statistically significant difference between men and women and the overall frequency of using moisturizer; the male hairdressers using moisturizer less frequently than the female hairdressers ( $p$ -value < 0.0001; OR 0.34; CI (0.21-0.57)).

#### *Hairdressing tasks performed during the past week at work*

The mean number of hairdressing tasks performed at work during the past week is described in Table 3. The tasks are arranged in sequence of descending order (for all hairdressers, green column). Wet work hairdressing tasks such as cutting wet hair and hair washing were the most

frequently performed (36.4 times/week equivalent to 7.3 times/day and 27.8 times/week equivalent to 5.6 times/day, respectively). Male hairdressers did significantly more haircuts than female hairdressers (weekly mean: 40.3 times;  $p$ -value = 0.017; 95% CI of the difference 0.72-7.40). Cutting wet hair following any type of hair colouring was performed 2.9 times a day (equivalent to 14.7 times a week, Table 3). Also hair colouring procedures were performed on a daily basis; full head colouring with permanent hair dye being the most frequently performed type (9.3 times/week equivalent to 1.9 times/day). Except for high-/lowlighting using foil ( $p$ -value = 0.032; 95% CI of the difference 0.11-5.57) there were no statistically significant differences in the mean number of times a hair colouring procedure was performed between male and female hairdressers.

#### *Wearing gloves*

98.2% of all hairdressers (2834/2887) reported to use gloves at work (Table 4) and 40.9% of them wore gloves for 2 hours or more a day. The majority of the hairdressers (96.4%) were able to use as many gloves as they needed at work. The most frequently used gloves were vinyl gloves (35.6%, Table 4), latex gloves (34.9%) and nitrile gloves (22.3%). The re-use of gloves was frequent; 20.2% (569/2818) of hairdressers did not take a new pair of gloves every time and the majority of those only took a new pair of gloves when the old ones were torn (381/569 equal to 67.7%). The mean number of times a pair of gloves was used was 3.46 (range 1-20).

Of the hairdressers who re-used their gloves, 59.6% (336/564) never turned their gloves in-side out before re-using them (Table 5). Consequently, a total of 40.4% (228/564) regularly turned their gloves in-side out before re-using them (Table 5). This is equivalent to 8% of all hairdressers (228/2834) who used gloves at work.

#### *Wearing gloves for individual hairdressing tasks*

Although almost all hairdressers answered that they wore gloves at work the picture changes when looking at glove use for the individual hairdressing tasks. The majority of both male and female hairdressers wore gloves for full head colouring (regardless of type) and bleaching (Table 5), but when high-/lowlighting by using a cap or foil this tendency changed to 60.5% and 49.7%, respectively. There is a statistically significant difference in glove use between male and female hairdressers for these treatments (Table 5). Though glove use was frequent during hair colouring procedures, less than half of the hairdressers wore gloves when washing the dye out of the hair (48.9%, Table 5).

For a high risk exposure such as permanent waving only 28.3% wore gloves, and in addition gloves were very rarely worn when colouring eyelashes and/or eyebrows (0.7%). For plain hair washing 10% wore gloves.

Figure 1 illustrates the percentage of glove use for each hairdressing task among hairdressers divided into 6 age groups. A statistically significant difference in glove use between the age groups was seen for 8 out of 12 treatments (Figure 1); for hair washing after chemical treatments, high-/lowlighting using foil, and mixing hair dye the glove use increased with age. For full head colouring with either permanent or semi-permanent hair dye, bleaching, permanent waving, and hair washing prior to cutting the use of gloves decreased with age.

#### *Hairdressing tasks performed during the past week without gloves*

Hairdressers in Denmark participating in this study were fairly good at using protective gloves for full head colouring and bleaching procedures (between 93–97.7%, Table 6). This was not the case for several other hairdressing tasks involving hair dye or permanent wave solution. When analyzing the mean number of times these tasks were performed among hairdressers who did not always wear gloves for specific treatments we found that ‘cutting wet hair after any type of hair colouring’ was performed an average of 14.7 times a week (equivalent to 2.9 times/day) without gloves (N=2146), ‘permanent waving’ an average of 3.4 times a week (equivalent to 0.7 times/day) without gloves (N = 1193), and ‘colouring eye lashes and/or eyebrows’ 5.3 times a week (equivalent to 1.1 times/day) without gloves (N= 1931). Further, high-/lowlighting using either foil or a cap were weekly performed an average of 7 times (equivalent to 1.4 times/day, N= 1074) and 4.6 times (equivalent to 0.9 times/day, N=539), respectively, without gloves.

#### *Correlation with hand eczema*

Among the hairdressers participating in this study 37.6% (1089/2895) had ever had hand eczema and the majority (61.3%) had had it several times (1). A total of 394 hairdressers (13.6%) had had recent hand eczema (within the past three months).

Both hairdressers with recent hand eczema (i) and hairdressers who had ever had hand eczema (i) used gloves significantly more often for hair washing tasks compared with their colleagues; this was also applicable for glove use during permanent waving procedures (Table 7). Extensive glove use (2 hours or more a day) as well as frequent cleaning of the hands (> 20 times a day) were more pronounced among (i) hairdressers with recent hand eczema and (ii) hairdressers who had ever had

hand eczema compared with their colleagues (data not shown). No difference in the reported re-use of gloves was observed in either of the analyses (data not shown).

## **DISCUSSION**

In this study we aimed to assess the occupational skin exposure and the use of protective gloves among hairdressers. Overall, we found that more than half of the hairdressers had wet hands for 4 hours or more a day and that no hairdressing task was performed wearing gloves every time. Consequently, hairdressers have an excessive skin exposure on a daily basis of very potent allergens, water and other irritants; all of which are well known causes of hand eczema (15;25).

Several studies have shown a strong correlation between wet work and hand eczema (3;4;10). In this study, the extent of wet work was high; 86.6% had wet hands for 2 or more hours a day and of those 54% reported to have wet hands for 4 or more hours a day. We defined cutting wet hair as a wet work task, and it was the most frequently reported hairdressing task being performed an average of 36.4 times a week. Hair washing was the second most frequently performed hairdressing task (mean 27.8 times per week). Despite the fact that the majority of hairdressers with hand eczema believe that their hand eczema is caused by hair washing (2), only 10% of the hairdressers in this study always wore gloves for this task. These findings are coherent with those of other studies: wearing gloves for hair washing is reported in 5.5% of hairdressers by Nixon et al and in 11% of hairdressers by Lind et al (5;8). Even though this study was performed among trained hairdressers who had been an average of 11.3 years in the trade, the hairdressers reported a high extent of wet work. Thus, hairdressers have an extensive exposure to wet work throughout their career regardless of their seniority.

Beside the wet work, hairdressers performed several tasks a day involving hairdressing chemicals. Hair colouring procedures were the most frequently performed type of chemical treatments whereas full head bleaching was the least frequently performed type.

No hairdressing task was performed wearing gloves every time, and as a consequence hairdressers had a daily skin exposure to hairdressing chemicals. However, the majority of hairdressers in Denmark always wore gloves for certain hairdressing tasks such as applying full head colouring with permanent hair dye (97.7%), semi-permanent hair dye (94.7%) and bleaching (93.0%). In studies by Nixon et al and Lind et al similar frequencies were found (5;8). However, gloves were

rarely used for the procedures of mixing and rinsing off hair dye (12.6% and 48.9%, respectively, Table 5), permanent waving (28.3%) and hair washing (10%). All these procedures provide a significant exposure to allergenic hairdressing chemicals.

We found that the age of the hairdressers played a significant role for glove use for the individual hairdressing tasks. The young hairdressers were better at using gloves for full head colouring with both permanent and semi-permanent hair dye, permanent waving and plain hair washing (Figure 1), whereas the older hairdressers more frequently wore gloves for hair washing after a chemical treatment (any type of hair colouring and permanent waving), high-/low lighting using foil, and mixing hair dye (Figure 1). The young hairdressers in Denmark have been taught about glove use at the vocational schools to a higher extent than the older hairdressers, and these results highlight the need for a better training material and incorporation of better working habits.

Additionally, we found that hairdressers with hand eczema had a higher frequency of extensive glove use (> 2 or more hours a day) and used gloves more frequently for hair washing procedures compared with their colleagues. The reasons for this are speculative as we do not know when the individual hairdressers began using gloves. The results may suggest, however, that the hairdressers are better at using gloves after they develop hand eczema.

An alarming lack of knowledge becomes evident due to the fact that 1 in 5 hairdressers re-use their gloves and that 8% of all hairdressers turn their gloves inside out before reusing them. Turning the gloves inside out leads to prolonged skin contact with the contaminated surface of the gloves. This practice must be stopped. Efforts should be made to understand and remedy the motivation for this habit.

Wearing jewellery at work is a potential risk factor for developing eczema as a hairdresser. Excess styling products, detergents etc. are caught under the jewellery providing an extended exposure. Further, the area of skin covered by the jewellery is likely to be moist for a prolonged period of time unless the jewellery is removed when drying the hands. The majority of hairdressers in this study wore rings and/or bracelets/wrist watches to work on a daily basis.

As this is a questionnaire study a possible shortcoming might be that the number of tasks performed is self reported. This may lead to recall bias. However, by restricting the question to include the



number of tasks performed within the past week only, we believe that we have reduced this risk significantly. Further, the weekly number of hairdressing tasks reported in this study is largely coherent with that reported by Lind et al in 2008 (8).

Information on glove use was also self reported. Wearing gloves has been highly promoted among hairdressers within the past decade. Thus, it is likely that respondents may have over reported their glove use, as 'I wear gloves' is the socially desirable answer. However, the glove use reported in this study is similar to that of other studies (5;8).

In the questionnaire, the hairdressers could specify what type of gloves they used (Table 3). Unfortunately, we did not specify what gloves were disposable and what types that could be used several times.

This study is performed among 7840 trained hairdressers. The relatively high response rate of 67.9% (N =5324) makes it possible for us to assume that the results can be extrapolated to the entire population of hairdressers in Denmark. However; it is possible that we lost valuable information about the ex-hairdressers among the non-respondents: according to the ATP-data 73.2% of the non-respondents no longer worked in the trade and this could suggest selection bias since one could speculate that they would be more reluctant to answer a questionnaire regarding something that may not be of relevance to them anymore. However, the sample sizes of both current and ex-hairdressers are considerable.

Hairdressers have excessive skin exposure to both irritants and very potent allergens on a daily basis and they are therefore at very high risk of developing both hand eczema and allergies. In this study we chose to focus on wet and chemical exposures only. As a consequence, hair styling procedures are not included. Thus, the exposure to potential irritants and allergens among hairdressers are likely to be even higher than reported in this study.

In an earlier publication we proved occupational hand eczema to be of crucial importance for the high occurrence of career change among hairdressers in Denmark (1). Several studies support these findings (9;11;26-28). Prevention of hand eczema in the hairdressing trade is a remedy to cause hairdressers to stay in the hairdressing trade for longer than the currently 8.4 years (1) and further to reduce the morbidity in this trade and the very high costs of this occupational disease (29).

Hand eczema among hairdressers is largely preventable. Preventive measures should include a reduction of exposure to irritant and allergenic hairdressing products by substitution of these products to less hazardous variants as well as relevant skin protection legislation (e.g. a requirement that gloves in all sizes should be located by (i) every workstation and by (ii) every sink where wet work is performed in the salon, that glove use should be statutory for all chemical treatments and wet work; the gloves must be hypo-allergenic and be able to hold back hairdressing chemicals).

Although glove use exceeding 2 hours a day is an independent risk factor for hand eczema (10;21-23) the unprotected exposure to wet work, irritants and allergens in this trade is a more significant risk factor (10). As a consequence, the use of suitable protective gloves should be promoted for hair washing as well as for all procedures (i.e. mixing, applying and rinsing off) that could involve skin contact with extreme sensitizers such as hair dyes, bleach and permanent wave solutions.

In order to further reduce the skin exposure to hair dye chemicals (15), hairdressers should cut the costumers' hair before initiating the colouring process. Traditionally, hairdressers colour the costumers' hair prior to cutting it, and as a consequence hairdressers cut newly dyed hair several times a day (Table 2) exposing their skin to hair dye compounds that are released from the hair (15).

In conclusion: the results from this study show that hairdressing is an occupation with a high degree of skin exposure to wet work and allergenic substances, and that hairdressers are very inconsistent in their glove use. This study further demonstrates the need for an increased focus, a raised awareness, and a mind-set change regarding this subject among all stakeholders in the hairdressing trade.

## **ACKNOWLEDGEMENTS**

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**Table 1** Characteristics of the 2918 hairdressers participating in this study. The respondents are described with regard to sex, age and number of years in the hairdressing trade.

	Male N = 125 (4.3%)	Female N = 2793 (95.7%)	Total N = 2918 (100%)
<b>Age</b>			
Mean (range)	38.5 (26-52)	36.3 (22-65)	36.4 (22-65)
Median	39	36	36.5
<b>Number of years in the hairdressing trade</b>			
Mean (range)	10.6 (1-24)	11.3 (1-27)	11.3 (1-27)
Median	10	10	10

**Table 2** Description of the occurrence of potential risk factors for hand eczema among 2918 trained hairdressers; 125 men and 2793 women, who answered a postal questionnaire. The purple bars describe the subject: hand washing, wet hands, and jewellery. The golden bars indicate the question asked. The varying 'n' in the subsamples are due to missing data for the individual items.

	Male hairdressers Total (%)	Female hairdressers Total (%)	All hairdressers Total (%)
<b>Hand washing</b>			
<i>Q: On any normal day at work: how many times do you wash your hands? Do not include washing hair. Please tick one box only.</i>	<i>n</i> = 125 (100)	<i>n</i> = 2786 (100)	<i>n</i> = 2911 (100)
0-5 times a day	45 (36.0)	596 (21.4)	641 (22.0)
6-10 times a day	48 (38.4)	1147 (41.2)	1195 (41.1)
11-20 times a day	27 (21.6)	843 (30.3)	870 (29.9)
More than 20 times a day	5 (4.0)	200 (7.2)	205 (7.0)
<b>Wet hands</b>			
<i>Q: On any normal day at work: for how long are your hands wet? Include cutting of wet hair, washing hair, washing dishes, cleaning in the salon etc. Please tick one box only.</i>	<i>n</i> = 125 (100)	<i>n</i> = 2771 (100)	<i>n</i> = 2896 (100)
Never	0 (0)	3 (0.1)	3 (0.1)
Less than half an hour a day	10 (8.0)	55 (2.0)	65 (2.2)
½-1 hour a day	8 (6.4)	111 (4.0)	119 (4.1)
More than 1 hour but less than 2 hours a day	9 (7.2)	194 (7.0)	203 (7.0)
2-3 hours a day	21 (16.8)	464 (16.7)	485 (16.8)
More than 3 hours but less than 4 hours a day	25 (20.0)	431 (15.6)	456 (15.8)
4 hours or more a day	52 (41.6)	1513 (54.6)	1565 (54.0)
<b>Jewellery</b>			
<i>Q: Do you wear rings when you work? Please tick one box only.</i>	<i>n</i> = 125 (100)	<i>n</i> = 2790 (100)	<i>n</i> = 2915 (100)
Yes, every day	69 (55.2)	1921 (68.9)	1990 (68.3)
Yes, several times a week	0 (0)	118 (4.2)	118 (4.0)
Yes, approximately once a week	2 (1.6)	29 (1.0)	31 (1.1)
Yes, but rarer	2 (1.6)	110 (3.9)	112 (3.8)
No, never	52 (41.6)	612 (21.9)	664 (22.8)
<i>Q: Do you wear bracelets and/or wrist watch when you work? Please tick one box only.</i>	<i>n</i> = 120 (100)	<i>n</i> = 2713 (100)	<i>n</i> = 2833 (100)
Yes, every day	85 (70.8)	1838 (67.7)	1923 (67.9)
Yes, several times a week	3 (2.5)	184 (6.8)	187 (6.6)
Yes, approximately once a week	0 (0)	60 (2.2)	60 (2.1)
Yes, but rarer	7 (5.8)	199 (7.3)	206 (7.3)
No, never	25 (20.8)	432 (15.9)	457 (16.1)

**Table 3** Hairdressing tasks.

<b>Q: How many times have you carried out the following tasks at work during the past week? Please write the number of times or tick the box for each task. If you can't remember, please look at your work slip.</b>						
	<b>Male hairdressers</b>		<b>Female hairdressers</b>		<b>All hairdressers</b>	
	<b>Number of times the past week at work</b>	<b>Did not perform this task N = 125 Total (%)</b>	<b>Number of times the past week at work</b>	<b>Did not perform this task N = 2793 Total (%)</b>	<b>Number of times the past week at work</b>	<b>Did not perform this task N = 2918 Total (%)</b>
<b>Cutting wet hair</b>	N = 111 Range: 1-99 <b>Mean: 40.3</b> Median: 40	3 (2.4)	N = 2276 Range: 1-99 <b>Mean: 36.3</b> Median: 35	73 (2.6)	N = 2387 Range: 1-99 <b>Mean: 36.4*</b> Median: 35	76 (2.6)
<b>Hair washing</b>	N = 109 Range: 2-80 <b>Mean: 26.7</b> Median: 25	5 (4.0)	N = 2252 Range: 1-99 <b>Mean: 27.9</b> Median: 25	86 (3.1)	N = 2361 Range: 1-99 <b>Mean: 27.8</b> Median: 25	91 (3.1)
<b>Scalp massaging</b>	N = 79 Range: 1-50 <b>Mean: 17.9</b> Median: 14	31 (24.8)	N = 1542 Range: 1-99 <b>Mean: 19.9</b> Median: 15	732 (26.2)	N = 1621 Range: 1-99 <b>Mean: 19.8</b> Median: 15	763 (26.1)
<b>Cutting wet hair after any type of hair colouring</b>	N = 102 Range: 1-70 <b>Mean: 15.3</b> Median: 10	10 (8.0)	N = 2106 Range: 1-99 <b>Mean: 14.6</b> Median: 10	219 (7.8)	N = 2208 Range: 1-99 <b>Mean: 14.7</b> Median: 10	229 (7.8)
<b>Full head colouring with permanent hair dye</b>	N = 94 Range: 1-50 <b>Mean: 9.6</b> Median: 8	17 (13.6)	N = 2079 Range: 1-60 <b>Mean: 9.3</b> Median: 8	259 (9.3)	N = 2173 Range: 1-60 <b>Mean: 9.3</b> Median: 8	276 (9.5)
<b>Deep conditioning</b>	N = 68 Range: 1-50 <b>Mean: 8.3</b> Median: 5	40 (32.0)	N = 1367 Range: 1-99 <b>Mean: 7.7</b> Median: 5	918 (32.9)	N = 1435 Range: 1-99 <b>Mean: 7.8</b> Median: 5	958 (32.8)
<b>Highlighting/lowlighting using foil</b>	N = 88 Range: 1-30 <b>Mean: 8.1</b> Median: 6	25 (20.0)	N = 2008 Range: 1-60 <b>Mean: 6.8</b> Median: 5	331 (11.9)	N = 2096 Range: 1-60 <b>Mean: 6.8*</b> Median: 5	356 (12.2)
<b>Colouring of eyelashes and/or eyebrows</b>	N = 56 Range: 1-50 <b>Mean: 5.6</b> Median: 4	55 (44.0)	N = 1945 Range: 1-80 <b>Mean: 5.3</b> Median: 4	391 (14.0)	N = 2001 Range: 1-80 <b>Mean: 5.3</b> Median: 4	446 (15.3)
<b>Root/regrowth colouring</b>	N = 72 Range: 1-20 <b>Mean: 4.9</b> Median: 4	37 (29.6)	N = 1673 Range: 1-60 <b>Mean: 4.5</b> Median: 3	605 (21.7)	N = 1745 Range: 1-60 <b>Mean: 4.6</b> Median: 3	642 (22.0)
<b>Highlighting/lowlighting using a cap</b>	N = 53 Range: 1-20 <b>Mean: 4.7</b> Median: 3	55 (44.0)	N = 1545 Range: 1-40 <b>Mean: 4.5</b> Median: 3	766 (27.4)	N = 1598 Range: 1-40 <b>Mean: 4.5</b> Median: 3	821 (28.1)
<b>Full head colouring with semi-permanent hair dye</b>	N = 72 Range: 1-40 <b>Mean: 5.2</b> Median: 4	38 (30.4)	N = 1380 Range: 1-50 <b>Mean: 4.4</b> Median: 3	890 (31.9)	N = 1452 Range: 1-50 <b>Mean: 4.5</b> Median: 3	928 (31.8)
<b>Permanent waving</b>	N = 51 Range: 1-20 <b>Mean: 3.2</b> Median: 2	58 (46.4)	N = 1611 Range: 1-40 <b>Mean: 3.4</b> Median: 2	713 (25.5)	N = 1662 Range: 1-40 <b>Mean: 3.4</b> Median: 2	771 (26.4)
<b>Full head bleaching</b>	N = 43 Range: 1-20 <b>Mean: 3.4</b> Median: 2	65 (52.0)	N = 627 Range: 1-50 <b>Mean: 2.8</b> Median: 1	1630 (58.4)	N = 670 Range: 1-50 <b>Mean: 2.8</b> Median: 2	1695 (58.1)
<b>Attaching hair extensions using hot adhesives / thermal hair bonding</b>	N = 4 Range: 1-2 <b>Mean: 1.3</b> Median: 1	103 (82.4)	N = 115 Range: 1-10 <b>Mean: 2.0</b> Median: 1	2207 (79.0)	N = 120 Range: 1-10 <b>Mean: 2.0</b> Median: 1	2310 (79.2)

This table describes the number of times a typical hairdressing task was carried out during the past week of work by 2918 hairdressers. Note that in Denmark, a full time hairdresser works a maximum of 37 hours a week divided on 5

days. For each task the hairdressers could write the number of times that the particular task was carried out or tick off 'Did not perform this task'. Respondents who had written '0' were added to the latter category. The following information is provided for each task: the number of respondents who answered the question, the range, the mean, the median and the number and percentage of hairdressers who did not perform the task. The tasks are arranged in sequence of descending order (for all hairdressers, green column).

The means were compared using the t-test; an \* following the value of the total mean indicates that a statistically significant difference ( $p$ -value < 0.05) was found between the mean number of times a particular task was performed among male and female hairdressers.

**Table 4** Glove use among 2918 trained hairdressers (125 men and 2793 women) who answered a postal questionnaire. The golden bars indicate the question asked. The varying 'n' in the subsamples are due to missing data for the individual items.

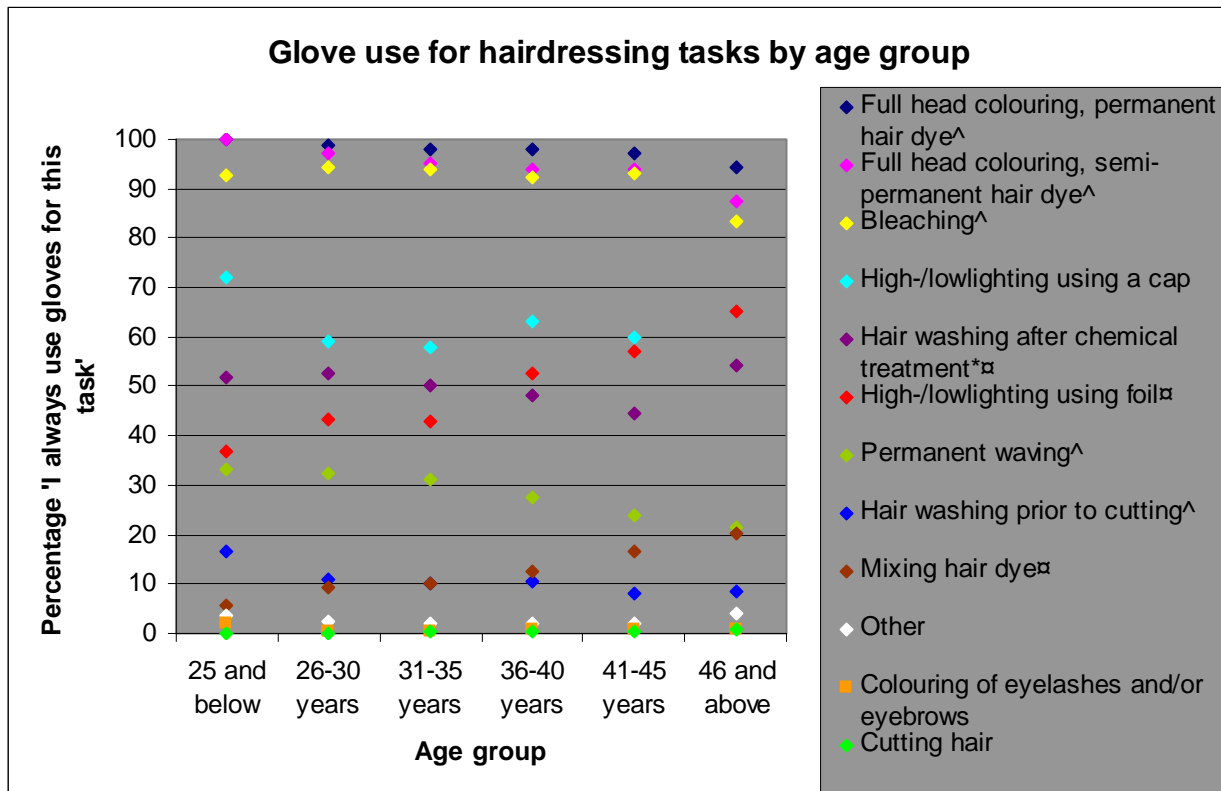
	Male Total (%)	Female Total (%)	All hairdressers Total (%)
<b>Q: Do you use gloves at work? Please tick one box only.</b>	<i>N</i> = 124 (100)	<i>N</i> = 2763 (100)	<i>N</i> = 2887 (100)
Yes	119 (96.0)	2715 (98.3)	2834 (98.2)
No	5 (4.0)	48 (1.7)	53 (1.8)
<b>Q: What type of gloves do you <u>most frequently</u> use at work? Please tick one box only.</b>	<i>N</i> = 109	<i>N</i> = 2441	<i>N</i> = 2550
Vinyl gloves	44 (40.4)	863 (35.4)	907 (35.6)
Latex gloves	30 (27.5)	859 (35.2)	889 (34.9)
Nitrile gloves	28 (25.7)	541 (22.2)	569 (22.3)
Polyethylene gloves	5 (4.6)	48 (2.0)	53 (2.1)
Rubber household gloves	0 (0.0)	20 (0.8)	20 (0.8)
Other	0 (0.0)	41 (1.7)	41 (1.6)
Do not know	2 (1.8)	69 (2.8)	71 (2.8)
<b>Q: For how many hours a day do you wear gloves at work? Please tick one box only.</b>	<i>N</i> = 119	<i>N</i> = 2678	<i>N</i> = 2797
Less than half an hour a day	18 (15.1)	143 (5.3)	161 (5.8)
½-1 hour a day	34 (28.6)	514 (19.2)	548 (19.6)
More than 1 hour but less than 2 hours a day	39 (32.8)	905 (33.8)	944 (33.7)
2-3 hours a day	23 (19.3)	865 (32.3)	888 (31.7)
More than 3 hours but less than 4 hours a day	4 (3.4)	186 (6.9)	190 (6.8)
4 hours or more a day	1 (0.8)	65 (2.4)	66 (2.4)

**Table 5** Of the 569 respondents who report not to take a new pair of gloves every time, 564 answered the question on turning gloves in-side out before re-using them.

<b>Q: Do you turn your gloves in-side out and re-use them? Please tick one box only</b>	<b>N = 564 Total (%)</b>
Yes, every time	104 (18.4)
Yes, more than half the time	43 (7.6)
Yes, approximately half the time	43 (7.6)
Yes, but less than half the time	38 (6.7)
No, never	336 (59.6)



**Figure 1** The percentage of glove use for each hairdressing task among hairdressers divided into 6 age groups. A  $\chi^2$  trend test was performed to examine whether there was a difference in glove use for each hairdressing task between the age groups. A significant difference between the age groups was seen for 8 out of 12 treatments; for hair washing after chemical treatments, high-/lowlighting using foil, and mixing hair dye the glove use improved with age. For full head colouring with either permanent or semi-permanent hair dye, bleaching, permanent waving, and hair washing prior to cutting the use of gloves decreased with age.



\* chemical treatments defined as any type of hair colouring and permanent waving

<sup>^</sup>  $p(\chi^2 \text{ trend}) < 0.05$  indicating a negative association with age

<sup>α</sup>  $p(\chi^2 \text{ trend}) < 0.05$  indicating a positive association with age

**Table 6** Usage of gloves for hairdressing tasks among 119 male and 2715 female respondents who report to use gloves at work. Multiple answers were possible. Glove use for the individual hairdressing tasks were compared among male and female hairdressers using Fischer's exact test. A *p*-value of < 0.05 was considered significant.

<i>Q: For what treatments do you <u>always</u> use gloves?</i>	<b>Male N = 119 Total (%)</b>	<b>Female N = 2715 Total (%)</b>	<b>Total N = 2834 Total (%)</b>
<b>Full head colouring with permanent hair dye</b>	114 (95.8)	2656 (97.8)	2770 (97.7)
<b>Full head colouring with semi-permanent hair dye</b>	107 (89.9)	2577 (94.9)	2684 (94.7) <sup>†</sup>
<b>Bleaching</b>	111 (93.3)	2524 (93.0)	2635 (93.0)
<b>Highlighting/lowlighting using a cap</b>	47 (39.5)	1668 (61.4)	1715 (60.5)*
<b>Highlighting/lowlighting using foil</b>	44 (37.0)	1364 (50.2)	1408 (49.7) <sup>§</sup>
<b>Hair washing after hair colouring or permanent waving</b>	58 (48.7)	1327 (48.9)	1385 (48.9)
<b>Permanent waving</b>	33 (27.7)	769 (28.3)	802 (28.3)
<b>Mixing of hair dye</b>	19 (16.0)	337 (12.4)	356 (12.6)
<b>Hair washing prior to cutting hair</b>	13 (10.9)	269 (9.9)	282 (10.0)
<b>Other</b>	4 (3.4)	60 (2.2)	64 (2.3)
<b>Colouring of eyelashes and/or eyebrows</b>	1 (0.8)	20 (0.7)	21 (0.7)
<b>Cutting hair</b>	1 (0.8)	11 (0.4)	12 (0.4)

<sup>†</sup> Fischer's exact, *p* = 0.022

\* Fischer's exact, *p* < 0.0001

<sup>§</sup> Fischer's exact, *p* = 0.003

**Table 7** Glove use for individual hairdressing tasks and the correlation with hand eczema. Analysis (i) compared hairdressers with recent hand eczema with all other hairdressers (regardless of hand eczema status). This analysis is referred to as '(i) Recent vs. all other' in the table. Analysis (ii) compared hairdressers who had ever had hand eczema with hairdressers without hand eczema. This analysis is referred to as '(ii) Ever vs. never' in the table. The analyses were carried out as separate two by two tables for the individual hairdressing tasks.

<i>Q: For what treatments do you <u>always</u> use gloves?</i>	<i>p; OR; (CI)</i>
<b>Hair washing prior to cutting hair</b>	
- (i) Recent vs. all other	<0.0001; 3.58; (2.72-4.74)
- (ii) Ever vs. never	<0.0001; 2.38; (1.85-3.06)
<b>Hair washing after hair colouring or permanent waving</b>	
- (i) Recent vs. all other	0.034; 1.26; (1.02-1.56)
- (ii) Ever vs. never	0.027; 1.18; (1.02-1.38)
<b>Permanent waving</b>	
- (i) Recent vs. all other	0.007; 1.36; (1.09-1.71)
- (ii) Ever vs. never	0.021; 1.22; (1.03-1.44)

## 8 COMMENTS AND CONSIDERATIONS ON METHODOLOGY AND VALIDITY

This section includes additional comments and considerations on methodology and validity that are either not presented or presented very superficially in the three manuscripts.

### 8.1 STUDY DESIGN

This thesis relies on a register-based questionnaire study performed among trained hairdressers in Denmark. The study was approved by the Danish Data Protection Agency.

In May 2009, a self-administered questionnaire was sent to all students from public hairdressing vocational schools who graduated between 1985 and 2007. An introductory letter and a pre-paid return envelope were included with the questionnaire. Two reminders were subsequently sent to non-respondents.

#### *8.1.1 Comments and considerations on study design*

The questionnaire-based study design was chosen in order to retrieve information that was not available from any registers about exposure, working habits, reasons for leaving the trade etc. In addition, the questionnaire would provide a more realistic description of the prevalence of hand eczema among hairdressers than would any of the available registers: in Denmark, consultations with general practitioners and private practising dermatologists are not registered with regard to diagnosis in an accessible register, so a register-based diagnose for hand eczema would originate from either hospital records or the National Board of Industrial Injuries.

The postal questionnaire was chosen instead of a web-based version mainly due to considerations about the response rate. Several studies have shown an increased response rate in postal questionnaires when compared to internet based versions of the same questionnaire (67-69). A combination of a postal questionnaire and a web-based version might have provided an even higher response rate (69;70).

### 8.2 DATA FROM REGISTERS

In order to perform this study information from several registers was used.

The Danish Hairdressers' and Beauticians' Union (representing the employees) and the Danish Organization for Independent Hairdressers and Cosmeticians (formerly known as The Danish Hairdresser Association, representing the employers) have a joint committee that administers all diplomas issued for hairdressers trained at the public hairdressing vocational schools. This joint committee provided information (name, CPR number and year of graduation) on all the graduates. The CPR number (Central Person Registration number) is a unique identification number that has been issued to every resident in Denmark since 1968. The CPR-number is issued at birth, or upon receiving right to residency, and contains information on the person's sex and birth date (date, month and year). It is used in everyday life for contact with public authorities, the health-care system, banks, insurance companies etc.

Information on hairdressing graduates from 1988–2007 was obtained in excel-files. The information on the graduates from the years 1985–1987 was not available electronically and had to be typed manually by the chief investigator (SHL).

In addition, address information on researcher protected individuals was obtained from the two hairdressing unions (cf. Chapter 8.3.1).

Based on the CPR number of every hairdressing graduate, information on vital status and current postal addresses was provided from the Central Person Registration Office. In addition, the Labour Market Supplementary Pension Scheme (the ATP register) provided information on the annual affiliation to the hairdressing trade for every individual in the cohort. The Labour Market Supplementary Scheme is a mandatory Danish pension scheme where all employers have to pay a monthly contribution for every employee above the age of 16 years. Each trade has a unique code. A description of the trade-specific code for every year (from the year the respondent turned 16 years until 31 December 2007) was received from this register for every individual in the cohort. For all ex-hairdressers the number of years with the trade-specific code were added in order to calculate the mean number of years in the hairdressing trade.

#### *8.2.1 Comments and considerations on information received from registers*

The information received from the Unions' Joint Committee was not associated with the individual hairdresser's affiliation with either of the two unions. This is beneficial to this project as selection bias could have occurred if only union members had been included.

Every person in Denmark has the right to restrict the Central Person Registration Office from providing information on their current address to researchers ('researcher protection'). A substantial proportion of hairdressers exercised this right and this may have led to selection bias (cf. Chapter 8.3.2).

The data from the Labour Market Supplementary Pension Scheme are flawed because it is mandatory only for the employers to contribute on behalf of their employees, whereas it is voluntary for the employers to contribute on their own behalf. Thus these individuals would not appear with the code specific for the hairdressing trade and would therefore not contribute to the calculation of the mean number of years in the trade. This percentage of ex-hairdressers who were self-employed and who did not contribute to the pension scheme is unknown. This may have led to an underestimation of the mean number of years spent in the hairdressing trade before leaving it. If the number of years in the hairdressing trade had been addressed in the questionnaire this drawback could have been avoided. However, the result from this study is consistent with the result from a Danish report published in 1999 (71) for the Joint Committee in the hairdressing trade. The report describes the reasons for leaving the hairdressing trade and found that hairdressers stay in the trade for an average of 9 years.

### 8.3 STUDY POPULATION

#### *8.3.1 Delineation of the cohort size*

The study population consisted of all hairdressers who graduated from the public vocational schools during 1985–2007. The information on the graduate hairdressers was available only in hand written books up until 1987 and therefore had to be typed in manually. As this was very time consuming, 1985 was set as the lower limit. The year 2007 was set as the upper limit because the data from the Labour Market Supplementary Pension Scheme were available only up until that point.

Overall, information was obtained on 8831 hairdressers. According to the data from the Central Person Registration Office 38 CPR numbers were invalid (Figure 2) and 307 were inactive (i.e. the individual was either dead or had emigrated). Of the remaining 8486 hairdressers, more than 20% (1906 individuals) had chosen to be researcher protected. As a consequence, the Central Person Registration Office was not permitted to provide their addresses. Following an approval from the Data Protection Agency, all the researcher protected individuals were manually traced in the union member registers. This provided addresses for 1260 individuals who either were or had been members of either of the two unions.

Thus the cohort consisted of 7840 trained hairdressers.

The CPR number identifying each hairdresser was replaced by a serial number (0001–7840) as the unique identifier.

### *8.3.2 Characterization of researcher protected individuals*

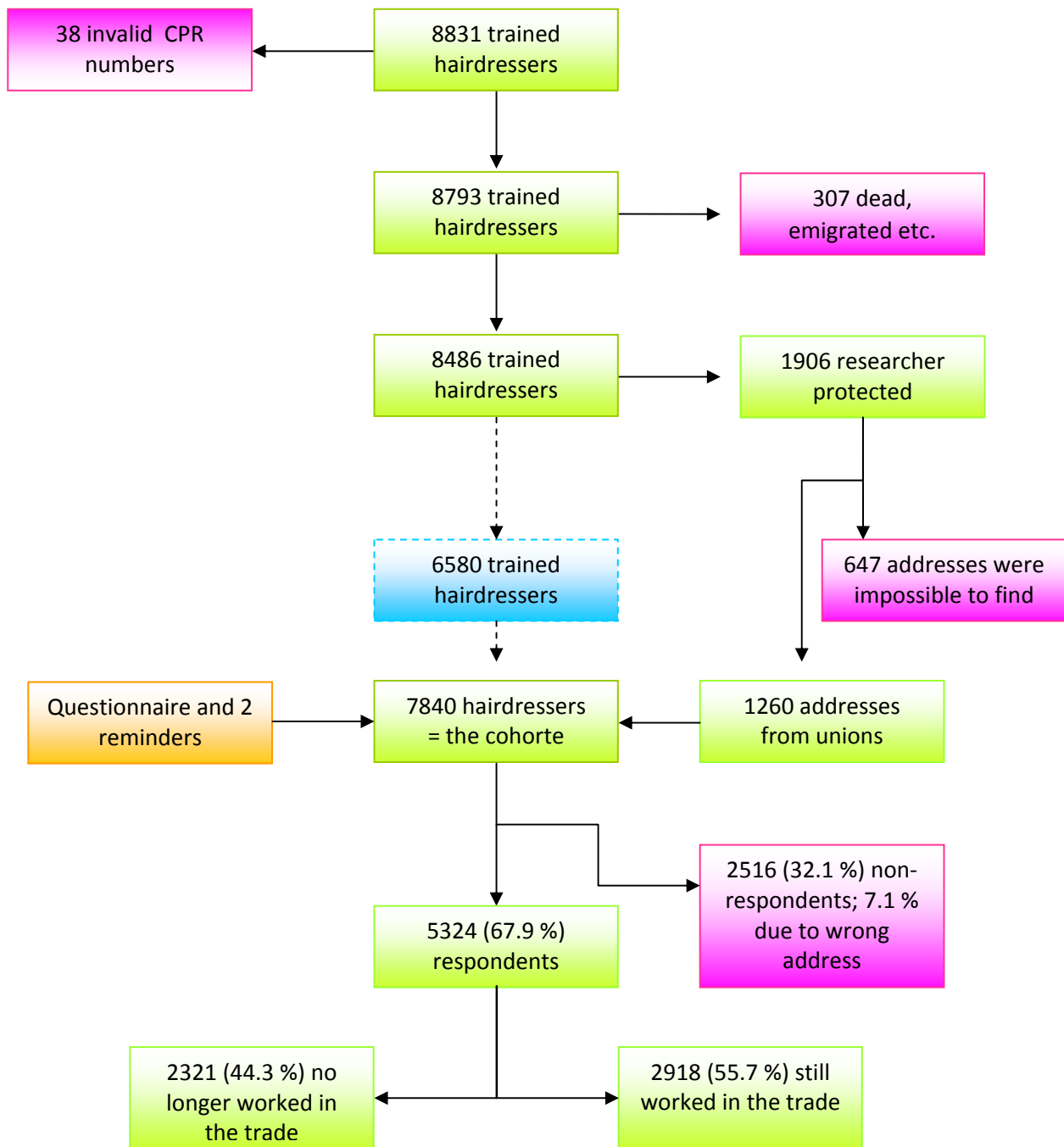
Whereas the non-respondents are characterized in the individual manuscripts the researcher protected individuals have not been described in detail. This group consists of the remaining 647 individuals who were not listed in the union member directories as described above. There were significantly more men (13.1%, n=85) in this group compared to the study population (4.3%) ( $p < 0.0001$ ; OR 3.39; CI (2.60-4.41)). The mean age was 38.8 years and this group was therefore significantly older than the respondents (mean age 36.4 years) ( $p < 0.0001$ ; 95% CI for the mean difference (-2.34;-1.385)). The geographic distribution of this group differed significantly from the respondents' with more people living in Region Zealand and in the Capital Region of Denmark and fewer people living in the three remaining Danish regions. According to the ATP data 572 (91.7%) of the researcher protected individuals no longer worked in the hairdressing trade.

### *8.3.3 Comments and considerations on the study population*

The study population comprised all graduates from public hairdressing vocational schools in Denmark during 1985–2007. The only exclusion criteria were emigration or death. Thus the study population reflected the hairdressing population in Denmark regardless of sex, age, ethnicity, geographic distribution or affiliation to hairdressing unions.

When comparing respondents with non-respondents, analyses detected a significant difference regarding the sex ratio and affiliation to the trade. A slight difference was also found in the geographic distribution as well. Accordingly, women, persons still working in the trade, persons living outside the capital region, and persons of slightly younger age were more likely to answer the questionnaire.

However, the response rate was relatively high (67.9%) and created a cohort of 5324 trained hairdressers of whom 5239 gave information on current occupation. The size of the study population increases the precision of the study results and reduces the risk of selection bias. The results extracted from this study are considered to be representative of the hairdressing trade in Denmark.



**Figure 2** Flowchart describing the delineation of the cohort size.

## 8.4 THE QUESTIONNAIRE

The questionnaire was developed by the chief investigator (SHL) in cooperation with the supervisors of the project. The final version of the questionnaire consisted of 147 questions and was divided in 12 categories as described in the following table (Table 1):

**Table 1** A description of the categories in the questionnaire.

<b>CATEGORY</b>	<b>QUESTIONS REGARDING:</b>
<b>At work</b>	Wet work, weekly number of hairdressing treatments performed, use of gloves and local exhaust ventilation
<b>The hairdressing trade</b>	Reasons for having left /considering leaving the trade (working hours, salary, health complaints, psychological working environment)
<b>Your skin</b>	Atopic dermatitis, self-reported hand eczema, the report of hand eczema as an occupational disease to the authorities
<b>Your health</b>	Height, weight, respiratory tract symptoms, use of in vitro fertilization
<b>Questions for women</b>	Menstrual cycle, abortions and pregnancies.
<b>Asthma</b>	Self-reported asthma, report of asthma as an occupational disease
<b>Allergies</b>	Known allergies, allergy testing and positive reactions
<b>Hair colouring</b>	Personal use of hair dyes
<b>Smoking</b>	Personal use of tobacco
<b>Alcohol</b>	Personal use of alcohol
<b>Decoration of your body</b>	Tattoos, black henna tattoos, piercings
<b>You and your family</b>	Respondents' family and financial situation

The results in the three manuscripts are based mainly on answers to the questions described below.

Previously validated questions concerning self-diagnosed hand eczema were adapted from the Nordic Occupational Skin Questionnaire (NOSQ-2002) (72). The main questions used were: 'Have you ever had hand eczema?' (question D1, NOSQ-2002), 'How often have you had eczema on your hands, wrists or forearms?' (question D4, NOSQ-2002), 'When did you last have eczema on your hands, wrists or forearms?' (question D5, NOSQ-2002), and 'What was your occupation when the eczema started?' (question D8, NOSQ-2002). Questions D4 and D5 were asked without the phrase 'wrists or forearms'. To avoid text variables, response categories were given for questions D8.

The following questions were adapted from the Copenhagen Hairdresser Studies (24;73): '*Do you use gloves at work?*', '*Do you take a new pair of gloves every time?*' and '*Do you turn your gloves inside out and re-use them?*'.

To define atopic dermatitis among the respondents, questions from the U.K. Working Party's diagnostic criteria were used. The criteria are based on the Hanifin and Rajka criteria (74). To qualify as having atopic dermatitis a respondent must meet one major criterion ('*Have you ever had an itchy skin condition?*') and a minimum of two of four minor criteria: onset under the age of 2 years; flexural, neck or facial involvement; a personal history of hay fever or asthma; and a history of generally dry skin (75-78).

Lastly, the questions concerning health reasons for leaving the hairdressing trade (cf. appendix in Manuscript I), the report of hand eczema as an occupational disease to the authorities (Manuscript II ‘*Is your hand eczema reported as an occupational disease?*’), glove use for specific hairdressing tasks and the number of daily hairdressing tasks performed during the past week at work (cf. golden bars in tables in Manuscript III) were constructed for this study.

#### *8.4.1 Validation of the questionnaire*

The questionnaire validation process is illustrated in Figure 3. Initially, a preliminary questionnaire study was carried out in 2007 by the Research Centre for Hairdressers and Beauticians among 1679 hairdressers in Copenhagen (24;73). Several questions used in the Copenhagen Hairdresser Studies were revised and subsequently used in the present studies.

The questionnaire was developed by the chief investigator (SHL) and supervisors. Individual experts, e.g. in the fields of smoking and alcohol, were involved in this process. The pre-test was performed among peers and they evaluated the questionnaire with regard to wording, structure, flow and response categories. On the basis of their comments the questionnaire was revised and subsequently pilot-tested among 19 trained hairdressers. Telephone interviews were performed after the respondents had answered the questionnaire. Aspects such as comprehension, ease of completion, relevance, layout and time spent filling in the questionnaire were commented upon. A second revision of the questionnaire was carried out based on the results from the pilot-test. A peer-review was conducted before the final version of the questionnaire was completed.

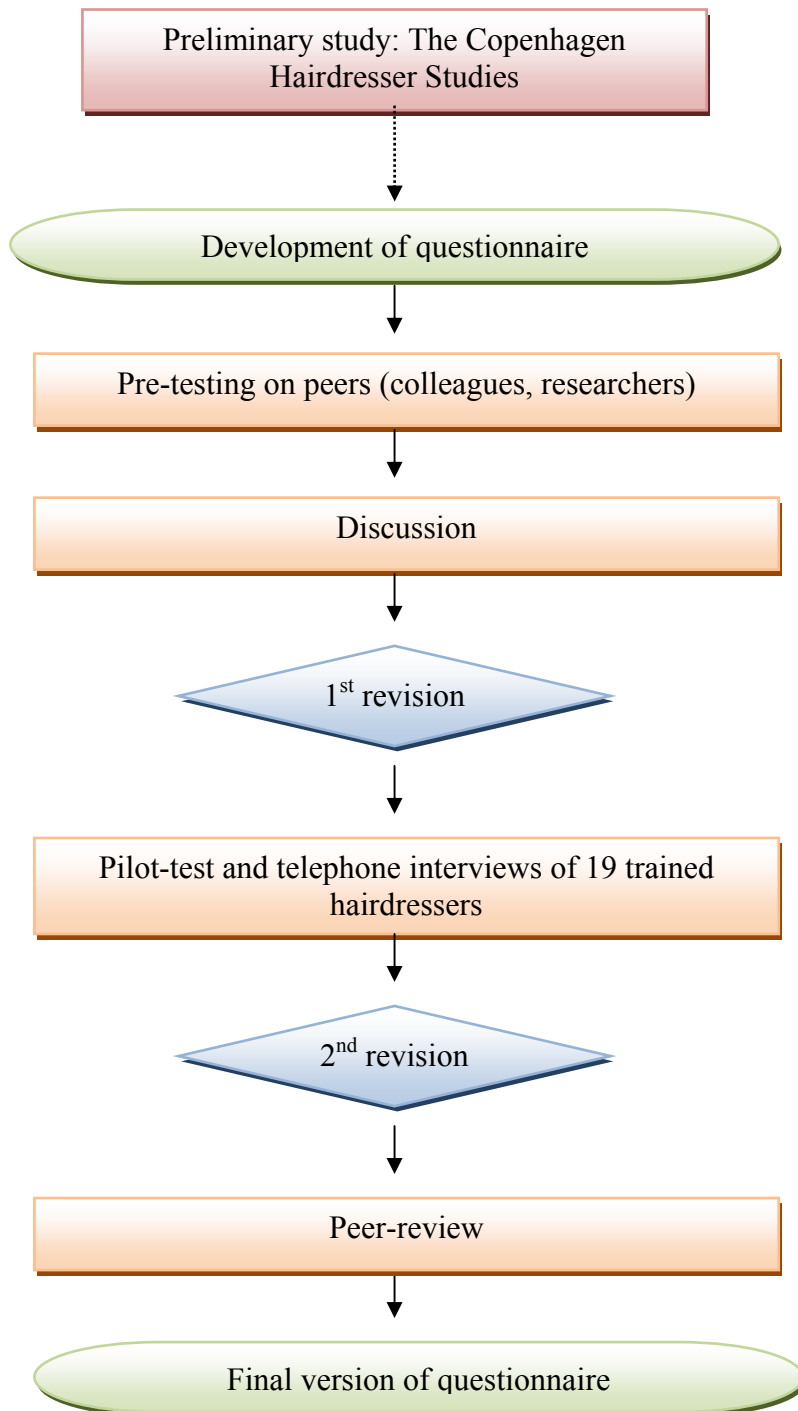
#### *8.4.2 Measures taken to increase response rate*

To increase the response rate, a personal letter with a pre-paid return envelope was sent to each respondent with the questionnaire. The letter briefly explained the purpose of the study and why it was of great importance to answer the questionnaire even if the respondent no longer worked in the trade. A considerable amount of effort was put into making the questionnaire look appealing to the hairdressers. With the assistance of a graphic designer, the cover was made almost magazine-like (Figure 4). The first reminder was sent to non-respondents 2–3 weeks after the questionnaire. It was a custom-made postal card with a standardized text. The image was the same as on the questionnaire (Figure 5). A second reminder was sent to non-respondents 2–3 weeks after the first reminder. The second reminder consisted of the questionnaire, a pre-paid return envelope and a personal letter. Finally, there was a draw among all respondents for 20 gift certificates (500 DKK/ 67 Euros a piece).

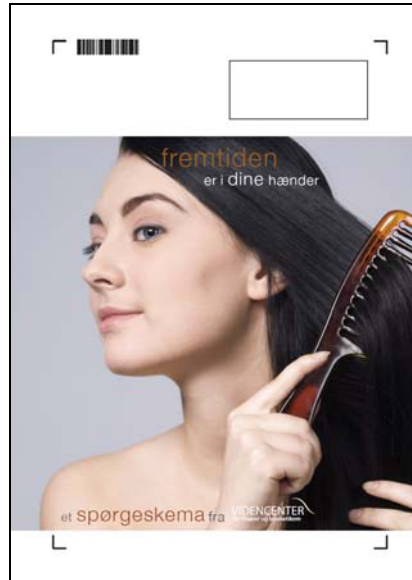
#### *8.4.3 Comments and considerations*

The questionnaire was large and consisted of 147 questions. Due to the size of the questionnaire reliability should have been checked. It took approximately 30 min to answer the questionnaire, which may have tired some respondents; consequently, the answers at the end of the questionnaire may have been less precise. However, a considerable amount of effort was put into making the questionnaire comprehensible and easy to answer for the hairdressers: the majority of the questions had response categories that could be easily be ticked off. In addition, the response categories for the questions constructed especially for this questionnaire had been discussed in detail with hairdressers to make them as relevant as possible. Even though experts recommend avoiding extended use of skipping and branching patterns (indicated by ‘go to’ instructions or arrows) when





**Figure 3** Questionnaire validation process.



**Figure 4** The front page of the questionnaire.



**Figure 5** The front and back of the postcard that served as the first reminder.

constructing a questionnaire (79), this was used when relevant in order to secure that respondents answered only questions that were relevant to them.

The validation process could have been elaborated. Ideally, an additional pilot study should have been performed where a sample of e.g. 100 hairdressers received and filled in the questionnaire. If the data had been entered and analysed according to the research hypotheses some additional changes could have been made.

The questions used for this questionnaire were a combination of both previously validated questions and questions constructed especially for this purpose. Both constitute separate challenges and considerations, some of which are elaborated in the following section.

The main focal point of this study was the occurrence of hand eczema among hairdressers. Due to the size of the study a clinical diagnosis was not obtainable and the diagnosis had to rely on either a register-based diagnosis or self-diagnosed hand eczema. However, the prevalence of hand eczema would be grossly underestimated with a register-based diagnosis since only a percentage of hand dermatoses are recorded in registers available for research.

Self-reported hand eczema (*'Have you had...?'*) is traditionally preferred over symptom-based hand eczema (based on a list of symptoms) in epidemiological studies as it has better predictive values (80). In general, validation studies of self-reported hand eczema yield a high specificity (more than 90%) but a lower sensitivity (less than 70%) (80-82) which indicates that a self-report of hand eczema is more likely to underestimate the true prevalence of hand eczema rather than overestimate it. In a recent validation study by Bregnhøj et al these questions were validated in a group of hairdressing apprentices and a high degree of consistence between the clinical diagnosis and self-reported hand eczema was found (83). These results indicate that self-reported hand eczema is a valid method to estimate the prevalence of hand eczema among hairdressers.

Several questions were constructed for this questionnaire in order to obtain knowledge that had previously not been described. An example is the question: *'how many times have you carried out the following tasks at work the past week?'* A question like this is highly susceptible to recall bias, but by making the period in question relatively short this was thought to be limited. The time of year may be a possible confounder of the answers given to this question: traditionally hairdressers experience busy seasons prior to national holidays such as those at Christmas and Easter and less busy periods during certain weeks during the summer, for example. As the questionnaire was distributed in May/June, this effect is thought to have been eliminated. As this is a cross-sectional study, the answers should be regarded as a snapshot of reality at that particular point with all the variations that normally occur.

As described above, several measures were taken to improve the response rate: a personalized letter, a prepaid return envelope, a questionnaire designed to appeal to the respondents, 2 reminders including a second copy of the questionnaire, and a monetary incentive. In a comprehensive review by Edwards et al of 292 questionnaire trials, all of these approaches improved the response rate of postal questionnaires (84). A response rate of 67.9% was obtained and this was considered satisfactory bearing in mind the size of the questionnaire and the fact that a large proportion of the hairdressers no longer worked in the trade and were therefore less likely to answer.

## 8.5 DATA ENTERING AND VALIDATION

The layout of the individual pages in the questionnaire was done by the National Research Centre for the Working Environment in order to make the questionnaires appropriate for scanning. Every questionnaire was equipped with a barcode and a serial code.

The respondents returned the questionnaires to the Research Centre for Hairdressers and Beauticians where the chief investigator registered the serial codes on the incoming questionnaires to keep track of the response rate and reminders. Finally, the completed questionnaires were delivered to the National Research Centre for the Working Environment for scanning.

On screen, every answer to every question in every questionnaire was manually checked staff at the National Research Centre for the Working Environment according to a verification manual prepared by the chief investigator. This manual contained information on how to handle any discrepancy for every question (for instance if the respondent had ticked off two boxes where only one was allowed). Further, if the staff member registered any inconsistencies between the original paper version of the questionnaire and the scanned version the answers were corrected to match the paper version (for instance if the machine had failed to understand a written number or text). Answers that could not be interpreted correctly (unreadable answers, ticks placed between boxes etc.) were defined as missing values.

The scanned versions of the questionnaires were delivered to the Research Centre for Hairdressers and Beauticians on CD-ROMs including both scanned pictures of every page in every questionnaire and a dataset. The original questionnaires were destroyed.

Each variable was checked for missing data and outlying values by frequency tables. Extensive cross tabulations were conducted to check internal consistency. Values were checked for inconsistencies against the scanned questionnaires.

### *8.5.1 Comments and considerations on data entering*

This method was chosen due to the size of this study. If the data should have been entered manually, several assistants would have been needed compromising the validity. As described above, extensive measures were taken to secure data validity.

## 8.6 DEFINITIONS

### *8.6.1 Wet work*

It is generally accepted that wet work is defined by (i) having wet hands for two hours or more on a regular work day or (ii) using occlusive gloves for two hours or more per day or (iii) frequent cleaning of hands (> 20 times a day) (21;85-87). In this study, the definition of having wet hands was defined as performing the following tasks in the salon without using gloves: cutting wet hair, washing hair, dishwashing and cleaning etc.

### 8.6.2 *Comments and considerations on the definition of wet work*

The definition of having wet hands included cutting wet hair as the hands of the hairdresser are moist during this procedure. Cutting wet hair proved to be the most frequently performed hairdressing task in this study (36.4 times a week), and it may have led to an overestimation of the time spent during a working day with wet hands.

Even though the results of all of the aspects defining wet work (i-iii) are reported in the results section of Manuscript III, the element of having wet hands was the main focal point and was generally referred to as 'wet work'. Excessive hand washing (<20 times a day) was reported by only 7.0% of all hairdressers, and although 40.9% of the hairdressers reported wearing gloves for 2 hours or more a day it is our opinion that the excessive daily skin exposure to water and hairdressing chemicals among hairdressers is of far greater concern than the time spent wearing occlusive gloves. Thus no attempt has been made to combine these exposures to a variable resembling the total amount of wet work among hairdressers.

### 8.6.3 *Hand eczema*

Hand eczema was defined as a positive answer to the question '*Have you ever had hand eczema?*'. Comments and considerations regarding this definition are presented in Chapter 8.4.3.

### 8.6.4 *Glove use*

Glove use for specific hairdressing tasks was defined as wearing gloves every time the particular task was performed.

### 8.6.5 *Comments and considerations on the definition of glove use*

This definition is considered to be more precise than a description such as 'usually' or 'more than half the time'. It might result in an underestimation of glove use, however, because the hairdressers who have an irregular use of gloves are sorted out.

### 8.6.6 *Atopic dermatitis*

Atopic dermatitis was defined according to the U.K. criteria as described in Chapter 8.4.

### 8.6.7 *Comments and considerations on the definition of atopic dermatitis*

The purpose of defining a personal history of atopic dermatitis among the respondents is to characterize dermatitis risk groups, i.e. persons with a history of atopic dermatitis (flexural eczema) or atopic respiratory diseases (allergic rhinitis or asthma). In the Nordic Occupational Skin Questionnaire it is suggested to use the major U.K. criterion only combined with national questions on atopic dermatitis ('*Have you had "flexural/childhood" eczema?*') (72). This procedure is recommended because most Nordic countries have layman's terms that describe atopic dermatitis well (e.g. childhood eczema). However, this procedure has not yet been validated and, additionally it would complicate the comparison of the results found in this study with international publications.

## 9 GENERAL DISCUSSION

This section includes a general discussion of the results presented in the Manuscripts I-III. The methodological comments and considerations are presented in Chapter 8.

### 9.1 HAND ECZEMA AND LENGTH OF CAREER

The results from the three studies comprising this thesis confirm that hand eczema is a considerable problem in the hairdressing trade. A total of 42.3% of the hairdressers reported having had hand eczema, and the majority had had hand eczema several times (Manuscript I). Additionally, the hairdressers were relatively young at hand eczema onset (mean age 21.6 years) and 68.7% were apprentices at the time of hand eczema debut (Manuscript I).

The ex-hairdressers differed significantly from the current hairdressers in that they had a significantly higher lifetime prevalence of hand eczema, developed the disease at a younger age, and reported having chronic hand eczema to a higher extent (Manuscript I). These findings suggest a healthy worker effect in the hairdressing trade. However, it does not exclude hand eczema being an issue for hairdressers currently working in the trade as the one-year prevalence of hand eczema was 22.3% (Manuscript I). The current hairdressers still have a high prevalence of hand eczema compared with the general population (cf. Chapter 2.2) and it indicates that individuals with less severe hand eczema continue to work in the profession.

The results from our study strongly indicate that hand eczema affects the length of career in hairdressers. On average, the ex-hairdressers had been in the trade for 8.4 years before leaving it (Manuscript I), and more than 23% of all the ex-hairdressers participating in our study indicated that hand eczema was a reason for leaving the hairdressing trade (Manuscript I). Among all ex-hairdressers who had ever had hand eczema, however, hand eczema was the predominant reason for leaving the trade (45.5%). The risk of abandoning the profession due to hand eczema increased significantly with severity of hand eczema (Manuscript I).

Other studies have also reported a correlation between hand eczema and leaving the trade (23;25;45;88-90), and as hand eczema is often chronic (Manuscript I;(26;72)) and affects the hairdressers in their prime working age, its impact on both the individual and society is considerable.

Considering the hairdresser training lasts 4 years in Denmark, a career length of 8.4 years is very short. There are several reasons for leaving the trade other than those we have touched upon in this thesis e.g. long hours, low wages and weekend shifts. However, it deserves attention that so many reported hand eczema and other health complaints as a reason for leaving the trade especially considering that the mean age of the ex-hairdressers participating in this study was only 37.7 years.

Our results showed that even though the majority of hairdressers with hand eczema believed that their hand eczema was caused by their occupation, only a minority reported it as an occupational disease to the authorities (Manuscript II). These facts illustrate many hairdressers' perception of hand eczema. *'It goes with the job'*, *'It's a part of the trade and can't be avoided'* and *'I assumed it was a normal side effect for hairdressers'* were common comments given in the questionnaire. However, our results starkly underline the seriousness of the disease: among the ex-hairdressers, the one-year prevalence of hand eczema was 18.6% and the point prevalence was 6.9% (Manuscript I). This illustrates the relapsing nature of hand eczema and adds weight to the point that once

established, occupational hand eczema has a poor prognosis in general (26). What may start as dry patches on the knuckles in winter suddenly ends up being chronic hand eczema (91).

## 9.2 PREVENTION OF HAND ECZEMA

The need for prevention of hand eczema in the hairdressing trade becomes evident from the studies comprising this thesis. The excessive skin exposure on the hands of water, irritants and allergens in the hairdressing trade (Manuscript III;(39)) is largely preventable by stringently establishing appropriate skin protection measures. This may be difficult to implement fully as long as hairdressers regard hand eczema as unavoidable and something that they have to live with, rather than as a legitimate occupational disease. If this mindset persists, the use of protective gloves will be inadequate irrespective of the preventive measures taken.

Thus, it must be assured that hairdressers' knowledge about hand eczema and skin protection is sufficient to enable them to make decisions in their everyday working life that will help them avoid hand eczema. In a study by Nixon et al, only 14.5% of hairdressing apprentices and 12.0% of trained hairdressers correctly identified wet work as a potential skin hazard (26). In our study, very few hairdressers used gloves for hair washing (10%). Additionally, glove use for hair washing was significantly more prevalent in hairdressers with hand eczema (Manuscript III). This may suggest that many hairdressers do not wear gloves for simple hair washing procedures until they develop hand eczema. As a respondent put it: *'Whenever I get hand eczema it just reminds me that I have to remember to use gloves'*.

However, traditional methods for prevention are difficult to implement in the hairdressing trade (92): hairdressers are a very heterogeneous group consisting of employers, employees and apprentices traditionally working in small enterprises. As a consequence several approaches should be used.

There is no doubt that an intensive educational programme as presented by Bregnhøj et al (30) decreases the prevalence of hand eczema among hairdressing apprentices. But even though the apprentices used gloves more frequently than their peers in the control group did throughout the study, the frequency of glove use dropped dramatically when the apprentices were in the salons (30). This underlines that a preventive educational programme should be extended to include all trained hairdressers who work in salons that take in apprentices. It is important that hairdressers adopt preventive strategies at an early point in their career to avoid the development of potentially chronic hand eczema.

Germany has recently established a secondary prevention programme for all occupational hand eczema patients from different wet work occupations (93). The unique feature of this programme is that it is a combination of dermatological consultations and therapy, skin protection seminars with practical exercises, and workplace consultations (93). For the workplace consultations all employees as well as the employer took part. Participation in this intervention strategy has resulted in fewer occupational hand eczema patients leaving their job because of hand eczema (93). Implementing a similar multi step strategy in Denmark for all patients with occupational hand eczema would most likely yield similar results and may also prevent several from getting severe hand eczema. The educational elements of this strategy, as well as the inclusion of colleagues and salon owners, could also be implemented in a primary prevention scheme. The salon owners have a crucial role in successful implementation of preventive measures in the salon, especially because their function is multifaceted, serving as a role model, a tutor and as a boss.

More research is needed to evaluate different prevention strategies for occupational hand eczema in the hairdressing trade. A creative trade such as hairdressing might call for untraditional approaches, but irrespective of the approach, it is important to include all stakeholders in order to increase the focus on occupational hand eczema.

### 9.3 HAND ECZEMA AND ATOPIC DERMATITIS

Several studies have shown that individuals with atopic dermatitis in childhood are more likely to develop hand eczema in adulthood (6;11;12;23;94). Our study showed that the proportion of ex-hairdressers with atopic dermatitis (23.7%) was slightly higher than among the current hairdressers (21.0%) ( $p=0.017$ ) (Manuscript I). Those with atopic dermatitis may have longer lasting hand eczema (4) compared with those without, and this may serve as an explanation for this difference.

Although in the high end, the proportion of atopic dermatitis in both groups was comparable with estimates for the general population which previous studies have reported to be between 15.6 and 23.6% (95-98). The relatively high estimates found in our study might be because the majority of the respondents were female (as are the majority of hairdressers); several studies have reported atopic dermatitis as being more prevalent in women compared with men (95;97;98).

Of all the respondents with hand eczema participating in this study, 38.1% had a history of atopic dermatitis according to the U.K. criteria (Manuscript II). This prevalence is high compared with some studies of occupational hand eczema (6;12;17), whereas Dickel et al found a similar prevalence of 37% (94). However, Lind et al concluded that even though a history of atopic dermatitis increases the individual risk of hand eczema, it is not a major risk factor for hand eczema among hairdressers: the attributable fraction of atopic dermatitis in hairdressers was estimated to be 9.6% in this study (23). This means that only one in ten hand eczema cases could be ascribed to atopic dermatitis. Although Dickel et al found a stronger correlation and reported that 19% of all occupational skin diseases could be ascribed to atopy (94), the results from these studies illustrate that the skin exposure in the hairdressing trade is a strong risk factor for hand eczema, regardless of the atopic disposition. As such, a high-risk strategy consisting of a stereotype exclusion of those with atopic dermatitis from the hairdressing trade seems to be ineffective in terms of primary prevention of hand eczema (21).

In conclusion, the hairdressing trade will continue to be a high-risk occupation for many years to come. The launch of a prevention programme for occupational hand eczema and continuous information on this subject to both hairdressers and other stakeholders in the trade are paramount.



## 10 CONCLUSION

This thesis contributes to the characterization of the hairdressing profession as a trade challenged by a high degree of occupational skin exposure, occupational diseases and career change.

Regarding the aims of this thesis presented in Chapter 3 the following conclusions can be drawn:

- Overall, the lifetime prevalence of hand eczema was 42.3%. The one-year prevalence was 20.7%, and the point prevalence of hand eczema was 7.2%. The lifetime prevalence was significantly higher among ex-hairdressers compared with current hairdressers. Conversely, the one-year prevalence was significantly higher among the current hairdressers. The point prevalence was similar in the two groups (Manuscript I).
- Wet work among hairdressers was excessive: 86.6% had wet hands for 2 hours or more a day and 54% for 4 hours or more. As a consequence, wet work hairdressing tasks, such as cutting wet hair (36.4 times/week) and hair washing (27.8 times/week), were the most frequently performed tasks. Full-head colouring with permanent hair dye was the most frequently performed hair colouring procedure being performed 9.3 times/week. Overall, hair colouring procedures were performed several times a day. More than 93% of the hairdressers used protective gloves for hair dyeing and bleaching procedures, whereas gloves were rarely used for hair washing (10%) (Manuscript III).
- The average length of a hairdressing career was 8.4 years (Manuscript I).
- Among all the ex-hairdressers, the health complaints that most frequently led to a career change were musculoskeletal pain (41.9%) and hand eczema (23.1%). Among all ex-hairdressers who had ever had hand eczema, hand eczema was the predominant reason for leaving the trade (45.5%) (Manuscript I).
- Overall, 84.9% of all the hairdressers with hand eczema believed that their hand eczema was caused or worsened by their occupation. However, in only 20.7% of these was their hand eczema reported as an occupational disease to the National Board of Industrial Injuries. Thus there is considerable underreporting (Manuscript II).
- The main reasons for not reporting hand eczema as an occupational disease to the National Board of Industrial Injuries were 'I thought it would eventually get better' (40.4%) and 'My doctor didn't tell me it was possible to report it' (26.6%) (Manuscript II).

## 11 PERSPECTIVES AND FUTURE STUDIES

This thesis shows that hand eczema is still a very common problem among hairdressers due to excessive skin exposure to wet work and hairdressing chemicals combined with an inappropriate use of gloves. It further underlines the career consequences of both hand eczema and other occupational diseases, thereby illustrating the need for an improvement of the working environment. Consequently, as a solid foundation for prevention, more research among hairdressers is needed to document and map all aspects of the possible occupational health consequences for those working in the hairdressing trade.

The cohort of hairdressers created for this study is unique due to its size and because it consists of all hairdressers trained in Denmark between 1985 and 2007. It provides the opportunity for future studies, not only on hand eczema but regarding all aspects of the possible health implications that hairdressers experience. Future studies could be aimed at mapping the health of the hairdressers using disease registers, e.g., the Danish Cancer Registry, and estimating the possible fertility consequences among hairdressers using both answers from the questionnaire and information from the In Vitro Fertilisation Register. Additionally, a mapping of filaggrin null mutations in these hairdressers would be of great interest in order to clarify the attributable fraction of endogenous factors vs. exposure. Lastly, the same questionnaire study could be performed on a new cohort of hairdressers trained from 2008 onwards to clarify whether the problems illustrated in the present thesis remain.

More information is needed on effective prevention of hand eczema in hairdressers. Future studies of this subject could be qualitative and include interviews, focus-group discussions and observational studies in hairdressing salons to reveal potential barriers for glove use.

The type of gloves used in the hairdressing trade matters. It is important to assure that hairdressing chemicals are efficiently blocked, that the glove itself does not cause allergies, that the hairdressers find it comfortable to wear, and that they have access to it. A consensus in the trade regarding requirements to the type of gloves used would be a giant step in the right direction.

Additionally, future studies should also include more precise assessments of both the skin exposure and the airborne exposure to hairdressing chemicals that hairdressers experience on a daily basis. Measurements of hairdressing chemicals in the blood and urine of hairdressers will provide knowledge about the possible health consequences of these types of exposure.

More research should be aimed at substituting the harmful chemicals in hairdressing products with less harmful chemicals. This would provide less sensitizing products, which would be a benefit to hairdressers, their clients, and all users of cosmetic hairdressing products. Legislation may play an important role in this scenario.

All hairdressers, employers as well as employees, and other stakeholders in the trade need to be aware of the potential health consequences of the trade and to take the necessary precautions. An increased effort should be launched; preventive measures, such as mandatory educational programmes, as introduced by Bregnhøj et al (30), and more effective control in the salons must be implemented. Information is the most important condition for making a better choice.

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