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Degree of employment, sick leave, and costs following notification of occupational contact dermatitis—A register-based study

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Abstract

Background: Occupational contact dermatitis (OCD) is the most commonly recognized occupational disease in Denmark.

Objectives: To examine the impact of recognized OCD on degree of employment, sick leave, unemployment, and job change.

Methods: Data on all recognized individuals with OCD notified in Denmark between 2010 and 2015 (n = 8940) were linked to information on social transfer payments in the years before and after notification. The number of weeks on unemployment benefits or sick leave and the degree of employment during the 2 years prior to notification was compared with the 2 years following notification.

Results: The degree of employment decreased by on average 8.9 work-hours/month, corresponding to an average annual loss of income per worker of approximately €1570. The average number of weeks that workers were receiving unemployment benefits and paid long-term sick leave rose by 2.5 and 3.4 weeks, respectively, corresponding to an average additional annual cost per worker of approximately €420 and €770, respectively. Longer case-processing time was significantly associated with lower degree of employment and higher levels of unemployment and sick leave.

Conclusions: OCD has a significant negative impact on employment and economics, thus highlighting the need for a national, strategic action plan for effective prevention of OCD.

KEYWORDS

allergic contact dermatitis, degree of employment, irritant contact dermatitis, job loss, labor market affiliation, occupational, prognosis, sick leave

1 | INTRODUCTION

Occupational contact dermatitis (OCD) is the most commonly recognized occupational disease in Denmark, comprising around one-third of all recognized occupational diseases.[1] More than 90% of all OCD cases have eczema on the hands.[2,3] The 1-year prevalence of hand eczema in the general population is approximately 10% and twice as high in high-risk occupations such as health care and hairdressing.[4-6]

OCD often has an early onset in life, the average age at debut being 25 to 36 years.[2,7] Furthermore, OCD often debuts during

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training or within the first few months of working in high-risk occupations.[2] OCD is often a chronic relapsing condition with a poor prognosis, and considerable impact on the quality of life and the work-life of the individual.[4,8-10] In Germany, the socioeconomic costs of OCD have been estimated to exceed €1.5 billion.[11] In Denmark, the socioeconomic costs have been suggested to be close to €100 million a year, but this estimate is based on assumptions made more than 20 years ago.[12]

In several countries, different kinds of prevention programs aimed at reducing the burden of OCD have been tested.[11,13-16] Considering the impact of OCD, surprisingly few investigations into the potentially derived inequality in health, and societal and personal costs exist. The aim of this study was to investigate the occupational and socioeconomic consequences of having OCD and to examine the indicators of potential inequality due to OCD using Danish official registers of OCD, sick leave, and social benefits in order to estimate societal costs.

2 | METHODS

Study definitions can be found in Table 1.

2.1 | Study population

The study population consisted of all workers with OCD, who were notified to the Danish Labour Market Insurance (DLMI) from January 1, 2010 to December 31, 2015. Only cases later recognized as being occupational diseases were included in the study population (latest recognition date was December 31, 2018) resulting in 8940 cases.

2.2 | Data from the Danish Labour Market Insurance (DLMI) register

The DLMI register comprises all notified and recognized cases of occupational diseases in Denmark. In Denmark, anyone can notify the DLMI of an occupational disease, whereas doctors and dentists are obliged by law to notify all suspected cases without delay. Almost all notifications are made by doctors. Individuals with suspected OCD are patch tested and examined by a dermatologist. In most cases, the DLMI will ask for a dermatologist's statement as the basis for their case handling. A lawyer, supported by medical specialists, is responsible for the final decision regarding recognition. The main criteria for recognition of OCD are that the disease should present itself with typical symptoms documented in the patient's files by a doctor, and that a relationship in time is established between the OCD and the documented exposures at the workplace, and that these exposures are known to cause contact dermatitis. The contact dermatitis can be recognized as occupational if the above-mentioned criteria are met, and this can result in compensation to the worker. It is possible also to have a worsening of a pre-existing skin disease recognized as a partly occupational disease. The data used in this study were obtained from the DLMI register, and included demographic information such as sex and age at onset, diagnosis, and information on industry of employment. The classification of the industry of employment was based on the Danish Industry Code year 2007 (DB07). The 726 different industries of employment in DB07 were for analysis purposes

TABLE 1 Study definitions

Degree of employment	Number of hours the worker has been working in a given month (work-hours/month).
Case-processing time	The time between notification and recognition. As all doctors are required by law to notify the DLMI at the first suspicion of occupational contact dermatitis (OCD), we use the time between notification and recognition as a proxy for the time between the first visit to a doctor with symptoms of OCD and the final diagnosis. A long case-processing time is therefore indicative of a complex disease and/or that the worker has had a longer way through the medical system. The case-processing time was dichotomized to ≤1 year (short case-processing time) or >1 year (long case-processing time).
Employer sick leave period	The period that a worker is required to be on sick leave before being eligible for paid long-term sick leave. During the employer sick leave period, the worker's sick leave is covered by the employer. Changing legal reforms have resulted in differing employer sick leave periods during the period being evaluated in this study.
Decrease in degree of employment of ≥21 work-hours/month	The 25% of the workers in our study population who experienced the greatest decrease in degree of employment during the 2 years after notification decreased with ≥21 work-hours/month. For this reason, we chose a decrease in degree of employment of ≥21 work-hours/month as the cut-off point when evaluating which occupational groups were most affected by their OCD.
Exceedingly high-risk occupations	Occupations with incidence rates of OCD ≥7 cases per 10 000 workers per year.
High-risk occupations	Occupations with incidence rates of OCD 3–7 cases per 10 000 workers per year.
Self-supporting	Periods of time during which the worker is not given any form of government subsidy.
Unemployment benefits	All forms of governmental subsidies given during periods during which the worker is not employed.
Paid long-term sick leave	Governmental subsidy given during sick leave stretching beyond the initial employer sick leave period.

categorized into 24 main occupational groups with inspiration from the literature.[7,17] Some workers occurred several times in the register, and to avoid duplicates, workers with both a recognized occupational irritant contact dermatitis (OICD) and a recognized occupational allergic contact dermatitis (OACD) were coded as having an OACD.

2.3 | Data from the Danish Register for Evaluation of Marginalization

Data from the DLMI register was transferred to Statistics Denmark, and Statistics Denmark linked the data from the DLMI register to the information from the Danish Register for Evaluation of Marginalization (DREAM) on an individual level. DREAM comprises information on the weekly social transfer payments for all inhabitants in Denmark (such as paid long-term sick leave, disability pension, education grant, unemployment benefits, and maternity pay), and the degree of employment for each month (work-hours/month). Only paid long-term sick leave is registered in the DREAM register. Before being eligible for paid long-term sick leave, the worker must receive sick leave for a set period of time covered by their employer, called the employer sick leave period. Changing legal reforms have resulted in different employer sick leave periods between January 2008 and December 2017. The employer sick leave period was 15 days between April 2007 and June 2008, 21 days between June 2008 and January 2012, and 30 days between January 2012 and ongoing.[18] The length of the employer sick leave period and the reasons for paid long-term sick leave are not registered in the DREAM register. Moreover, the DREAM data included demographic information about sex, origin, citizenship, place of residency (municipality), place of work (municipality), and industry of employment for each month (DB07).

2.4 | Data analysis and statistics

The statistical analyses were made in SPSS version 24. Analyses comprised prevalence proportions (PPs), paired sample *t* test, independent samples *t* test, two-way analysis of variance (ANOVA), and binary logistic regression models. All *P*-values are two-sided, and a 5% level of statistical significance was used. The estimated incidence rates of OCD (cases per 10 000 person-years) according to the occupational groups were calculated based on the average yearly numbers of full-time employees in the various occupational groups between 2010 and 2015. These data were provided by estatistik.dk in March 2020.

In this study, we used the workers with OCD as their own controls, as we compared the degree of employment and the number of weeks self-supporting or on unemployment benefits or paid long-term sick leave in the 2 years after notification with the 2 years before notification of OCD. To avoid misleading results, the following exclusion criteria were applied: death, emigration, maternity leave, or retirement on age pension (public) within 2 years before or after notification of the OCD, or age <18 years 2 years before notification (Appendix S1), leaving 6685 workers for analysis.

Paired sample *t* test was used to compare the degree of employment (work-hours/month) and the average number of weeks that workers were self-supporting, obtaining unemployment benefits, or paid long-term sick leave during the 2 years before and after notification. The changing length of the employer sick leave period during the period of evaluation in this study represented a problem. A worker being on sick leave for 30 days would be registered in the DREAM registry with three different durations depending on when he was sick (15 days if he was sick between January 2008 and June 2008, 9 days if he was sick between June 2008 and January 2012, and 0 days if he was sick between January 2012 and December 2017). In addition, the problem could not be solved by adding the known length of the employer sick leave period to the registered data, as the earlier described worker would figure in the data with 30 days if he was sick between January 2008 and January 2012, and 0 days if he was sick between January 2012 and December 2017. For this reason we decided to compare only the amount of paid long-term sick leave before and after notification of OCD on workers, who had the same employer sick leave period during the 2 years before and after notification—that is, workers with OCD notified between January 2014 and December 2015 (n = 2172).

Two-way ANOVA was used to examine the effect of long vs short case-processing time (duration of time between notification and recognition) on the monthly degree of employment and the number of weeks that workers were self-supporting, obtaining unemployment benefits or paid long-term sick leave during the 2 years after notification adjusted for age and sex. To avoid misleading results because of the changing duration of the employer sick leave period, we compared only the amount of paid long-term sick leave after notification of OCD on workers, with the same employer sick leave period in the 2 years after notification—that is, workers with OCD that was reported between January 2012 and December 2015 (n = 4503).

We found that the 25% of workers with OCD in our data set who had experienced the greatest drop in degree of employment in the 2 years after notification were working on average 21 hours a month less compared to before the notification of OCD. To examine which of the 24 occupational groups experience the greatest drop in degree of employment after notification, a log-binomial regression analysis was performed for each of the occupational groups adjusted for sex and dichotomized age (≤ vs. >35 years) and with all other workers in the data set as the reference group. A decrease in degree of employment during the 2 years after notification of ≥21 or <21 hours was modeled as outcome. The log-binomial regression analysis yielded (adjusted) prevalence ratios (PRs) as risk estimates with accompanying confidence intervals (CIs).

Information on the average number of inhabitants and the average yearly income before taxes in each municipality in Denmark between 2010 and 2015 was provided by Statistics Denmark in February 2020. A linear regression analysis was performed to investigate the relation between the average yearly income before taxes and

the number of OCD cases per 10 000 persons per year in the municipalities of Denmark. The study was approved by the Danish Data Protection Board (no. HGH-2017-093, I-suite no. 05911).

3 | RESULTS

3.1 | Study population

The characteristics of the study population are shown in Table 2. The study population consisted of 67.3% (6020) women and 32.7% (2920) men (female/male ratio approximately 2:1). The mean age at notification was 37.4 years (median 36, quartiles 26–48): 37.2 years for women (median 36, quartiles 26–48) and 37.9 years for men (median 37, quartiles 26–49). Occupational irritant contact dermatitis (OICD) was recognized in 72.6%, whereas occupational allergic contact dermatitis (OACD) was recognized in 27.4%. The majority of workers were Danish (89.6%) and had a Danish citizenship (94.5%).

3.2 | Incidence rates

The prevalence proportion (or PP) of OICD in the study population was 75.0% among women and 67.7% among men, whereas the PP of OACD was higher among men compared to women (32.3% and 25.0%, respectively). The distribution of men and women and the estimated incidence rates of OCD per 10 000 workers per year for the 24 different occupational groups are listed in Table 3. We found 16 occupational groups to be exceedingly high-risk and 4 occupational groups to be high-risk occupations. We found especially high incidence rates among hairdressers (136 per 10 000 workers per year), leather tanning and processing workers (99 per 10 000 workers per year), beauticians (76 per 10 000 workers per year), bakers (59 per 10 000 workers per year), florists (57 per 10 000 workers per year), and glue manufacture workers (52 per 10 000 workers per year).

There was a marked difference in the distribution of men and women in the different occupational groups; for example, 1915 women and 139 men were working in health care, whereas 497 men and 82 women were working as metalworkers. There were more than six times as many men than women working as mechanics, fitters and technicians, craftsmen and builders, and metalworkers, whereas more than 10 times as many women than men were working as hairdressers, beauticians, florists, and healthcare workers. The five most common occupational groups in the data set for men were metalworkers, craftsmen and builders, factory workers, restaurant workers, and sales assistants, whereas the five most common occupational groups for women were healthcare workers, hairdressers, restaurant workers, daycare and nursery workers, and sales assistants.

TABLE 2 Characteristics of the study population: Workers with recognized occupational contact dermatitis and notification date between January 1, 2010 and December 31, 2015 (N = 8940)

Characteristics	Total
Male, % (n)	32.7 (2920)
Female, % (n)	67.3 (6020)
Age ± SD (years)	37.4 ± 12.9
Age ≤35 years, % (n)	48.7 (4357)
Diagnoses	
OICD, % (n)	72.6 (6492)
OACD, % (n)	27.4 (2448)
Case-processing time ± SD (months)	10.6 ± 7.0
Origin	
Danish, % (n)	89.6 (8009)
Immigrant from non-Western country, % (n)	1.1 (98)
Immigrant from Western country, % (n)	0.2 (16)
Descendant from non-Western country, % (n)	6.1 (541)
Descendant from Western country other than Denmark, % (n)	3.1 (276)
Citizenship	
Denmark, % (n)	94.5 (8445)
Non-Western country, % (n)	2.8 (248)
Western country other than Denmark, % (n)	2.8 (247)

Abbreviations: OACD, occupational allergic contact dermatitis; OICD, occupational irritant contact dermatitis; SD, standard deviation.

3.3 | Degree of employment

The average degree of employment during the 2 years prior compared to the 2 years following notification fell from 122.7 to 113.7 work-hours/month (mean difference of 8.9 work-hours/month, 95% CI: 7.8–10.0; $P < .001$; n = 6685). Results are shown in Table 4. In Denmark, the minimum wage was €14.72 per hour in 2015. If the workers in the study population were working at minimum wage, the average annual loss of income per worker was €1570, corresponding to a total loss of income for the whole group (n = 6685) in the 2 years after notification of at least €21 000 000. Estimates of the economic costs of OCD for the individual worker and society are shown in Table 5.

Workers with case-processing time >1 year were on average working 5.5 fewer hours per month (95% CI 2.6–8.3, $P < .001$) adjusted for sex and age in the 2 years after notification than workers with case-processing time ≤1 year (Table 6). This corresponds to workers with case-processing time >1 year earning approximately €970 less per year than workers with case-processing time ≤1 year during the 2 years after notification.

The following occupational groups had a significantly higher risk of working at least 21 hours less per month after notification of an OCD: florists (PR 2.3, 95% CI: 1.02–5.03; $P = .045$), cleaning personnel (PR 2.2, 95% CI: 1.63–2.86; $P < .001$), hairdressers (PR 2.19, 95% CI: 1.64–9.91; $P < .001$), bakers (PR 2.03, 95% CI: 1.39–2.97; $P < .001$), butchers and slaughterhouse workers (PR 1.94, 95% CI:

TABLE 3 The distribution of occupational contact dermatitis according to occupational group, sex, and estimated incidence rates (n = 8940)

Occupation	No. of males with OCD (%)	No. of females with OCD (%)	No. of workers with OCD (%)	Number of full-time employees in Denmark[a]	Estimated rates (cases per 10 000 workers per year)
Hairdressers	<3[b]	>370[b]	374 (4.2)	4590	135
Leather tanning and processing	4 (0.1)	-	4 (<0.1)	67	99
Beauticians	-	21 (0.3)	21 (0.2)	462	76
Bakers	58 (2.0)	110 (1.8)	168 (1.9)	4758	59
Florists	-	45 (0.7)	45 (0.5)	1315	57
Glue manufacture	5 (0.2)	-	5 (0.1)	161	52
Dentists and dental assistants	9 (0.3)	164 (2.7)	173 (1.9)	11 782	24
Restaurant workers	206 (7.1)	354 (5.9)	560 (6.3)	38 939	24
Hotel workers	37 (1.3)	81 (1.3)	118 (1.3)	12 742	15
Butchers/ slaughterhouse workers	71 (2.4)	47 (0.8)	118 (1.3)	14 865	13
Cleaning personnel	65 (2.2)	208 (3.5)	273 (3.1)	38 765	12
Healthcare workers	139 (4.8)	1915 (31.8)	2054 (23.0)	293 636	12
Metalworkers	497 (17.0)	82 (1.4)	579 (6.5)	89 308	11
Mechanics/fitters/ technicians	149 (5.1)	10 (0.2)	159 (1.8)	25 785	10
Food production workers (factory workers)	80 (2.7)	69 (1.1)	149 (1.7)	27 204	9
Agricultural workers/ farmers/gardeners	82 (2.8)	79 (1.3)	161 (1.8)	31 597	8
Daycare/nursery workers	15 (0.5)	316 (5.2)	331 (3.7)	83 704	6
Craftsmen and builders	386 (13.2)	53 (0.9)	439 (4.9)	122 208	6
Sale assistants	205 (7.0)	277 (4.6)	482 (5.4)	137 897	6
Factory workers	235 (8.0)	168 (2.8)	403 (4.5)	117 192	6
Other occupations	488 (16.7)	1254 (20.8)	1742 (19.5)	581 194	5
Postal workers	25 (0.9)	26 (0.4)	51 (0.6)	18 691	4
Teachers	69 (2.4)	241 (4.0)	310 (3.5)	205 095	2
Office workers	93 (3.2)	128 (2.1)	221 (2.5)	275 718	1

Abbreviations: OCD, occupational contact dermatitis.

[a]Information obtained from estatistik.dk, the average number of full-time employees during 2010–2015.

[b]Exact numbers cannot be disclosed due to discretion rules.

1.24–3.01; P = .003), and craftsmen and builders (PR 1.48, 95% CI: 1.15–1.89; P = .002), while healthcare workers had a significantly lower risk (PR 0.62, 95% CI: 0.53–0.72, P < .001) (Table 7).

3.4 | Unemployment benefits

The number of weeks the workers were self-supporting during the 2 years prior compared to the 2 years following notification fell from 81.4 to 73.9 weeks (mean difference of 7.4 weeks, 95% CI: 6.6–8.2; P < .001). In turn, the number of weeks the workers were obtaining unemployment benefits rose significantly from 9.7 to 12.2 weeks (mean difference of 2.5 weeks, 95% CI: 1.9–3.0; P < .001) (Table 4).

There are different degrees of unemployment benefits depending, among other factors, on the age of the worker and if they are the sole provider of their family. A worker over the age of 30 years without children was in 2015 given approximately €1451 a month in unemployment benefits. If, hypothetically, the workers in the study population were all given this standard rate when on unemployment benefits, the average additional annual costs per worker would be €420 during the 2 years after notification compared to the 2 years before notification, corresponding to a total additional societal cost for the whole group (n = 6685) during the 2 years after notification compared to the 2 years prior to notification of at least €5 600 000 (Table 5).

Workers with case-processing time >1 year were self-supporting on average 3.0 weeks less during the 2 years after notification (95% CI: 0.9–

TABLE 4 Paired-samples *t* test examining the average monthly degree of employment, the average number of weeks self-supporting, on unemployment benefits and paid long-term sick leave during the 2 years prior to notification compared to the 2 years after notification of an occupational contact dermatitis (n = 6685)

Variable	Two years prior to notification	Two years after notification	Mean difference (95% CI)
Average monthly degree of employment (work-hours/month)	122.7	113.7	**− 8.9 (−10.0 to − 7.8]**
Average number of weeks self-supporting (weeks)	81.4	73.9	**−7.4 (−8.2 to − 6.6)**
Average number of weeks on unemployment benefits (weeks)	9.7	12.2	**2.5 (1.9 to 3.0)**
Average number of weeks on paid long-term sick leave (weeks)[a]	4.2	7.0	**2.8 (2.1 to 3.5)**

Note: Result in bold were statistically significant ($P < .05$).
[a]Based on the subgroup of workers, who were under the same employer sick leave period reform during the 2 years before and after notification—that is, workers with OCD that was notified between January 2014 and December 2015 (n = 2172).

TABLE 5 Estimates of the economic costs of OCD to the individual worker and society (n = 6685)

Variable	Average per worker per year	Total for the whole group during the 2-year follow-up period after notification (n = 6685 and n = 2171, respectively)
Loss of income, €[a]	1570	21 000 000
Unemployment benefits, €[b]	420	5 600 000
Paid long-term sick leave, €[c]	770	3 300 000

[a]Based on the minimum wage in Denmark in 2015 (€14.72/hour).
[b]Based on the standard rate of unemployment benefits in Denmark in 2015 for a worker without children who is over the age of 30 years (€1451/month).
[c]Based on the standard rate of paid long-term sick leave in Denmark in 2015 (€553/week) and on the subgroup of workers, who were under the same employer sick leave period reform during the 2 years before and after notification—that is, workers with OCD that was notified between January 2014 and December 2015 (n = 2172).

5.1, $P = .004$) adjusted for sex and age compared to workers with case=processing time ≤1 year. Furthermore, workers with case-processing >1 year were on unemployment benefits for on average of 2.7 weeks (95% CI: 1.3–4.1) more during the 2 years after notification than workers with case-processing time ≤1 year. This corresponds to workers with case-processing time >1 year, costing society €450 more per year after notification than workers with case-processing time ≤1 year (Table 6).

3.5 | Paid long-term sick leave

Paid long-term sick leave was registered for 31.9% of the study population (n = 2133) at some point during the 2 years before notification compared to 35.8% of the study population (n = 2396) during the 2 years after notification. The number of weeks the workers were on paid long-term sick leave during the 2 years prior compared to after notification rose from 4.2 to 7.0 weeks (mean difference of 2.8 weeks, 95% CI: 2.1–3.5; $P < .001$; n = 2172) (Table 4).

The standard amount a person on paid long-term sick leave was granted in 2014 and 2015 was €553 a week. If, hypothetically, the

TABLE 6 Two-way ANOVA examining the effect of case processing time >1 year on monthly degree of employment, number of weeks self-supporting, on unemployment benefits and long-term paid sick leave during the 2 years after notification (n = 6685)

Variable	Effect of case processing time >1 year on the variable during the 2 years after notification of OCD (95% CI)[a]	Additional cost per worker per year, €
Monthly degree of employment (work-hours/month)[b]	**−5.5 (−8.3 to − 2.6)**	970
Weeks self-supporting (weeks)	**−3.0 (−5.1 to − 0.9)**	-
Weeks on unemployment benefits (weeks)[c]	**2.7 (1.3 to 4.1)**	450
Weeks on long-term paid sick leave (weeks)[d]	**1.4 (0.4 to 2.4)**	390

Note: Result in bold were statistically significant ($P < .05$).
Abbreviations: CI, confidence interval; OCD, occupational contact dermatitis.
[a]Adjusted for sex and dichotomized age.
[b]Based on the minimum wage in Denmark in 2015 (€14.72/hour).
[c]Based on the standard rate of unemployment benefits in Denmark in 2015 for a worker without children over the age of 30 years (€1451/month).
[d]Based on the standard rate of paid long-term sick leave in Denmark in 2015 (€553/week) and on the subgroup of workers, who were under the same employer sick leave period reform during the 2 years after notification—that is, workers with OCD that was notified between January 2012 and December 2015 (n = 4503).

TABLE 7 Average decrease in work-hours/month and the risk of experiencing a drop of ≥21 work-hours/month in the 2 years after notification of occupational contact dermatitis for the 24 occupational groups (n = 6685)

Occupation	Average decrease in work-hours/month per worker in the 2 years after notification, work-hours/month	No. of workers, with employment decrease ≥21 work-hours/month (%)	Prevalence ratio (95% CI)[a]
Agricultural workers, farmers, and gardeners	14.9	34 (33)	1.3 (0.8–1.9)
Bakers	19.7	49 (43.8)	**2.0 (1.4–2.9)**
Beauticians	9.5	6 (37.5)	1.5 (0.5–4.2)
Butchers and slaughterhouse workers	23.6	33 (38.4)	**1.9 (1.2–3.0)**
Cleaning personnel	18.3	87 (40.8)	**2.2 (1.6–2.9)**
Craftsmen and builders	12.4	110 (33.4)	**1.5 (1.1–1.9)**
Daycare and nursery workers	8.2	54 (22.0)	0.9 (0.6–1.2)
Dentists and dental assistants	14.1	39 (29.1)	1.2 (0.8–1.8)
Factory workers	10.1	77 (22.6)	0.9 (0.7–1.2)
Florists	9.3	11 (44)	**2.3 (1.0–5.0)**
Food production workers (factory)	7.3	26 (21)	0.8 (0.5–1.3)
Glue manufacture workers	2.9	< 5[b]	-
Hairdressers	29.4	93 (44.7)	**2.2 (1.6–2.9)**
Healthcare workers	3.5	276 (18.5)	**0.6 (0.5–0.7)**
Hotel workers	10.5	27 (32.9)	1.3 (0.8–2.1)
Leather tanning and processing workers	0.9	< 5[b]	-
Mechanics, fitters, and technicians	9.0	24 (20.9)	0.7 (0.5–1.1)
Metalworkers	10.7	119 (25.0)	1.0 (0.8–1.3)
Office workers	5.6	35 (19.1)	0.7 (0.5–1.0)
Teachers	4.3	47 (21.4)	0.8 (0.6–1.1)
Postal workers	22.3	12 (27.9)	1.2 (0.6–2.4)
Restaurant workers	6.1	125 (31.2)	1.2 (0.9–1.4)
Sale assistants	4.8	82 (24.3)	0.8 (0.6–1.1)
Other occupations	8.5	319 (22.8)	0.9 (0.8–1.0)

Note: Result in bold were statistically significant ($P < .05$). CI, confidence interval.

[a]Log-binomial regression analysis performed for each of the occupational groups with decrease in employment of ≥ or <21 work-hours/month modelled as outcome. The reference group for the analysis was all other workers. Results have been adjusted for sex and dichotomized age.

[b]Exact numbers cannot be disclosed due to discretion rules.

workers in the study population on paid long-term sick leave were all given this standard rate, this would result in an average annual additional cost per worker of €770 during the 2 years after notification compared to the 2 years before notification, corresponding to a total additional societal cost for the whole group (n = 2172) during the 2 years after notification compared to the 2 years prior to notification of at least €3 300 000 (Table 5).

Workers with case-processing time >1 year were on long-term paid sick leave for on average of 1.4 weeks more during the 2 years after notification (95% CI: 0.4–2.4; $P = .007$) adjusted for sex and age compared to workers with case-processing time ≤1 year (Table 6). This corresponds to workers with case-processing time >1 year costing society €390 more per year after notification than workers with case-processing time ≤1 year. This analysis was based only on the workers who were under the same employer sick leave period reform during the 2 years after notification—that is, workers with OCD who were notified between January 2012 and December 2015 (n = 4503).

3.6 | Job change

The industry of employment (DB07) at the time of notification was known for all the workers in the study population (n = 8940). Two years after notification, the industry of employment (DB07) was known for 4704 of the workers. Of these 4704 workers, 47.9%

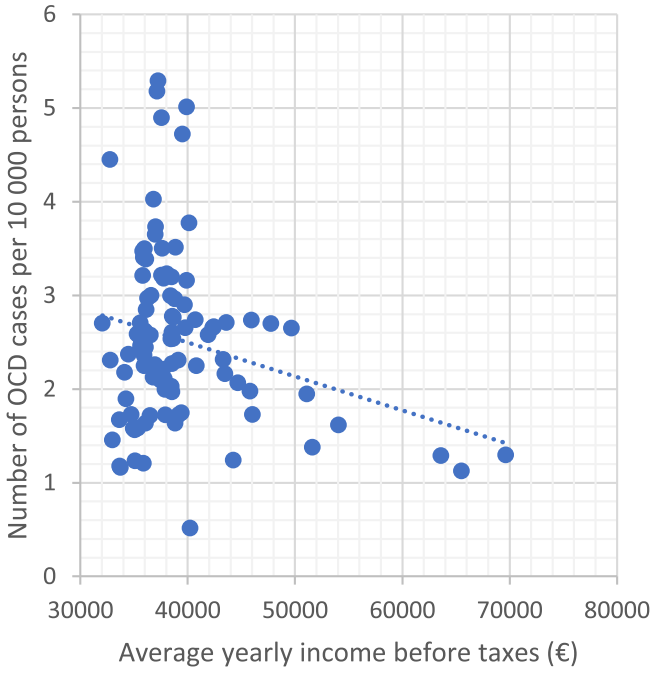

FIGURE 1 Number of OCD cases per year per 10 000 persons in relation to the average income in the municipality (€)

(n = 2255) were employed in the same industry of employment 2 years after notification, whereas 52.1% (n = 2449) were employed in a different or unknown industry. The reason for job change is not known.

3.7 | Inequality in health in relation to OCD

The average yearly income before taxes was compared with the number of OCD cases per 10 000 persons per year in the different municipalities in Denmark using a linear regression analysis. We found that the rates of OCD cases fell, with 0.362 (95% CI 0.074–0.651) cases per 10 000 persons when the average yearly income before taxes rose with €10 000 (P = .014), thus indicating a tendency toward lower rates of OCD in high-income municipalities (Figure 1.).

4 | DISCUSSION

4.1 | Incidence rates

The highest incidence rate in our study was found among hairdressers (135 per 10 000 workers), which was higher than the incidence rate in Northern Bavaria between 1990 and 1999 (97.4 per 10 000 workers),[7] and more than twice as high as the incidence rate among hairdressers found in a Danish study examining the incidence rates in different occupations in 2001–2002 (56.1 per 10 000 workers).[2] This is of major interest, as a prevention program was launched in 2011 in all hairdressing schools in Denmark, based on positive results from an intervention study.[16] However, no actions have been taken to educate employers in the hairdressing trade, which may impair the impact of educating apprentices. Another reason for the higher incidence rate of OCD among hairdressers in Denmark in 2010–2015 compared to 2001–2002 could be that a higher level of attention on work-related skin disease in the hairdressing field has resulted in more cases being notified, or the reason could be different definitions of the number of hairdressers in Denmark in the two studies.

The second highest incidence rate in our study was found among leather tanning and processing workers (99 per 10 000 workers), which was substantially higher than the incidence rate found in Northern Bavaria between 1990 and 1999 (5 per 10 000 workers).[7] Because of the small size of the group of leather workers in this study (4/67), the difference may be due to random variation; however, tanning is an occupation with potentially high risk exposures, for example, to chromium VI, and it is of concern that several cases are seen from such as small trade, indicating lack of proper protection.

Also top-ranking were bakers, florists, and dentists and dental assistants; incidence rates in our study (59, 57, and 24 cases per 10 000 workers, respectively) were twice as high as those in Northern Bavaria between 1990 and 1999 (33.2, 23.9, and 10.8 cases per 10 000 workers, respectively),[7] but were approximately half of the incidence rates in Denmark in 2001–2002 (83.7 cases per 10 000 workers for bakers and 41.8 cases per 10 000 workers for dental technicians; no incidence rates for florists exists).[2] Previously, acrylates were a major source of allergic contact dermatitis in dentist and dental technicians,[19] however, becoming much less after no-touch techniques were introduced. By contrast, no specific prevention programs have been launched in bakers.

The incidence rates among healthcare workers and metalworkers (12 and 11 cases per 10 000 workers, respectively) were comparable with the incidence rates in Northern Bavaria 1990–1999 (7.3 and 9 cases per 10 000 workers, respectively) and in Denmark 2001–2002 (6.8 cases per 10 000 workers for healthcare workers).[2,7]Trends in OCD during the observation period will be the subject of a separate paper.

4.2 | Loss of income

The monthly degree of employment of all the workers fell on average 8.9 work-hours in the 2 years after notification compared to the 2 years prior to notification, corresponding to a yearly loss of income of approximately €1570 per worker. €1570 is a considerable amount for the average worker, and as not all workers are affected, the sum may be even higher. Some of this loss might have been mitigated by either paid long-term sick leave or unemployment benefits, but the subsidies given during paid long-term sick leave and unemployment will always be significantly lower than a worker's previous income. It has earlier been reported that the average delay from onset of OCD to notification to the DLMI is around 4.5 years (median 2 years),[2] so it is reasonable to assume that the degree of employment has been affected by OCD not only in the 2 years after notification, but also in

the 2 years prior to notification. For this reason, the loss of income found in this study is more likely to be an underestimation than an overestimation. In this study, we do not know the reason for the drop in monthly degree of employment, or if OCD was the main driving factor. Meding et al[3] found that the personal economic situation worsened for 32% of workers because of their OCD, and 45% of the workers with worsened personal economy reported a loss of income of 25% or more. Mälkönen et al[20] found similar results, with a worsened economic situation for 23% of OCD patients. It could be considered that the average monthly degree of employment would drop naturally with age, but we confer that this should not be of significance when looking at a 4-year period.

The risk of a decreased degree of employment of ≥21 hours/month after notification differs between the various occupational groups. We found that florists, hairdressers, cleaning personnel, bakers, butcher and slaughterhouse workers, and craftsmen and builders had a significantly higher risk, whereas healthcare workers had a significantly lower risk of experiencing a decrease in degree of employment of ≥21 hours/month. Florists, hairdressers, bakers, and butchers often work in smaller enterprises, where it can be difficult to relocate the worker with OCD to another function, and in particular it can be difficult to find a position with less skin exposures to relocate to. This may also apply to larger enterprises, as exposure to allergens and irritants is tightly linked to core tasks of the trade. Healthcare workers on the other hand often work in a bigger hospital setting where it can be easier to relocate the worker to a different function. Moreover, some healthcare workers may also have a higher level of education making it easier for them to find different work tasks.

4.3 | Sick leave

Workers with OCD were on paid long-term sick leave significantly more weeks (3.4 weeks) during the 2 years after notification compared to the 2 years prior to notification. Only the amount of paid long-term sick leave extending past the employer sick leave period is registered in the DREAM register. A Danish report on the sickness absence of workers in Denmark showed that long-term sickness absence (over 30 days) represents 39% of the total sickness absence in Denmark.[21] Considering this, the amount of sick leave in our study is grossly underestimated. A German study examining the degree of sickness absence during the last 12 months among patients with OCD, showed that 62.9% of the patients had at least one absence day because of OCD during the previous 12 months—the average amount of sickness absence being 76.4 days, whereas 11.5% had extremely long sickness absence of 6 months or longer.[10] Meding et al[3] found in a 12-year follow-up study of patients with occupational skin disease that 48% had been on sick leave for at least one period of 7 days due to their occupational skin disease during the follow-up period. A questionnaire study examining Danish workers with OCD that had been recognized by the DLMI found that 19.9% reported prolonged sick leave of >5 weeks per year due to OCD.[22] The employers are only compensated for long-term sick leave, which means that OCD is a significant cause of production loss, which is a serious negative effect.

4.4 | Job change and unemployment

The number of weeks that workers were obtaining unemployment benefits rose significantly by 2.5 weeks in the 2 years following notification. Furthermore, we found that 52.6% of workers with OCD were employed in a different or unknown industry of employment 2 years after notification. These results are similar to the results found in a Danish study from 2017 where 48.7% of workers with recognized OCD were still in the same profession 5 years after recognition, whereas 32.6% had changed their profession and 18.8% were outside the labor market.[23] We do not know the reason for the change in industry of employment, but it is not unlikely that OCD was a contributing or driving factor. A number of studies have found that ~23–25% of workers with OCD lose their job because of OCD, with 15% ending up unemployed or on disability pension, and 34–82% of workers make occupational changes (most commonly change of job) because of their OCD.[20,22] Among high-risk occupations, the numbers are even worse. In a study from 2011, 44.3% of hairdressers left the hairdressing field after an average of 8.4 years, 45.5% because of hand eczema.[6]

Across studies and countries it is shown that OCD is a cause of unemployment; this affects the worker and their families, as unemployment is linked to impaired mental health.[24] In our study many workers had changed their industry of employment 2 years after notification of OCD. It has been shown that change of work improves OCD; however, it is also associated with a negative impact on the workers' quality of life.[23]

4.5 | Case-processing time

Case-processing time was shown to be significantly related to the monthly degree of employment and the number of weeks on unemployment benefits and paid long-term sick leave. Workers with long case-processing time (>1 year) worked on average 5.5 hours less a month and were on unemployment benefits and paid long-term sick leave for 2.7 and 1.2 weeks more, respectively, than workers with short case-processing time (≤1 year). These results support earlier studies that have found that the time between debut and diagnosis has an influence on the prognosis of the contact dermatitis,[25] and underscore the need for reducing the case-processing time in the future.

4.6 | Inequality in health in relation to OCD

We found that the incidence of OCD correlated negatively with yearly income before taxes, with higher rates in low-income municipalities and lower rates in high-income municipalities, suggesting a social

inequality in the incidence of OCD. These results can be explained by the fact that compared to high-income work, low-income work more often involves wet work and chemical exposures. Furthermore, Noiesen et al[26] showed that individuals with lower socioeconomic status had more difficulty reading cosmetic ingredient labels and, for this reason, had more difficulty complying with the medical instructions. The prognosis has also been described to be poorer among workers with lower socioeconomic status in terms of severity, quality of life, and sick leave.[27-29]

4.7 | Socioeconomic costs

We found that the socioeconomic costs connected with OCD are substantial. The additional costs to society during the 2-year period after notification compared to the 2-year period before notification of unemployment benefits for the whole group of workers (n = 6685) were €5 600 000, whereas it was only possible to calculate the total cost of paid long-term sick leave for a subgroup of the workers because of the changing duration of the employer sick leave period. The total cost for the 2172 workers with OCD notified between January 2014 and December 2015 was approximately €3 300 000. The annual costs per worker with OCD were estimated to be approximately €1200 in socioeconomic costs (€420/year unemployment benefits and €770/year paid long-term sick leave), and approximately €1570 in lost income. These results are not comparable to cost-of-illness studies, as they do not take into account the direct costs of OCD (costs associated with medical care), or the indirect costs (costs associated with loss of productivity due to sick leave). The cost-of-illness of OCD in Denmark has earlier been estimated to €724 in direct costs for the 4 years prior to patch testing and the year after patch testing, with productivity costs for the same period of €10 722.[30] In comparison, the cost-of-illness in Germany has been calculated to be €5358.4 per patient in the year leading up to a 3-week interdisciplinary inpatient rehabilitation (with 80% attributable to indirect costs).[31] This suggests that the total cost of OCD in Denmark is significantly higher than the initial calculations made in this study. Further studies into the cost-of-illness of OCD focusing on the productivity loss due to sick leave and the cost of medical care in Denmark are necessary to completely illuminate the socioeconomic costs of OCD in Denmark.

4.8 | Strength and weaknesses

The strengths of this study are the large size of the study population, comprising all patients with recognized OCD in Denmark between 2010 and 2015, and the use of reliable register data of high quality. Because the DREAM register provides objective measures on social transfer payments, there was no recall bias regarding the degree of employment or the number of weeks on unemployment benefits or paid long-term sick leave.

Although the Danish registers are generally of a high standard, there are well-known limitations in a register-based study. In this study design it is not possible to evaluate the potential causal relationship between OCD and the social benefits, as the reasons for paid long-term sick leave or disability pension are not registered and could be due to a different independent disease. Moreover, not all data relevant for a complete economic analysis was available in the registers. For example, only sick leave extending past the employer sick leave period is registered in the DREAM register, making it impossible to make assumptions about the productivity loss costs, which have earlier been shown to be substantial in OCD cases.[10,30,32] Some costs were estimated using assumptions, as explained above. These assumptions have in general been conservative, making an underestimation of costs more likely than an overestimation.

We did not include a separate control group, but instead the person served as their own control before and after recognition of OCD over a reasonably short period. Having a separate control group could have supported the results further, but would entail a risk that cases would also be present in the control group because all data were handled anonymized. Another problem would be the presence of workers with not-yet recognized OCD in the control group. We believe that the current analysis represents the best possible and conservative estimate of some of the costs of OCD to society and the individual.

4.9 | Conclusion

Occupational contact dermatitis (or OCD) has a significant negative impact on the occupational and economic situation of the afflicted workers and cause substantial costs for society. We found that while the degree of employment falls, the unemployment and sick leave rises after notification of OCD, especially for workers with long case-processing time. Some occupations were high risk and more affected than others. We also found that the duration of the case-processing time is associated with worsened outcome for the worker, indicating a need to lower the case processing time. The case cannot be concluded before a final diagnosis has been made; this is why a speedier diagnosis and treatment may be of benefit. The results of the study highlight the need for a national action plan for effective prevention of OCD, preventing new cases as well as reducing the consequences in those who have acquired the disease.

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AUTHOR CONTRIBUTIONS

Jojo Biel-NielsenDietz: Conceptualization; Data Curation; Formal Analysis; Methodology; Project Administration; Writing-original draf; Writing-review & editing. **Torkil Menné:** Conceptualization; methodology; writing-review and editing. **Harald Meyer:** Writing-review and editing. **Sven Viskum:** Writing-review and editing. **Mari-Ann Flyvholm:** Conceptualization; funding acquisition; writing-review and editing. **Ulrik Ahrensbøll-Friis:** Writing-review and editing. **Swen**

Malte John: Writing-review and editing. **Jeanne Duus Johansen:** Conceptualization; formal analysis; funding acquisition; methodology; project administration; writing-original draft; writing-review and editing.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the Danish Labour Market Insurance Register and Statistics Denmark (DREAM). Restrictions apply to the availability of these data, which were used under license for this study. Data are available from the Danish Labour Market Insurance and Statistics Denmark with the permission of the Danish Data Protection Board.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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Supporting information - Online supplemental information

Appendix 1

Overview of workers excluded from the analysis where relevant.

Reason for exclusion	Number
Death	7
Emigration	64
Age pension (public)	104
Maternity leave	1609
< 18 years of age two years before notification	485