

10-year prevalence of contact allergy in the general population in Denmark estimated through the CE-DUR method

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The prevalence of contact allergy in the general population has traditionally been investigated through population-based epidemiological studies. A different approach is the combination of clinical epidemiological (CE) data and the World Health Organization-defined drug utilization research (DUR) method. The CE-DUR method was applied in Denmark to estimate the prevalence of contact allergy in the general population and compare it with the prevalence estimates from the Glostrup allergy studies. Contact allergy prevalence estimates ranging from very liberal ('worst case') to conservative ('best case') assumptions were based on patch test reading data in combination with an estimate of the number of persons eligible for patch testing each year based on sales data of the 'standard series'. The estimated 10-year prevalence of contact allergy ranged between 7.3% and 12.9% for adult Danes older than 18 years. The 10-year prevalence of contact allergy measured by CE-DUR was slightly lower than previous prevalence estimates from the Glostrup allergy studies. This could probably be explained by a decrease in nickel allergy. The CE-DUR approach holds the potential of being an efficient and easy monitoring method of contact allergy prevalence.

Key words: CE-DUR; contact allergy; contact dermatitis; DUR; fragrance mix; nickel; prevalence clinical epidemiology. © Blackwell Munksgaard, 2007.

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The prevalence of contact allergy in the general population has previously been estimated by population-based epidemiological studies (1–6). Such large studies demand planning as well as resources and are therefore not applicable in all countries. Furthermore, they cannot be repeated frequently to monitor trends in contact allergy.

The drug utilization research (DUR) was defined by the World Health Organization in 1977 as research addressing 'the marketing, distribution, prescription, and use of drugs in a society, with special emphasis on the resulting medical, social and economic consequences' (7). Briefly, this method estimates the number of diseased persons in a population based on information about specific drug prescription and consumption (8, 9). In 2002, the DUR approach was used in combination with clinical epidemiological (CE) data to estimate the prevalence of contact allergy

in Germany (10). The CE-DUR method is mainly based on the total annual patch test sales, which is justified as patch testing is uniquely used for the diagnosis of contact allergy as a cause of allergic contact dermatitis (ACD). The results of the study were largely in accordance with previous epidemiological studies but not directly comparable with prevalence estimates from Denmark because of different medical systems as well as the methods itself.

The Glostrup allergy studies from 1990 to 1998 estimated the prevalence of contact allergy in a general population in Denmark (3, 5). The main objective of the present investigation was to apply the CE-DUR approach in Denmark to estimate the 10-year prevalence of contact allergy and compare it with prevalence outcomes from the Glostrup allergy studies. It is our hope that this will help determine the quality of the CE-DUR

method as it is foreseen to be an inexpensive and rapid future tool for epidemiological monitoring in many countries.

Materials and Methods

The CE-DUR method requires a variety of information and data that should be collected before an adequate prevalence estimate is calculated and presented (Table 1).

Patch test sales data

Information on the total patch test sales data regarding the standard series (the overall number of sold syringes for the Danish standard test series), the TRUE-test (the total number of sold tests containing panel 1 and 2), and methyldi-bromo glutaronitrile (MDBGN) (the number of sold single syringes containing MDBGN) was supplied by the 3 main manufacturers on the Danish market (Mekos Laboratories, Hillerød, Denmark; Hermal, Reinbeck, Germany; and Chemotechnique, Malmö, Sweden). MDBGN is not included in the standard series in Denmark. Sales data were collected for a total period of 4–10 years depending on available company sales data. This was performed to adjust for possible changing trends in the use of patch testing in Denmark over the past decade. However, no consistent trends were found, except for an increased sale of MDBGN since 1998 that has stabilized since 2001.

The number of applications per sold syringe was estimated to be 150, that is 150 patients on average were patch tested until the material in 1 syringe was used up. This number was an average conservative estimate taken from retrospective registrations at the laboratory at Gentofte Univer-

sity Hospital. The estimate offered by scientific staff at Trolab and Chemotechnique was 100 and 120 applications per syringe, respectively. If the hypothetical maximum number of applications per syringe (petrolatum) is calculated (5000 μ l/20 μ l), an estimated 250 applications is possible. Thus, the numbers vary significantly, but we believe that the most accurate estimate is 150 according to local registration. In total, patch test material sufficient to test approximately 25 000 patients/year was sold in Denmark between 1996 and 2005 (Table 2).

Patch test reading data

Patch test outcomes regarding the patch test standard series, MDBGN, and the TRUE-test (except thimerosal) were collected from the Danish Contact Dermatitis Group (DCDG) database. Thimerosal was omitted from our analysis because patch test results for thimerosal were only available for a minority of patients (i.e. patients tested with TRUE-tests). The DCDG network is based on 3 different university clinics as well as 7 local dermatology clinics. This network represents an average clinical (patch test) population in Denmark, and we venture to assume that this is fairly representative of the entire population eligible for patch testing in Denmark. Patch test readings were performed at least on D3 according to the criteria defined by the International Contact Dermatitis Research Group (11). Patients were included in the study based on positive readings on at least 1 day. Patients were included only once in the database. A 5-year period was selected as the database does not go further back (1 January 2001 to 31 December 2005). The patch test outcomes were assessed for Danes of all ages and for

Table 1. The type, source, year span and validity of data, and its resulting correction factor collected for the estimation of the 10-year prevalence of contact allergy in Denmark using the CE-DUR method (10)

Data type	Data source	Period of data collection	Resulting correction factor (%)	Validity of data
National patch test sales data	Chemotechnique, Hermal, and Mekos Laboratories	1997–2006	NA	Good
Patch test reading data	Danish Contact Dermatitis Group database	2001–2005	NA	Good
Proportion of discarded test	Laboratory staff at Gentofte Hospital	2005–2006	2.5 (0–5)	Good
Proportion of diseased persons who seek medical consultation	National Institute of Public Health in Denmark (16)	1987–1994	25 (20–30)	Fair
Persons previously tested	Danish Contact Dermatitis Group database	2001–2005	10 (5–15)	Fair
Magnitude of the Danish population	Statistics Denmark (17)	2006	NA	Good

CE, clinical epidemiological; DUR, drug utilization research; NA, not applicable.

Table 2. Stepwise estimation of number of patients eligible for patch testing, based on the number of patch tests sold annually and published evidence concerning the selection process^a

	Model I – worst-case scenario	Model II – best-case scenario	Model III – medium-case scenario
The number of sold patch tests per year	25 000	25 000	25 000
Correction factor 1: the proportion of discarded patch tests (0–5%)	0%	(- 5%)	(- 2.5%)
The number of actually applied patch tests	25 000	23 750	24 375
Correction factor 2: the proportion of previously tested persons (5–15%)	(- 5%)	(- 15%)	(- 10%)
First time patch tests	23 750	20 188	21 938
Correction factor 3: the proportion of diseased persons who seek medical consultation (20–30%)	/20%	/30%	/25%
Persons eligible for patch testing per year	118 750	67 290	87 750

^aWith model III, a more conservative estimation process, the number of patients eligible for patch testing would be 87 750/year. With model I, a worst-case scenario, the number would be 118 750/year.

adult Danes older than 18 years and were used for the prevalence estimates. This was performed to allow a comparison with results from the German CE-DUR (based on all ages) as well as the Glostrup allergy studies (based on adult Danes). However, as the contact sensitization prevalence estimates to individual allergens hardly differed between the 2 groups of calculations (i.e. 'all ages' and 'adults older than 18 years'), the estimate for adult Danes has only been stated when it was specifically needed for comparison with the Glostrup allergy studies.

The proportion of discarded patch test

The proportion of purchased patch test that was discarded rather than used for testing was estimated. In the German CE-DUR investigation, it was assumed that 10–20% of purchased patch test was discarded (10). The experience from the laboratory at Gentofte University Hospital shows that the expiry dates of syringes are never or very rarely lapsed. However, in smaller departments or offices also contributing to the database, this may be the case to some extent. We thus estimated that 2.5% of all purchased patch tests are discarded each year in Denmark. As a consequence, the estimated number of patients patch tested will be lower (Table 2).

The proportion of previously tested persons

Experience from the Department of Dermatology in Göttingen determined that 38% of all patients have been tested on a previous occasion (10). However, according to the DCDG database, only some 15% have been tested previously. This figure is comparable with data (7.9%) published from St John's Institute in London (12). Hence, to establish the number of persons eligible for patch

testing, the patch test sales figures have to be corrected downwards accordingly (Table 2).

The proportion of diseased persons who seek medical consultation

In the German CE-DUR investigation, it was estimated that only 15–38% of patients with ACD consult a physician, based on Swedish and German observations (13–15). 2 consecutive Danish surveys from 1987 to 1994 estimated that approximately 25% of patients with ACD are patch tested (16). Thus, the sales figures have to be corrected upwards (Table 2).

Persons eligible for patch testing per year

The absolute number of diseased persons eligible for patch testing per year was estimated through the use of the above presented information (Table 2), summarized as 3 correction factors, ranging from very liberal assumptions ('worst case') to a combination of the most conservative, in terms of a low number of persons tested, assumptions ('best case'). Applying these correction factors, 3 different scenarios were defined, namely model I (worst case), model II (best case), and model III (medium case).

Population

The Danish population, according to Statistics Denmark, is currently 5 400 000 persons (17). Of these, 1 200 000 are children and adolescents younger than 18 years. Hence, the Danish adult population older than 18 years was 4 200 000 persons.

Prevalence estimation

Population-based, cross-sectional studies such as the Glostrup allergy studies estimate the prevalence

of contact allergy in samples of the population. The morbidity estimate derived from CE-DUR is less straightforward conceptually: although patients are commonly patch tested for *incident* ACD (but sometimes for chronic suspected ACD), the spectrum of contact allergy diagnosed on patch testing does not necessarily relate exclusively to the *current* episode of ACD. Moreover, ACD is far from always confirmed after patch testing, with positive test results relating to past episodes of ACD or having uncertain clinical relevance in these cases. Hence, the contact allergy frequencies derived from patch test databases cannot be interpreted as contact allergy incidence rates. Rather, the CE patch test data and the DUR estimation of the annual number of patients eligible for patch testing can be regarded to represent prevalence, estimated during a sampling period of several years. In this period, which was set to a standard of 10 years in our analysis, 'nearly all' patients from the general population, potentially affected by contact allergy, are assumed to consult and be patch tested. The 10-year prevalence of contact allergy to at least 1 allergen of the respective standard series (and MDBGN) was calculated on the basis of patch test reactions (the percentage of patients with at least 1 positive reaction $\times$ 10 years $\times$ the number of patients eligible for patch testing per year for the different scenarios/the Danish population). For better comparison, the 9-year prevalence from the German study was recalculated to a 10-year prevalence.

Results

Between 2001 and 2005, a total of 14 284 patients were patch tested with the patch test standard series, MDBGN, or the TRUE-test (except thimerosal). Among these, 6299 (44.1%) patients had at least 1 positive reaction (+/++/+++), and 3720 (26%) had at least 1 strong positive reaction (++/+++). The patch test sales figure during the 10-year period was estimated to be 250 000 (25 000/year $\times$ 10 years). After the correction factors were applied to the number of sold patch test, 3 different scenarios of persons eligible for patch testing per year were defined, namely model I (worst case), 118 750; model II (best case), 67 290; and model III (medium case), 87 750. The estimated 10-year prevalence of contact allergy to at least 1 allergen of the respective standard series is presented together with the German prevalence estimates in Table 3 (10). The prevalence of contact allergy among adult Danes older than 18 years ranged between 7.3% and 12.9%, whereas the prevalence estimate for Danes of all

ages ranged between 5.5% and 9.7%. The German CE-DUR investigation showed prevalence estimates between 4.4% and 18.4% based on Germans of all ages. Furthermore, when the Danish estimates were compared with the German CE-DUR estimates, it was observed that best-case estimates were higher in Denmark than in Germany, whereas worst-case estimates were considerably lower in Denmark. The Danish study applied correction factors ranging from 2.69 to 4.75 [i.e. 118 750 and 67 290 persons eligible for patch testing per year divided by 25 000 sold patch test/year (Table 2)], whereas the German model incorporated factors ranging from 1.31 to 5.40, that is allowed for much more diversity of scenarios. Table 3 also presents prevalence estimates of strong patch test reactions (++/+++) in Denmark and Germany and shows that a higher percentage of worst-case strong reactions were observed in the German CE-DUR (9.0% versus 5.7%).

The 10-year prevalences of contact allergy to individual allergens in Denmark and Germany (in all ages) were calculated based on models I (worst case) and III (medium case), including + to +++ and ++/+++ test reactions, respectively, and are presented in Tables 4 and 5. The worst-case scenario showed that nickel was the most prevalent allergen in Denmark as 3.9% (all ages) and 3.7% (adults older than 18 years) positive reactions were estimated. In comparison, the prevalence of nickel allergy in Germany was 6.1% for all ages. Furthermore, the prevalence of contact allergy to cosmetic-related allergens [fragrance mix, colophonium, balsam of Peru, quarternium-15, parabens, wool alcohol, and methylchloroisothiazolinone/methylisothiazolinone (MCI/MI)] was estimated to be 4.5% among adult Danes as opposed to 3.6% among Danes of all ages. In the German CE-DUR, this estimate (without quarternium-15) for all ages showed that 12.7% were contact sensitized. The main contribution to the high German estimate was fragrance mix (4.6%) and balsam of Peru (3.3%). The prevalence of strong patch test reactions to individual contact allergens in Germany and Denmark was most pronounced for nickel (3.3% versus 2%), fragrance mix (1.6% versus 0.7%), balsam of Peru (1% versus 0.2%) and purified protein derivative (PPD) (0.8% versus 0.2%).

Discussion

10-year prevalence estimate

This study estimates that the 10-year prevalence of contact allergy in Denmark is between 5.5% and 9.7% for Danes of all ages and between 7.3% and 12.9% for adult Danes older than 18 years

Table 3. Calculated 10-year prevalence estimates of contact allergy to worst-, medium-, and best-case scenarios for all age groups and for adults >18 years of age in Denmark and for all age groups in Germany

Scenario	10-year prevalence, + to +++ reactions (%) (for adults aged >18 years in Denmark)	10-year prevalence, + to +++ reactions (%) (for all age groups in Denmark)	10-year prevalence, + to +++ reactions (%) (for all age groups in Germany)	10-year prevalence, ++/+++ reactions (%) (for all age groups in Denmark)	10-year prevalence, ++/+++ reactions (%) (for all age groups in Germany)
Worst case	12.9	9.7	18.4	5.7	9.0
Medium case	9.5	7.2	7.7	4.2	3.7
Best case	7.3	5.5	4.4	3.2	2.2

(Table 3). In comparison, the German CE-DUR estimate from 2002, based on all ages, was considerably higher (4.4–18.4%). It has earlier been assessed that the worst-case scenario is most suitable when applying the CE-DUR method, which makes 9.7% and 12.9%, respectively, the most reasonable estimates of the contact allergy prevalences in Denmark (10). The prevalence estimate for adult Danes (12.9%) should be used for comparison with the results from the Glostrup allergy studies because they were also based on adults Danes. The Glostrup studies showed that the con-

tact allergy prevalences in Denmark were 15.2% in 1990 (Danes of age 15–69 years) and 18.6% in 1998 (Danes of age 15–41 years) (3, 5). When a comparison is made between our results and the results from the Glostrup allergy studies, it should be emphasized that the CE-DUR data are based on data from the DCDG database [standard test series, TRUE-test (except thimerosal), and MDBGN], whereas the Glostrup data are based on older versions of the TRUE-test (including thimerosal but not primin, MDBGN, and formaldehyde). In addition, the age difference

Table 4. Selected '10-year prevalences' of contact allergy to allergens in the standard patch test series, MDBGN, and TRUE-test (except thimerosal), tested over a 5-year period (2001–2005) in the Danish Contact Dermatitis Group ($n = 14\ 284$)^a

Allergen/reactions	Population (%)					
	Clinical patients		Model I (worst)		Model III (medium)	
	+/++++	++/++++	+/++++	++/++++	+/++++	++/++++
Nickel sulfate	17.50	9.10	3.85	2.00	2.84	1.48
Fragrance mix	7.70	3.00	1.69	0.66	1.25	0.49
MDBGN	4.90	1.80	1.08	0.40	0.80	0.29
Cobalt chloride	4.50	1.70	0.99	0.37	0.73	0.28
Colophonium	3.80	1.60	0.84	0.35	0.62	0.26
Balsam of Peru	3.50	0.90	0.77	0.20	0.57	0.15
Potassium dichromate	3.30	1.20	0.73	0.26	0.54	0.20
Carba mix	3.30	0.90	0.73	0.20	0.54	0.15
Formaldehyde	3.10	1.10	0.68	0.24	0.50	0.18
<i>p</i> -Phenyldiamine	2.40	0.90	0.53	0.20	0.39	0.15
Thiuram mix	2.30	1.00	0.51	0.22	0.37	0.16
Methylchlorisothiazolinone/methylisothiazolinone	1.90	0.80	0.42	0.18	0.31	0.13
Epoxy resin	1.70	0.80	0.37	0.18	0.28	0.13
Quaternium-15	1.60	0.60	0.35	0.13	0.26	0.10
Neomycin	1.60	0.60	0.35	0.13	0.26	0.10
Sesquiterpene lactone mix	1.50	0.90	0.33	0.20	0.24	0.15
<i>p</i> -tert-Butylphenol-formaldehyde resin	1.50	0.60	0.33	0.13	0.24	0.10
Quinolin mix	1.10	0.40	0.24	0.09	0.18	0.07
Ethylendiamine	1.00	0.60	0.22	0.13	0.16	0.10
Black rubber mix	1.00	0.50	0.22	0.11	0.16	0.08
Wool alcohol	1.00	0.30	0.22	0.07	0.16	0.05
Cliquinol	0.80	0.40	0.18	0.09	0.13	0.07
<i>N</i> -isopropyl- <i>n</i> -phenyl- <i>p</i> -phenyldiamine	0.60	0.30	0.13	0.07	0.10	0.05
Primin	0.60	0.30	0.13	0.07	0.10	0.05
Mercaptomix	0.60	0.20	0.13	0.04	0.10	0.03
Mercaptobenzothiazole	0.60	0.30	0.13	0.07	0.10	0.05
Paraben mix	0.50	0.10	0.11	0.02	0.08	0.02
Benzocaine	0.50	0.20	0.11	0.04	0.08	0.03

MDBGN, methylidibromo glutaronitrile.

^aPrevalences of contact allergy in the general population were estimated on the basis of models I (worst case) and III (medium case) and related to the total Danish population (5 400 000). To address potential diagnostic uncertainties of the positive patch test reactions, the frequencies of unequivocal allergic reactions (++/++) are also presented.

Table 5. Selected '10-year prevalences' of contact allergy to allergens in the standard patch test series in the IVDK ($n = 78\,067$), Germany, patch tested over a 9-year period (1992–2002)^a

Allergen/reactions	Clinical patients		Population (%)			
			Model I (worst)		Model III (medium)	
	+ / +++	++ / ++++	+ / +++	++ / ++++	+ / +++	++ / ++++
Nickel sulfate	15.5	8.3	6.1	3.3	2.6	1.3
Fragrance mix	11.7	4.0	4.6	1.6	2	0.7
Balsam of Peru	8.5	2.5	3.3	1	1.4	0.4
<i>p</i> -Phenyldiamine	4.6	2.0	1.8	0.8	0.8	0.3
Potassium dichromate	4.2	1.6	1.7	0.7	0.7	0.2
Colophonium	3.9	1.8	1.6	0.7	0.7	0.3
Wool alcohol	3.8	0.9	1.6	0.4	0.7	0.1
Methyldibromo glutaronitrile/phenoxyethanol ^b	2.0	0.8	0.4	0.2	0.2	0.06
	4.2	1.2	0.8	0.2	0.3	0.08
Thiuram mix	2.7	1.1	1.1	0.4	0.4	0.2
Neomycin	2.7	0.8	1.1	0.3	0.4	0.1
Methylchloroisothiazolinone/methylisothiazolinone	2.5	0.8	1	0.3	0.4	0.1
Formaldehyde	2.0	0.5	0.7	0.2	0.3	0.1
Oil of turpentine	2.0	0.5	0.8	0.2	0.3	0.1
Benzocaine	1.6	0.65	0.7	0.2	0.2	0.1
Paraben mix	1.5	0.3	0.6	0.1	0.2	0.05
Epoxy resin	1.2	0.6	0.4	0.2	0.2	0.1
Cetearyl alcohol	1.2	0.3	0.4	0.1	0.2	0.05
<i>p</i> -tert-Butylphenol-formaldehyde resin	1.0	0.4	0.4	0.1	0.15	0.06

IVDK, Information Network of Departments of Dermatology.

^aPrevalences of contact allergy in the general population were estimated on the basis of models I (worst case) and III (medium case) and related to the total German population (82 000 000). To address potential diagnostic uncertainties of the positive patch test reactions, the frequencies of unequivocal allergic reactions (++/+++) are also presented (10).

^bMethyldibromo glutaronitrile/phenoxyethanol was tested in 2 different concentrations (0.5% and 1%) in 1992–1996 and 1997–2000, respectively.

between the studies should be taken into account. Despite these inconsistencies, the present CE-DUR generates a plausible prevalence estimate. The German CE-DUR assessed that the prevalence of contact allergy was 18.4% in 2002. This is based on all ages and would therefore be even higher if it was based on adult Germans only. Thus, the CE-DUR prevalence estimate is higher in Germany than in Denmark. This corresponds well with an estimate from a German population-based epidemiological study on 1141 adults aged 28–78 years (4). An overall frequency estimate assessed that 28% were contact sensitized in 2001 in Germany. It appears that the CE-DUR method might be slightly inaccurate but produces prevalence estimates that are adequately realistic.

Nickel has traditionally been responsible for a high proportion of contact allergy prevalence in the general population (1–5). Consequently, a decrease in the prevalence of nickel allergy will automatically decrease the total prevalence markedly. The present study estimated that 3.7% (adult Danes older than 18 years) had a positive reaction to nickel. In comparison, the German CE-DUR estimated that 6.1% were nickel sensitized. According to the Glostrup studies, the prevalence of nickel sensitization was 6.7% in 1990 and remained almost unchanged in 1998 (3, 18). The Danish CE-DUR result may therefore suggest

that the prevalence of nickel allergy is decreasing in Denmark and with it the overall prevalence of contact allergy. However, it should be emphasized that the method itself may explain the different estimates. A possible decrease in the nickel allergy prevalence is supported by other studies that have showed a similar decrease, probably as a consequence of the Danish nickel regulation from 1990 (19, 20). However, it is unknown whether the CE-DUR prevalence estimate is biased downwards. Individuals sensitized to nickel are most often aware of its connection to allergen exposure, for example imitation jewellery, and therefore do not seek medical consultation leading to patch testing.

Besides a decrease in nickel allergy, a minor contribution to the lower prevalence estimate in the general population could be explained by a possible decrease of allergy against cosmetic-related allergens (fragrance mix, colophonium, balsam of Peru, quarternium-15, parabens, wool alcohol, and MCI/MI). The Glostrup allergy study assessed that the prevalence of cosmetic-related allergens was 3.7% in 1990 and 5.8% in 1998 as opposed to 4.5% in the present study (3, 5). An explanation for this decrease could be that the decline of fragrance mix allergy observed among German patients is also occurring in Denmark and is reflected in the general population (21). The prevalence of allergy to cosmetic-related

allergens (except quaternium-15) in the German CE-DUR investigation was surprisingly higher (12.7%), which can be explained not only by the different study periods but also by possible different personal habits and exposure in Germany and Denmark.

Finally, a reason for the lower prevalence of contact allergy in the general population could be the exclusion of thimerosal from the calculations. Thimerosal was included in the Glostrup allergy studies and contributed with 3.4% positive reactions in 1990 and 2.1% in 1998 (5). Thimerosal is also known from other studies to make a significant contribution to the contact allergy prevalence in unselected populations (22). However, MDBGN was included in the CE-DUR estimate but not in the Glostrup allergy studies. This could more or less make up for the exclusion of thimerosal in the calculation.

Besides the discussed findings, the estimated contact allergy prevalences to individual allergens in Denmark and Germany show some interesting differences (Tables 4 and 5). The comparisons are based on 10-year prevalence estimates for all ages in the 2 populations. It is notable that the proportions of strong (+++/++) patch test reactions are more similar than the accumulated positive reactions (+/++/++) (Tables 3 and 4). One explanation may be different criteria in the definition of a weak positive reaction (+) in Germany and Denmark. The marked similarity of the frequency of strong patch test reactions suggests that allergens such as thiuram mix, (chloro-) methylisothiazolinone, and epoxy resin are responsible for a comparable extent of ACD in the 2 countries. However, the clinical prevalence of contact allergy to fragrance mix, balsam of Peru, and PPD was markedly higher in Germany than in Denmark, and this was reflected in the general population estimates. Even though the DCDG database represents an average clinical patch test population in Denmark, not only the prevalence of contact allergy but also the relative frequency of certain sensitizations may differ between patients and the general population (23). In patient data, there may be a higher proportion of positive reactions to occupationally related allergens and also an elevated number of persons with more than 1 positive allergic reaction, as the patients are selected for morbidity (suspected ACD). Hence, the prevalence of contact sensitization to individual allergens seems mostly reliable when focusing on high-prevalence allergens, such as nickel and fragrance mix, that are widespread and non-occupational.

An observation that deserves attention is the number of sold patch tests in Germany and Denmark. In Germany, an estimated 600 000 patch

tests are sold each year as opposed to 25 000 in Denmark. When related to the size of the populations, patch testing is performed approximately 60% more often per inhabitant in Germany than in Denmark. This is partly explained by the different medical systems in the 2 countries. In Denmark, nearly all patients consult their primary physician if they develop a skin rash. Usually, the physician will prescribe corticosteroids, and consequently many patients are never tested. In Germany, patients may consult a dermatologist without prior visitation and this probably leads to a higher degree of patch testing. Furthermore, the reimbursement for patch testing was high in the early 1990s in Germany, which may have increased its use at the time (10). At least to some extent, this difference has been taken into account by setting the CE-DUR model parameter 'dermatological consultation' differently: the medium setting for Germany is 30%, whereas it is 25% for Denmark (Table 2).

General remarks

So far, the Glostrup allergy study has been carried out twice, and a new study has recently been initiated. The studies require significant funding as they are conducted over several years and also require an organization that can organize the invitation, the scheduling, and the patch test reading of numerous individuals. A subject of concern is that patch test reading is performed after only 2 days, which is known to introduce a significant number of false-negative readings (24). Furthermore, it has been discussed whether patch testing with certain allergens, especially PPD, may cause active sensitization (25). Recent data suggest that active sensitization from PPD is not a problem in population-based epidemiological studies (26). In favour of such studies is their principal ability to assess morbidity and the possible role of risk factors. This has led to previously un-described associations, such as smoking and contact allergy (27). Evidently, the CE-DUR approach does not offer such advantages.

To the best of our knowledge, the CE-DUR approach has so far only been applied in Germany and Denmark. Because it is inexpensive and very easily carried out, we believe that it holds the potential of estimating contact allergy prevalences in other countries as well. Before doing so, it is of uttermost importance that the necessary assumptions and model factors are defined as exactly as possible and that they are based on local observations and experience (Table 1). We believe that the CE-DUR approach holds the potential of being an economical and easy monitoring method of

contact allergy prevalence in the general population. Its prevalence estimates were in range with those from the Glostrup allergy studies. Future results from the recently initiated Glostrup allergy study will offer an additional opportunity to validate the present CE-DUR findings.

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