

Rash related to use of scented products. A questionnaire study in the Danish population. Is the problem increasing?

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Fragrances are used in many types of cosmetic and household products, which are an important part of everyday life in modern society. The aim of the current investigation was to describe the frequency of self-reported rash due to scented products in a random sample of the adult Danish population. Further, it was determined whether risk of self-reported 1st-time rash from scented products had increased during the past 15 years compared to the preceding period. The sample consisted of 1537 persons, 801 female and 736 male, above the age of 15 years. The participants were interviewed person-to-person to obtain a general health profile, and in this connection, questions were asked concerning rash related to the use of scented products. 28.6% (440/1537) had on some occasion experienced rash from scented products, 10.6% had experienced rash within the year prior to interview. A multivariate analysis showed that women had a significantly increased risk of reporting rash from scented products compared to men (odds ratio: 1.56, $p < 0.0001$). Furthermore, it was shown that individuals below the age of 40 years had a significantly increased risk of reporting rash from scented products compared to older age groups. The risk of reporting 1st-time rash occurring after 1978 was significantly increased (odds ratio: 2.34, $p < 0.0001$), as compared to the preceding period. This may be taken as indicative of an increasing problem with scented products, involving potentially severe public health implications.

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Fragrances have been used since ancient times for pleasure and personal hygiene. Originally, herbs and flowers were crushed and mixed with different oils or unguents. Many years later, methods of distillation made a breakthrough in the manufacturing of fragrances (1). Today, increasing sophistication in the art and technology for manufacturing, formulating and using fragrance raw materials, has made the fragrance industry most successful (2). Scented products, like soaps, cosmetics, personal care products, detergents and household cleaners, are produced in large volumes, and social and economic development and marketing strategies have increased the number of people who can afford to buy scented consumer products and are willing to do so. In 1997, the sale of cos-

metics and toiletries amounted to 21.1 billion ECU (manufacturing prices) in the USA and 24.6 billion ECU in the EU (3).

The aim of this investigation was to determine the prevalence of rash associated with the use of scented products in a random sample of the Danish population. Further, to observe whether the risk of self-reported 1st-time rash from scented products had increased in the recent 15 years compared to the previous period.

Materials and Methods

Study population

In 1994, The Danish Institute for Clinical Epidemiology (DICE) performed a health-interview

survey based on a random sample of 6000 adult persons (age 16+) drawn from the Danish population of 5.2 million people. Data collection took place in 3 interview rounds (February, May and September) with 2000 in each round (4). The population sample for the total health interview survey did not differ from the total Danish population with regard to age, sex and marital status. The overall participation rate was 78%. The non-participation rate was almost identical among women and men, but increased with increasing age (4). The population sample for the current study consisted of 1537 persons, that is all respondents from the 1st interview round.

Questionnaire and definitions

The participants were interviewed person-to-person by professional interviewers. The questionnaire was designed to obtain a general health profile and the participants were furthermore asked about rash related to the use of scented products. 'Rash' was defined as redness or spots and 'scented products' entailed any kind of scented cosmetics, toiletries, soaps and household cleaners. When rash was reported, the respondent was asked to indicate the age at which they experienced rash due to a scented product for the 1st time. Questions were also put about the type of product that had caused the rash, results of which have been reported elsewhere (5). Childhood atopic dermatitis was defined to be present in individuals who reported eczema with a flexural distribution and with onset of eczema before 16 years of age.

Statistical analysis

Statistical analysis was performed applying a Cox proportional hazards model (6). The model yields an equation for the hazard as a function of, in this case, 4 covariates. The hazard ratio for onset of perfume rash was calculated and adjusted for the effects of the other variables in the model: sex, age at time of interview, atopic dermatitis and time period since 1st-time rash, that is whether the perfume rash occurred the 1st time within the recent 15 years (1978–1993) or before 1978. The model can be expressed by:

$$\log h_i(t) = \log h_0(t) + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3} + \tau_1 z_{i1}(t), \quad (1)$$

where the hazard at a given time depends on the baseline hazard h_0 which is not of interest, while the estimates related to the 4 following variables are. The x 's denote age group (with 3 levels), sex, and childhood atopic dermatitis (yes/no). The variable z is time-dependent and has 2 levels corre-

sponding to the 2 time periods when rash may occur.

All possible 2-variable interactions were also tested in the analysis. The interaction between period and sex and period and age were close to the usual 5% level of significance but, since their inclusion increased standard errors dramatically, it was decided to focus on the main effect model as described above. Subjects who had not developed rash at the time of interview were censored in the analysis. The main effect model with the estimates of simultaneous effect of age/sex and atopy is reported in Table 2.

Results

Rash from scented products had been experienced by 440/1537 (28.6%) at some point in their life. 163 (1/3) had had such a rash within the year prior to interview, that is 10.6% of the total population. Women were more prone to report rash than men and a trend was found such that rash was reported more frequently by the youngest age group than the older ones (Table 1). The sex of the person influenced the age of onset of rash, so that the median age of rash onset for women was 20 years (range 0–83 years) and for men 24.5 years (4–75 years).

In 66.3% (292/440) of cases with rash, the symptoms appeared for the 1st time within the recent 15-year period, 1978–93.

Regression analysis

The main variables sex, age and time period were found to influence the risk of reporting rash to scented products significantly by Cox regression analysis (Table 2). Women had an increased risk of

Table 1. Characteristics of the population sample

		Whole population (%)	With rash (%)*
sex:	female	801 (52.1)	263 (32.8)
	male	736 (47.9)	177 (24.0)
age (years)	16–39	685 (44.6)	250 (36.5)
	40–59	465 (30.3)	134 (28.8)
	60 or more	386 (25.1)	56 (14.5)
prevalence of childhood eczema**		64 (4.2)	33 (51.6)
prevalence of previously patch tested		108 (7.0)	48 (44.4)
prevalence of previously patch test positive to perfume		10 (0.7)	9 (90.0)
total number		1537	440 (28.6)

*The % with rash of those with a particular characteristic in the population, e.g., % of females with rash.

**With a flexural distribution.

Table 2. Estimated effect of co-variables predicting occurrence of self-reported rash due to scented products: Cox regression model

Variable	Level	Odds ratio	95% confidence interval	p-value
sex	female	1.56	1.29–1.90	<0.0001
	male (ref)	1.0		
current age	age groups:			
	16–39 years (ref)	1.0		
	40–59 years	0.53	0.38–0.72	<0.0001
	60 years and more	0.15	0.09–0.26	
childhood atopic eczema	yes	1.11	1.0–1.25	0.0565
	no (ref)	1.0		
period	1st-time rash:			
	-within recent 15 years	2.34	1.74–3.14	<0.0001
	-before that (ref)	1.0		

Ref: reference group in the Cox analysis and, for this reason, the odds ratio is defined as 1.0.

reporting rash compared with men (odds ratio (OR): 1.56, $p < 0.0001$). Furthermore, the risk of reporting rash decreased significantly with increasing age, while childhood atopic eczema tended to increase the risk of reporting rash (OR: 1.11, $p = 0.057$). Risk of reporting a rash within the last 15 years as compared with an earlier onset was significantly increased (OR: 2.3, $p < 0.0001$).

Discussion

The 5-year prevalence of self-reported cosmetics-related adverse reactions were found to be 12% in a study of Swedish students and military conscripts (7) and 12.2% in inhabitants, aged 33–64, of a Dutch town (8). In our study, 28.6% of a random sample of the adult Danish population reported having experienced rash from a scented product at some time in their life (Table 1). Our study included more product categories than the studies from Holland and Sweden and had a longer observation period, which may in part explain the higher frequency of adverse reactions reported. It may be questioned whether individual respondents are able to interpret correctly the cause and nature

of an adverse event. In this study, only visible skin problems defined as redness or spots were recorded. The results of an American study suggest that, in general, consumers are able to determine the cause of adverse skin reactions (9). Individuals in 10,000 households reported adverse experiences related to cosmetics for 3 months. Dermatologists reviewed the reactions reported and concluded that, in 83.8% of cases, the reactions had been correctly, either probably or definitively, attributed to cosmetic products (9). It has also been shown that many consumers, who have experienced rash, are able to name 1 or more specific product categories as the cause of their reaction (5).

According to our results, women were shown to have an increased risk of reporting rash from scented products compared to men, a result which is in accordance with the use pattern of such products (10). The youngest age group of 16–39 years were most likely to report rash. This may be connected to the fact that teenage requirements for cosmetics and fragrances were discovered as a new market, when their purchasing power increased in 1960s and 1970s (11). From this generation onwards, exposure probably started at an earlier age, which means a greater risk of skin symptoms appearing at an early age.

The fragrance and cosmetic industry has in general become increasingly successful in the past decades (3, 11), which may be the reason why an accumulation of reported 1st-time rash from scented products was found within the recent 15 years, 1978–93, compared to the time before that (OR: 2.34, $p < 0.0001$) in the current study. The consumption of cosmetics increased by 18% from 1981 to 1982 in Denmark, a tendency also seen in other European countries (3). From 1991 to 1992 an increase of 11.5% was reported and from 1995 to 1997 an increase still of 6.0% in the consumption of cosmetics and toiletries in Denmark was seen (3). Such statistics are influenced by inflation rates

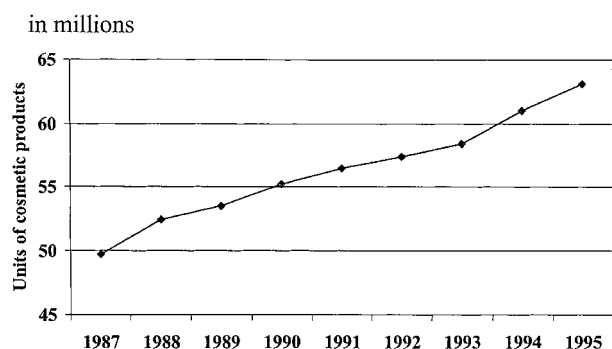


Fig. 1. Estimated sale of cosmetic products in Denmark in the period of 1987–1995 given in units of cosmetics (industry estimates, unpublished observations).

and profits, though the annual inflation rate during the last period was only 1.9% (3) and other industry estimates shows that the number of products used per capita increased by 20% from 1987–95 (Fig. 1). The consumption of other scented products over time is not known.

The present study design is open to the influence of recall bias, which may have influenced the time-dependent results in the observed direction. However, a recently published Danish study also provides evidence that an increase of similar magnitude has occurred in the frequency of skin problems related to the use of cosmetic products (12). A 3-fold increase in the prevalence of self-reported hypersensitivity to cosmetics and skin care products was found comparing 1994 to 1987. On both occasions a cross-section of the Danish population was interviewed. In the 1994 sample, 1/3 of the respondents were identical with participants in the current study. No change was found in the reporting of hypersensitivity to chemicals and metals such as nickel from 1987 to 1994 (12), supporting the interpretation of the increase in fragrance hypersensitivity as being real and not induced by recall bias. Nickel exposure has been regulated by law in Denmark since 1991 (13), while there is no such official regulation of the use of fragrance allergens in cosmetics products.

The perfume rash reported by participants in the current study may be caused by a range of different mechanisms, which is not possible to elucidate in an interview study. Usually contact allergy accounts only for a minor proportion of rash cases (8, 14). Nevertheless, self-reported rash from scented products have been shown by patch testing to be significantly associated with fragrance contact allergy (14). Parallel with the increased reporting of rash in the general population, as shown in this study, an increase in contact allergy to fragrances has been found among eczema patients in Denmark (15), Germany (16), Singapore (17) and the US (18). In the Danish study, the results of patch testing consecutive eczema patients in 1985/86 and again in 1997/98 were reported. Contact allergy to fragrances, as detected by the fragrance mix, had increased significantly from 4.1% in 1985/86 to 9.9% in 1997/98 ($p < 0.00001$) (15). This study showed, by multivariate analysis, that the risk of being diagnosed as allergic to fragrances, when adjusted for the effect of age, sex and atopic dermatitis, had increased 2.5× from the 1st to the 2nd period, 95% confidence intervals 1.8–3.5 (15). In the current investigation, the risk of reporting 1st-time rash from scented products had increased almost accordingly, OR: 2.3 (Table 2).

The current study is population based and demonstrates that a large proportion of adult Danes

have experienced adverse skin reactions to scented products. An accumulation of reported skin rash from scented products within the recent 15 years was found. This finding should be seen in the context of other studies showing the same trend and taken as indicative of a potential public health problem deserving more attention from researchers, producers and regulators in the future.

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