

ORIGINAL ARTICLE

Occupational contact sensitization in female geriatric nurses: Data of the Information Network of Departments of Dermatology (IVDK) 2005–2014

S. Schubert,^{1,*} A. Bauer,² S. Molin,³ C. Skudlik,⁴ J. Geier¹¹Information Network of Departments of Dermatology, University of Göttingen, Göttingen, Germany²Department of Dermatology, University of Dresden, Dresden, Germany³Department of Dermatology and Allergy, Ludwig-Maximilians-University München, Munich, Germany⁴Department of Dermatology, Environmental Medicine and Health Theory, University of Osnabrück, Osnabrück, Germany

*Correspondence: S. Schubert. E-mail: sschube4@gwdg.de

Abstract

Background Geriatric nurses (GN) have a high risk of occupational contact dermatitis (OCD), with chronic irritant contact dermatitis predominating. However, allergic contact dermatitis is an important issue as well. Little is known whether the relevant occupational allergen spectrum reported in the 1990s, including fragrances, preservatives, rubber chemicals and ingredients of surface disinfectants to be the most common sensitizers in GN, is still valid.

Objectives To monitor the current allergen spectrum in GN with OCD and verify the validity of the patch test recommendations (baseline-, preservative-, ointment base-, rubber-, disinfectant, series and fragrances) in GN with suspected OCD given by the German Contact Dermatitis Research Group (DKG).

Methods Retrospective analysis of IVDK data (2005–2014) of 743 female GN with OCD, in comparison to 695 GN without OCD.

Results GN with OCD reacted significantly more frequently to both fragrance mixes, hydroxyisohexyl 3-cyclohexene carboxaldehyde (HICC), thiuram mix, zinc diethyldithiocarbamate and mercaptobenzothiazole than GN without OCD. Reactions to MDBGN, methylchloroisothiazolinone/methylisothiazolinone and oil of turpentine occurred substantially, but not significantly more frequently among GN with OCD. The latter may be due to former use of a special alcoholic liniment in geriatric care. Among material from the patients' workplaces, tetrazepam was a frequent allergen, due to dust exposure from pill crushing. Furthermore, occupationally used protective gloves, body care products as well as surface disinfectants were often tested positively.

Conclusions The general allergen spectrum in GN with OCD is unchanged, so the DKG patch test recommendations are still valid. Prevention of occupational sensitization should focus on fragrance-free hygiene and body care products, usage of accelerator-free protective gloves and avoidance of drug dust exposure.

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Conflict of interest

The authors declare no conflicts of interests.

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Introduction

Due to demographic changes in the western civilization, elderly care is a growing occupational field. Geriatric nurses (GN) are, like other wet work-associated professions (e.g. nurses or hairdressers), at high risk of occupational skin disease and many of them already have skin symptoms within the first few years of employment.^{1,2}

Mainly, the hands of GN are affected by occupational contact dermatitis (OCD)^{2–4} but cases of airborne dermatitis due to surface disinfectants or medicament dust from crushed pills have been reported as well.^{5–8} Risk factors for occupational chronic irritant contact dermatitis are wet work during body care of seniors, frequent hand washing and disinfection, as well as contact with surface disinfectants.^{2,9,10} Intense or frequent skin

contact with body care products (e.g. moisturizers), topical drugs, systemic drugs (pill crushing), protective gloves, as well as surface disinfectants pose a risk for allergic contact dermatitis among GN.^{1,5,10}

Based on IVDK data of the years 1992–1998, we have analysed contact sensitization in 114 female GN with occupational dermatitis.¹⁰ Compared to all other women tested in the same time period, they had significantly more allergic reactions to fragrance mix, thimerosal, thiuram mix, formaldehyde, methyl dibromoglutaronitrile/phenoxyethanol (MDBGN/PE) and methylchloroisothiazolinone/methylisothiazolinone (MCI/MI). Sensitization to fragrances, MDBGN/PE and MCI/MI was attributed to occupationally used body care products, thimerosal to the occupationally obligatory hepatitis B vaccination, thiurams to rubber gloves, and formaldehyde to surface disinfectants.^{1,10} Based on these results and additional knowledge of the specific occupational exposure, the German Contact Dermatitis Research Group (Deutsche Kontaktallergie-Gruppe; DKG) recommended patch testing with the baseline, preservative, ointment base, rubber and disinfectant series as well as fragrances in GN with suspected OCD in 2005.¹

Meanwhile, the occupational exposure of GN on the one hand, as well as the patch test series on the other hand, has changed. For instance, MDBGN is no longer in use in body care products,¹¹ and new fragrances are being tested. Furthermore, in the Information Network of Departments of Dermatology (IVDK), we noted a more or less constant but considerable increase of GN among occupational dermatitis patients from 1.4% in 1995 to 5.2% in 2014.

Taken together, this prompted us to give an update on contact sensitization in this group of patients, based on IVDK data of the years 2005–2014 with regard to the validity of test recommendations.

Patients and methods

The Information Network of Departments of Dermatology (IVDK) is a network of, currently, 56 departments of dermatology in Germany, Switzerland and Austria dedicated to the epidemiology of contact allergy. Its structure and routine operating procedures are described elsewhere.¹² Briefly, patients' history, clinical data and patch test results of all patients patch tested in the participating centres are recorded in local databases and, after anonymization, transmitted to the IVDK central office at the University of Göttingen twice a year. Data are subject to standardized quality control, added to the central IVDK database, and analysed according to international standards.^{13,14} For this retrospective data analysis, we selected data of the years 2005–2014 from the central database of the (IVDK).

Of the 116744 patients patch tested in the IVDK during these years, we selected those patients with current or former profession being 'geriatric nurse'. Among the latter group, we limited our selection to those with current status being 'housewife',

'pensioner' or 'unemployed' in order to avoid contamination of the sensitization spectrum by other occupational exposures. Altogether, there were 1547 patients. Of these, 109 (7%) were men. As the frequency and spectrum of contact sensitization differs between the sexes, we excluded 109 male patients from our data analysis in order to enable a sound comparison of reaction frequencies to ubiquitous allergens. Thus, the study group consisted of female GN with OCD ($n = 743$) and the control group of female GN without OCD ($n = 695$).

All IVDK members, also are members of the DKG. Patch testing and evaluation of reactions is performed according to DKG guidelines.¹⁵ For this data analysis, patch test reactions at day 3 (D3) were taken into account. In few exceptional cases, when a reading was done at D4 instead of D3, this reading was selected. Readings coded as +, ++ or +++, i.e. positive reactions with erythema, infiltration, papules and/or (coalescing) vesicles, according to scoring, were rated as positive in dichotomized analyses. Patch test preparations were purchased from Almirall Hermal, Reinbek, Germany. Patch test exposure time was 24 h in 16%, and 48 h in 84% of the patients. With a few (temporary) exceptions, Finn-Chambers-on-Scanpor (8 mm inner diameter) was used as test chambers.

In order to allow a comparison of sensitization frequencies, reaction rates were standardized to age (50% <40 years of age; 50% ≥40 years) using previously published methods.^{16,17} Statistical significance ($P < 0.05$) of differences in sensitization frequencies was determined by non-overlapping 95% confidence intervals (CI) of standardized reaction rates. CIs of reaction rates with zero positive reactions were calculated according to Gefeller *et al.*¹⁸ Differences in proportions of population characteristics between the study group and the control group were tested for statistical significance with the chi-squared test. Data were managed and analysed using the statistical analysis software SAS[®], version 9.3 (SAS Institute, Cary, NC, USA).

Results

A short description of the study group (743 female GN with OCD) and the control group (695 female GN without OCD) using the MOAHLFA index is given in Table 1.

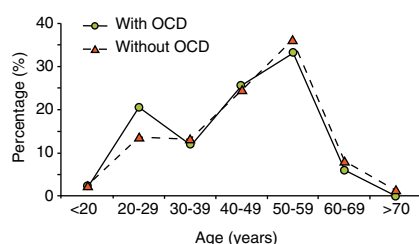
By group definition, the proportion of men is zero, and OCD patients are restricted to the study group. Proportions of all other MOAHLFA items were significantly different in both groups. There were far more patients with atopic dermatitis and hand dermatitis in the study group than in the control group. Age spectra of both groups are presented more in detail in Fig. 1. In both groups, more than 30% of the patients were in their 6th decade, representing the highest peaks. However, within the age spectrum of GN with OCD, another (smaller) peak was noted for the 3rd decade with 20%. In the study group, chronic irritant dermatitis was the most frequent current main final diagnosis (29%), followed by atopic dermatitis (28%) and allergic contact dermatitis (17%). Most frequently suspected

Table 1 MOAHLFA index of the study group ($n = 743$) and the control group ($n = 695$)

	Female geriatric nurses				χ^2 -test
	With OCD (<i>n</i> = 743)		Without OCD (<i>n</i> = 695)		
	Count	Per cent	Count	Per cent	
Male	0*	0.0	0*	0.0	n.t.
Occupational dermatitis	743	100.0	0*	0.0	n.t.
Atopic dermatitis (past or present)	399	53.7	185	26.6	<0.0001
Hand dermatitis	692	93.1	222	31.9	<0.0001
Leg dermatitis	0	0.0	40	5.8	<0.0001
Face dermatitis	17	2.3	100	14.4	<0.0001
Age ≥ 40 years	484	65.1	491	70.6	<0.0255

n.t., not tested for statistical significance; OCD, occupational contact dermatitis.

*No observation due to group definition.

**Figure 1** Age spectra of female geriatric nurses with occupational contact dermatitis (OCD) (study group; Green circles) and without OCD (control group; Orange triangles). IVDK, 2005–2014.

exposures responsible for the patients' complaints were disinfectants (68%), protective gloves (45%), cosmetics and leave-on body care products (41%), topical drugs (17%) and rinse-off body care products (11%). Up to three items could be selected per patient.

Comparison of reaction frequencies to single allergens in separate patient groups is generally hampered by unknown criteria for the selection of allergens to be patch tested. Therefore, it is meaningful to restrict such a comparison to the baseline series, which has been patch tested in 94% of the study group and 89% of the control group. A comparison of age-standardized reaction frequencies to allergens of the baseline series is given in Table 2.

As can be seen from non-overlapping 95% CIs, there were significantly more positive reactions among GN with OCD to fragrance mixes, hydroxyisohexyl 3-cyclohexene carboxaldehyde (HICC), thiuram mix, zinc diethyldithiocarbamate and mercaptobenzothiazole. Patch testing with MCI/MI as well as oil of turpentine also led to noteworthy increased sensitization rates in the study group but did not reach statistical significance.

Beyond the DKG baseline series, several other DKG patch test series have been tested in the study group in different frequency. Most frequently, the DKG ointment base series (in 90% of the patients), preservative series (90%), disinfectant series (86%) and rubber series had been tested (79%). Reaction frequencies to all allergens of these series which elicited positive reactions in at least 1% of those patch tested are listed in Table 3.

Additionally, of the preservatives series, diazolidinyl urea 2% pet. elicited positive reaction in 0.9% of the patients tested, chloroacetamide (0.2% pet.) in 0.8% and imidazolidinyl urea (2% pet.) in 0.6%. Among the allergens of the disinfectant series, glyoxal trimer (1% pet.) elicited 0.6% positive reactions, and benzalkonium chloride (0.1% pet.) in 0.5% of those tested.

In 416 patients of the study group, own material was tested in addition to standardized patch test preparations. Altogether, 3559 single patch tests were performed. Table 4 shows the results of patch tests with products from the patients' workplaces.

Body care products are listed in this table because they represent a typical occupational exposure of GN. However, from our data, we cannot see if these products were used professionally or privately by the patients. Most frequently, positive reactions to protective gloves or drugs for systemic use were observed. Of those 11 patients reacting to their gloves, five were sensitized to thiurams, two to zinc diethyldithiocarbamate, and of these two, one also to thiurams. Among the systemic drugs, tetrazepam was, by far, the leading sensitizer, with 11 out of 39 tested patients concerned. Diazepam was tested in four patients; all of them also being tested with tetrazepam. A positive reaction to diazepam occurred in one patient only, who was also sensitized to tetrazepam. Seven patients reacted to body care products, and all of them reacted to at least one of the fragrance mixes and/or a single fragrance material tested. Three of them also reacted to a preservative.

As mentioned above, the age spectrum of the study group showed two distinct peaks (Fig. 2). In order to analyse particularities in the sensitization spectra of younger vs. older GN with OCD, we separated the study group into two subgroups with a cut at the age of 35 years, representing the bottom between the two age peaks. Of the 743 patients in the study group, 224 (30%) were 35 years old or younger (≤ 35 years), while 519 (70%) were older (> 35 years). Of the younger subgroup, 156 patients (69.6%) had past or present atopic dermatitis, while this was the case in 243 patients (46.8%) of the older subgroup (difference significant, $P < 0.0001$). Duration of occupational activity was stated in about 80% of the patients, namely in 175 patients up to 35 years old, and in 419 patients above this age. The average duration was 7.5 ± 3.8 years in the younger subgroup, and 17.4 ± 9.1 years in the older subgroup. Reactions frequencies to most allergens were slightly higher in the older subgroup. However, statistically significant higher frequencies of sensitization were only seen to MCI/MI 0.01% aq. (10.2% vs. 3.6%), MDBGN 0.2% pet. (7.7% vs. 0.6%) and oil of turpentine

Table 2 Age-standardized reaction frequencies, supplemented with 95% confidence intervals (95% CI) to allergens of the baseline series in female geriatric nurses

Substance	Test concentration (%)	Number of patients tested (SG)	Patients with positive reactions (SG)	Age-standardized % positive [95% CI]	Number of patients tested (CG)	Patients with positive reactions (CG)	Age-standardized % positive [95% CI]
Nickel sulphate	5	617	131	20.9 [17.6–24.3]	599	130	22.0 [18.3–25.6]
Fragrance mix I	8	644	80	11.6 [9.1–14.1]	602	46	5.9 [4.2–7.6]
Cobalt chloride	1	652	66	10.1 [7.7–12.6]	607	48	8.8 [6.2–11.4]
Methyldibromo glutaronitrile*	0.3	164	19	10.0 [5.4–14.6]	198	13	5.7 [2.3–9.0]
Fragrance mix II	14	650	60	8.2 [6.2–10.3]	602	31	4.0 [2.5–5.4]
Methylchloroisothiazolinone/methylisothiazolinone (MCI/MI)	0.01 aq.	667	55	7.2 [5.3–9.1]	605	29	4.0 [2.5–5.6]
Balsam of Peru (<i>Myroxylon pereirae</i>)	25	664	51	6.9 [5.0–8.8]	606	37	5.0 [3.3–6.6]
Hydroxyisohexyl 3-cyclohexene carboxaldehyde (HICC)	5	666	46	6.2 [4.4–8.0]	610	21	2.9 [1.6–4.3]
Thiuram mix	1	657	41	5.7 [3.9–7.5]	607	14	2.0 [0.9–3.1]
Potassium dichromate	0.5	664	39	5.0 [3.4–6.6]	609	30	4.0 [2.5–5.5]
Colophony	20	662	34	4.7 [3.1–6.4]	608	18	2.8 [1.4–4.2]
Methyldibromo glutaronitrile*	0.2	526	29	4.5 [2.9–6.1]	447	15	3.0 [1.4–4.7]
Ylang-ylang (I + II) oil‡	10	489	18	3.6 [1.9–5.4]	352	7	1.7 [0.3–3.0]
Compositae mix†	5	342	12	3.5 [1.4–5.7]	326	5	1.0 [0.1–2.0]
Oil of turpentine	10	667	22	2.7 [1.6–3.9]	609	9	1.0 [0.4–1.7]
Compositae mix II†	5	262	8	2.7 [0.8–4.5]	192	3	1.6 [0.0–3.5]
Formaldehyde	1 aq.	666	16	2.1 [1.1–3.2]	608	7	1.3 [0.3–2.4]
Propolis	10	668	14	2.1 [1.0–3.3]	608	16	2.4 [1.1–3.6]
Bufexamac	5	597	10	2.0 [0.7–3.3]	560	6	0.9 [0.1–1.8]
Lanolin alcohols	30	669	11	1.9 [0.7–3.0]	609	11	2.1 [0.8–3.5]
Iodopropynyl butylcarbamate	0.2	639	14	1.8 [0.8–2.7]	422	3	0.7 [0.0–1.6]
Zinc diethyldithiocarbamate	1	667	10	1.5 [0.5–2.4]	609	1	0.1 [0.0–0.3]
Mercaptobenzothiazole	2	666	9	1.2 [0.4–2.1]	609	1	0.1 [0.0–0.3]
Jasmine absolute‡	5	475	6	1.2 [0.2–2.3]	343	2	0.7 [0.0–1.8]
Mercapto mix (without MBT)	1	662	9	1.1 [0.4–1.9]	607	3	0.7 [0.0–1.5]
Epoxy resin	1	575	7	1.1 [0.3–1.9]	602	7	0.8 [0.2–1.4]
N-Isopropyl-N'-phenyl-p-phenylenediamine (IPPD)	0.1	663	7	0.9 [0.2–1.6]	609	6	1.0 [0.1–1.9]
Paraben mix	16	666	6	0.9 [0.1–1.6]	607	3	0.3 [0.0–0.7]
Bronopol	0.5	661	6	0.8 [0.1–1.5]	595	7	1.0 [0.2–1.8]
Sandalwood oil‡	10	474	2	0.5 [0.0–1.1]	343	7	1.7 [0.4–3.1]
p-tert-Butylphenolformaldehyde resin	1	582	4	0.5 [0.0–1.0]	558	0	0.0 [0.0–0.7]
Cetearyl alcohol	20	667	4	0.5 [0.0–0.9]	609	2	0.4 [0.0–1.0]

Significant differences between the study group (SG, with occupational contact dermatitis; $n = 743$) and the control group (CG, without occupational contact dermatitis; $n = 695$) are marked in bold print. Slight variations in the number of patients tested with each allergen are mostly due to patients' individual circumstances or temporary unavailability of the test preparation. Vehicle was petrolatum unless otherwise indicated.

*Reduced number of patients due to reduction in test concentration from 0.3% to 0.2% in 08/2008; †reduced number of patients due to switch from compositae mix to compositae mix II in 10/2011; ‡reduced number of patients because allergen was not part of the baseline series before 09/2010.

10% pet. (4.5% vs. 0.5%). Additionally, substantially, but not significantly, more positive reactions were noted to the following allergens among the older GN with OCD: MI 0.05% aq. (10.2% vs. 3.9%), fragrance mix II 14% pet. (11.0% vs. 5.1%) and HICC 5% pet (7.9% vs. 4.6%).

Discussion

To the best of our knowledge, this study represents the analysis of the largest dataset (743 patients) of contact sensitization in GN with OCD published so far. As expected, and in line with other studies on OCD in GN,^{4,19} chronic irritant contact

Table 3 Frequency of sensitization to allergens from special DKG patch test series in the study group (female geriatric nurses with occupational contact dermatitis; $n = 743$)

Patch test series Allergen preparations	(%)	Number of patients tested	Number of patients with positive reactions	Percentage of patients with positive reactions
DKG ointment base series				
Amerchol L 101	50	655	14	2.1
Cocamidopropyl betaine	1 aq.	653	12	1.8
tert-Butyl hydroquinone	1	661	12	1.8
Octyl gallate	0.3	660	7	1.1
DKG preservative series				
Methylisothiazolinone*	0.05 aq.	508	43	8.5
Quaternium 15	1	653	9	1.4
DKG disinfectant series				
Povidone iodine	10 aq.	625	56	9.0
Glutaraldehyde	0.3	621	15	2.4
DKG rubber series				
Tetraethylthiuram disulphide	0.25	582	27	4.6
Tetramethylthiuram monosulphide	0.25	583	24	4.1
Tetramethylthiuram disulphide	0.25	583	11	1.9
1,3-Diphenylguanidine	1	575	9	1.6
Morpholinyl mercaptobenzothiazole	0.5	582	9	1.5
Cyclohexylthiophthalimide	0.5	569	6	1.1

Only those allergens are listed which elicited positive reactions in at least 1%. Slight variations in the number of patients tested with each allergen are mostly due to patients' individual circumstances or temporary unavailability of the test preparation. Vehicle was petrolatum unless otherwise indicated.

*Reduced number of patch tests because patch test preparation was not part of the respective test series during the total study period.

DKG, Dermatitis Research Group.

Table 4 Female geriatric nurses with occupational contact dermatitis: patch tests with products from the patients' workplaces

Category	Test concentrations	Number of patients tested	Patients with ≥1 positive reaction		Number of patch tests	Positive patch tests	
			<i>n</i>	%		<i>n</i>	%
Protective gloves	As is	243	11	4.5	1034	20	1.9
Workwear, face masks etc.	As is	9	0	0.0	16	0	0.0
Hand disinfection	0.1–100%	228	4	1.8	454	6	1.3
Surface and instrument disinfection	0.01–10%	83	6	7.2	213	7	3.3
Cleaning agents, dish detergents	0.01–10%	30	0	0.0	94	0	0.0
Liquid soap, soap, shower gel, shampoo	0.1–10%	156	5	3.2	426	8	1.9
Skin protection creams, hand creams	As is	136	4	2.9	280	4	1.4
Body care products	As is	130	7	5.4	284	8	2.8
Skin disinfection*	0.1–100%	13	0	0.0	21	0	0.0
Drugs for external use, eye drops	As is	73	2	2.7	188	2	1.1
Drugs for internal use (systemic drugs)	As is	43	12	27.9	222	19	8.6

*Products for disinfection of wounds or of the skin prior to puncture, surgery etc., most of them containing octenidine or propanol.

dermatitis and atopic dermatitis were the most frequent diagnoses (29% and 28%), and the hands were the most frequently involved sites (93%). Therefore, it is important and to be welcomed that current prevention programmes focus on the change of habits compromising the epidermal barrier.¹⁹ Although allergic contact dermatitis was diagnosed in a minority of the GN with OCD (17%), knowledge of the current allergen spectrum is important for primary and secondary prevention of OCD.

Similar to IVDK observations from the 1990s,¹⁰ we found an almost double increase in reactions to fragrance mix I among GN with OCD, compared to GN without OCD (11.6% vs. 5.9%). In addition, we found the same with fragrance mix II (8.2% vs. 4.0%) and HICC (6.2% vs. 2.9%), both of which had not been tested in the 1990s. Obviously, geriatric nursing still means a high risk of fragrance sensitization. This is most probably due to the professional use of various individual body care

products owned by the seniors, which contain widely used fragrances like HICC (e.g. Lyrall[®], IFF, New York, NY, USA). Comparison of sensitization patterns between GN and hospital nurses, where thiurams, MCI/MI, colophony and zinc diethyldithiocarbamate were found to be relevant for occupational skin disease,²⁰ displays a similar sensitization pattern (preservatives, rubber ingredients and substances in disinfectants) with the addition of fragrances in GN. This is of importance in the context of expert witnesses about GN with OCD because in most other professions, fragrance allergy is not regarded occupationally acquired. In Germany, an occupationally acquired fragrance allergy may result in (or at least contribute to) a claim to workers' compensation.²¹

The same exposure, i.e. the seniors' own body care products, is a potential source of sensitization to preservatives. Corresponding sensitization frequencies were slightly, but not significantly increased in GN with OCD when compared to those without OCD. In line with the general trends in preservative allergy and the changes in the common preservative exposure by use of body care products, the spectrum of preservative sensitization has changed in GN too. The use of MDBGN is prohibited in cosmetics and body care products in the EU since 2008,¹¹ resulting in decreasing sensitization frequencies. On the other hand, since 2009, Europe faces an epidemic of sensitization to MI, also leading to increasing frequencies of sensitization to MCI/MI.^{22,23} Both trends are also reflected in the data presented in this paper.

Most of the ointment base series allergens yield very low reaction rates in the study group. In addition, three of the four most frequent allergens in this series, namely Amerchol L 101, cocamidopropyl betaine and octyl gallate are known to be so called 'problematic' allergens which often cause doubtful and false (weak) positive reactions.²⁴ This means, that reactions to these test preparation have to be interpreted with caution. Clinical relevance has to be established thoroughly, and if in doubt, a repeated open application test (ROAT) or provocative use test (PUT) is recommended.

GN with OCD were significantly more often sensitized to rubber chemicals than those without OCD. This can be attributed to the occupational use of protective latex or nitrile gloves, as illustrated by the corresponding positive reactions to gloves from the patients' workplaces. Some years ago, we have analysed IVDK data on occupational contact allergy caused by rubber gloves, and concluded that the allergen spectrum had not changed compared to the 1990s.²⁵ Similarly, among the rubber allergens tested in the baseline series, thiurams are still by far the leading allergens (5.7%), followed by dithiocarbamates (1.5%) and mercaptobenzothiazole (MBT) derivatives (1.2%). However, it is notable that sensitization to 1,3-diphenylguanidine (DPG), which is tested in the rubber series only, was as frequent as sensitization to one of the MBT derivatives in this context (1.6% vs. 1.5%). From several European countries, increasing numbers of sensitization to DPG from protective medical gloves are being reported.^{26–28} Hence,

although DPG 1% pet. is known as a problematic patch test substance often eliciting doubtful or weak (presumably false) positive reactions,²⁴ clinical relevance of positive reactions to DPG should thoroughly be checked in every individual case.

The DKG disinfectant series covers allergens from skin as well as surface disinfectants. Most frequently, reactions to povidone iodine 10% aq. were observed. However, the reaction frequency was not higher than in former data analyses of other patient groups (unpublished IVDK data). This test preparation is known to elicit many erythematous and weak positive reactions, of which the majority does not indicate true sensitization.²⁴ Most of these reactions are probably false-positive, and for a reliable diagnosis, a ROAT or PUT with a commercial povidone iodine solution should be performed. From our data, one cannot deduce an increased occupational risk of sensitization to povidone iodine among GN. Among the surface disinfectants, aldehydes and quaternary ammonium compounds (QAC) are the most prominent contact sensitizers. In the 1990s, formaldehyde was the leading allergen among GN with OCD in this concern.¹⁰ In our present analysis, there was no significant difference in the frequency of formaldehyde sensitization between GN with and without OCD respectively. Probably, the corresponding exposure has changed, and glutardialdehyde is more frequently being used, leading to more cases of contact sensitization. The only QAC commercially available for patch testing is benzalkonium chloride, which only elicited positive reactions in 0.5% of the patients tested. However, benzalkonium chloride, which has an aromatic side chain, has rarely been described as a contact allergen and cannot be regarded representative for the total QAC exposure by surface disinfectants.²⁹ Other QACs, like didecylmethylammonium chloride, which seems to be present in many of these products, and has been described as a contact allergen in several cases,^{6,30,31} are not tested routinely.³²

In more than half of the GN with OCD, products from the patients' workplaces were patch tested. Besides gloves (as discussed above), systemic drugs elicited positive reactions most frequently. Among these, tetrazepam was the most frequent sensitizer eliciting positive reactions in 11/39 patients tested. Tetrazepam is a well-known cause of allergic airborne contact dermatitis in GN due to pill crushing,^{5,7,8} which can be prevented using a closed pill crushing device. One tetrazepam-sensitized patient also reacted to diazepam. Cross reactions between these benzodiazepines have been reported.^{7,33,34} Concerning other workplace materials, relatively few positive reactions were observed and it seems probable that patch testing with disinfectants, soaps or detergents in higher concentrations causes false-positive reactions.³⁵ Hence, no far-reaching conclusions can be drawn from these results. However, Tetrazepam has been outlawed by the European commission in all member states since 2013.³⁶

Comparing characteristics of younger and older GN with OCD revealed some remarkable differences. Among GN at the

age of 35 years or younger, there were significantly more patients with past or present atopic dermatitis (70% vs. 47%), and the average duration of working as a GN at the time of patch testing was substantially shorter (7.5 vs. 17.4 years). This is in accordance with the well-known fact that, generally, patients with atopic dermatitis have a higher risk of (severe) OCD, particularly in wet work professions.^{37,38} Furthermore, increased frequency of sensitization in older patients, in particular to fragrances and preservatives, can be explained by more years of service. Largely, both patients groups had the same allergen spectrum. However, the older patients were significantly more often sensitized to oil of turpentine than the younger ones (4.5% vs. 0.5%). Neither clinical or anamnestic data nor concomitant sensitizations gave a convincing clue to clinical relevance of these reactions. However, it could be speculated that a former source of sensitization was an alcoholic liniment (*spiritus vini gallici*) which had frequently been used in elderly care in Germany. It contains juniper oil, pine needle oil and similar extracts containing the same sensitizing terpenes as oil of turpentine.³⁹

In conclusion, the allergy spectrum of GN with OCD is largely unchanged, compared to the 1990s. Main sensitizers are fragrances and preservatives from the seniors' body care products, and rubber ingredients from protective gloves. Other occupationally relevant allergens are systemic drugs (pill crushing) and aldehydes in surface disinfectants. Although there are several reactions of ointments bases, their role as relevant contact sensitizers remains uncertain. In principle, the DKG patch test recommendations for GN with OCD are still valid.¹ In addition, patch testing with individual workplace material can be recommended. Prevention of contact sensitization should focus on fragrance-free body care products, accelerator-free (vinyl) gloves and avoidance of drug dust exposure using closed pill crushing devices.

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