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ORIGINAL ARTICLE

Prevalence of self-reported symptoms and consequences related to inhalation of airborne chemicals in a Danish general population

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Abstract
Objective To estimate the prevalence and consequences of self-reported symptoms related to inhalation of airborne chemicals in a Danish general population.
Methods A random sample of 18–69-year-old individuals (n = 6,000) was drawn from the Danish Civil Registration System. A questionnaire on self-reported symptoms related to inhalation of 11 categories of airborne chemicals was mailed to the population. Respondents who reported symptoms received an additional questionnaire to verify the reported symptoms and to characterise factors related to the initial onset of symptoms.
Results The response rate to the primary questionnaire was 71%. A total of 1,134 individuals (27%, 95% CI 25–28) reported symptoms related to inhalation of airborne chemicals, 141 individuals (3.3%, 95% CI 2.8–3.9) reported adjustments of social life or occupational conditions due to symptoms, whereas 20 individuals (0.5%, 95% CI 0.3–0.7) had made adjustments of both social life and occupational conditions. Women reported more exposures as annoying than men and had more symptoms related to inhalation of airborne chemicals ($P < 0.001$). However, sex had no effect on the reporting of adjustments of social life or occupational conditions ($P = 0.54$).
Conclusion Symptoms related to inhalation of airborne chemicals were common in this general population, and a minority reported that these symptoms affected social life or occupational conditions. Women as compared to men reported more symptoms but not adjustments of social life or occupational conditions.

Keywords Epidemiology · Population-based · Prevalence · Multiple chemical sensitivity · Idiopathic environmental intolerance

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Introduction

In some individuals inhalation of airborne chemicals may cause symptoms from different organ systems (Cullen 1987; Lacour et al. 2005). The number of population-based studies on symptoms related to inhalation of airborne chemicals are limited and have yielded different estimates of the prevalence of affected individuals according to which case definition the authors have applied.

In a random telephone survey in rural North Carolina 33% of the respondents reported becoming sick after smelling chemical odours (Meggs et al. 1996). In the 1995 behavioral risk factor survey in California 15.9% reported being unusually sensitive to everyday chemicals (Kreutzer et al. 1999), while the prevalence was estimated to be 12.6 and 11.2% in Atlanta, Georgia (Caress and Steinemann 2003) and the continental United States of America (Caress and Steinemann 2004), respectively in two random telephone surveys using the same phrasing of questions. In the New South Wales adult health survey 2002 24.6% of the

respondents reported sensitivity to chemical odours (Centre For Epidemiology And Research 2003). In Scania, Sweden 20.8% of the respondents to a questionnaire reported some or much annoyance to breathing air that smells of chemicals or other smells (Carlsson et al. 2005), and in another Swedish study in Skövde 33% of the participants in a clinical examination reported general odour intolerance (Johansson et al. 2005). Finally, in Germany 9% of the participants in a face-to-face interview survey reported that their body reacted immediately when exposed to chemicals (Hausteiner et al. 2005).

Exposure to airborne chemicals has been associated with loss of occupation and adjustments in social life. In the United States of America it has been estimated that approximately 4% of the adult population had trouble shopping in stores or eating in restaurants, whereas approximately 1.5% had lost or had to give up a job or occupation (Caress and Steinemann 2003; Caress and Steinemann 2004; Kreutzer et al. 1999). Furthermore, in the Skövde population-based study 19% of the participants were affected by odour intolerance in daily life to an extent that inflicted affective and behavioural consequences (Johansson et al. 2005).

Irrespectively of the cause of the reported symptoms related to inhalation of airborne chemicals these restraints in social life and occupational conditions are of importance to the affected individuals, and depending on the prevalence these individual consequences may also have socioeconomic implications. Population-based studies focusing on these consequences are needed to address the extent of the implications before requirements for general or individual interventions are considered.

To our knowledge, no study has investigated in greater detail the prevalence of restraints in social life and occupational conditions related to inhalation of airborne chemicals in a general population.

The aim of this study was to estimate the prevalence and individual consequences of symptoms related to inhalation of airborne chemicals in a Danish general population sample.

Methods

Study population and design

This population-based cross-sectional study was conducted between February 2006 and February 2007. In February 2006 a random sample consisting of 18–69-year-old individuals ($n = 6{,}000$) was drawn from the Danish Civil Registration System. All participants were Danish citizens born in Denmark and living in one of 11 municipalities of Copenhagen, the capital of Denmark (Albertslund, Ballerup, Brøndby, Glostrup, Herlev, Høje Taastrup, Hvidovre, Ishøj, Ledøje-Smørum, Rødovre, and Vallensbæk). The sample size was chosen as to allow an estimated prevalence with 95% confidence intervals of a given variable of e.g. 1% (0.7–1.3), 2% (1.6–2.4), or 3% (2.5–3.5) given a response rate of 66.7%.

A primary questionnaire on self-reported symptoms related to inhalation of airborne chemicals was mailed to the population in March and April 2006. Respondents who reported symptoms related to inhalation of airborne chemicals received an additional questionnaire in November 2006.

Questionnaires

The primary questionnaire focused on symptoms related to inhalation of airborne chemicals. The questionnaire was structured and initiated with questions on 11 categories of airborne chemicals that may be related to symptoms followed by questions on the character and individual consequences of the symptoms. Also included was a statement on whether the reported annoyance was due to symptoms or just to odours perceived as unpleasant. Questions on asthma were adopted from the stage I questionnaire of the European Community Respiratory Health Study (ECRHS) (Pekkanen et al. 2005). The eleven exposures were selected to cover a broad range of airborne chemicals commonly reported as annoying in the literature (Miller and Prihoda 1999) and by individuals reporting chemical intolerance in semi structured interviews conducted prior to this study. Exposure to pesticides is often associated with the reporting of chemical intolerance (Caress and Steinemann 2003). However, pesticides were not included in the questionnaire due to their restricted usage in Denmark especially in urban populations.

According to earlier studies, asthma is associated with the reporting of chemical sensitivity (Caress and Steinemann 2005; Elberling et al. 2005; Johansson et al. 2005; Kreutzer et al. 1999; Meggs et al. 1996). Questions on asthma were included in order to evaluate the impact of this disease on the severity of reported sensitivity.

The questionnaire was tested for linguistic comprehension, reproducibility, and relevance in a pilot group consisting of individuals with self-reported chemical sensitivities from the Danish patient organisation for multiple chemical sensitivities (MCS) ($n = 20$) and controls ($n = 10$). The questionnaire was mailed to the pilot group ($n = 30$), and a telephone interview was conducted 14–30 days after the completed questionnaire was received at the research centre. The same questions were used in the telephone interview without knowledge of the participant's initial answers. Reproducibility was assessed using Cohen's kappa, which yielded an average κ value of 0.86. The participants evalu-

ated the relevance and comprehension as satisfactory. Based on their comments no additional exposures or symptoms were found necessary to be included in the final questionnaire.

The additional questionnaire contained questions that allowed respondents to verify the reported symptoms from the primary questionnaire and to characterise factors related to the initial onset of symptoms.

Definition of variables

Respondents who reported at least one exposure as annoying and that exposure was not only unpleasant but induced symptoms as well were regarded as cases.

The cases were divided into categories according to which of the following three areas of adjustments of behaviour the symptoms had an impact on: (1) *personal lifestyle*, as defined by influence on products used for personal hygiene, products used for cleaning in the home, or choice of shopping places, (2) *social life*, as defined by influence on the use of public transportation, social functions in the private sphere, or gatherings in the public sphere, and (3) *occupational conditions*, as defined by influence on sick leave from work or school, permanently leaving employment or school, or inability to work.

Asthma was defined according to criteria previously employed by the ECRHS (Sunyer et al. 2004) as a positive answer to at least one of the following three questions: (1) Have you been woken by an attack of shortness of breath at any time in the last 12 months? (2) Have you had an attack of asthma in the last 12 months? (3) Are you currently taking any medicine (including inhalers, aerosols or tablets) for asthma?

In the analyses respondents were divided into five age groups in age bands of 10 years with the youngest being under 30 years of age and the oldest being over 60 years of age.

Collection of data

The response rate to the primary questionnaire after one reminder was 71% ($n = 4{,}242$). Twenty-nine questionnaires (0.5%) were returned because the address was unknown, 26 individuals (0.4%) declined to participate for various reasons, and 1,703 individuals (28%) did not respond. The response rate was attempted enhanced by rewarding 15 gift vouchers of 500 DKK to randomly selected participants who returned fully filled in questionnaires.

In the period between the collections of the primary and additional questionnaires, one respondent had died, four had moved outside Denmark, and one no longer had a known address, leaving 1,128 potential respondents to the additional questionnaire. The response rate to the additional questionnaire after one reminder was 78% ($n = 876$). Three questionnaires (0.3%) were returned because the address was unknown, five individuals (0.4%) declined to participate for various reasons, and 244 individuals (22%) did not respond. Ten gift vouchers of 500 DKK were rewarded to randomly selected respondents to the additional questionnaire in an attempt to enhance the response rate.

The primary questionnaires were scanned by the Danish company UNI·C using ReadSoft Eyes & Hands, whereas the additional questionnaires were double entered using SPSS Data Entry Builder 4.0 for Windows.

Statistical analyses

Ninety-five per cent confidence intervals for the estimated prevalence were calculated using the normal approximation to the binomial distribution (Altman 1991). Standardised proportions were calculated using the direct standardisation method (Clayton and Hills 1993) and the entire population ($n = 6{,}000$) as standard. Statistical analyses were performed with SPSS Version 13.0 for Windows. Mann–Whitney tests and Kruskal–Wallis tests were used to compare the number of reported exposures, symptoms, and adjustments of behaviour between the sexes and age groups, respectively. The associations between asthma and number of reported exposures, symptoms, and adjustments of behaviour were analysed using logistic regression. For all other comparisons the χ^2 two-tailed test was used.

Ethics

The study was approved by the Danish Data Protection Agency. According to Danish legislation questionnaire surveys do not need approval by an ethical committee.

Results

Characteristics of respondents and non-respondents are shown in Table 1. Male sex and young age were associated with non-respondence ($P < 0.001$, χ^2 two-tailed test).

Of the 4,242 respondents, 1,911 individuals (45%, CI 44–47) reported annoyance attributed to inhalation of at least one of the 11 exposures included in the questionnaire (Table 2). A total of 1,134 individuals (27%, CI 25–28) were defined as cases because they reported various symptoms, whereas the remaining 777 individuals (18% of total CI 17–19) denied symptoms and were only annoyed by the odour of the exposures.

Exposures related to symptoms have been ranked according to prevalence in Table 2. No exposure was related to symptoms by more than 15% of the respondents.

Table 1 Characteristics of respondents and non-respondents

	Respondents % (*n*)	Non-respondents % (*n*)	Total (*n*)
Sex[a]			
Women	75.8 (2,300)	24.2 (736)	3,036
Men	65.5 (1,942)	34.5 (1,022)	2,964
Total	70.7 (4,242)	29.3 (1,758)	6,000
Age[a]			
<30	55.3 (505)	44.7 (408)	913
30–40	66.9 (756)	33.1 (374)	1,130
40–50	72.3 (1,026)	27.7 (394)	1,420
50–60	77.5 (1,008)	22.5 (293)	1,301
>60	76.6 (947)	23.4 (289)	1,236
Total	70.7 (4,242)	29.3 (1,758)	6,000

[a] $P < 0.001$ (χ^2 two-tailed)

Women reported more exposures as annoying than men ($P < 0.001$, Mann–Whitney test). Table 3 shows the prevalence of symptoms related to inhalation of airborne chemicals. Headache and nasal symptoms were the most commonly reported symptoms by both sexes. At least one ocular or respiratory symptom was reported by 1,017 individuals (24%, CI 23–25), while at least one symptom from the CNS and at least one symptom from other organs were reported by 804 (19%, CI 18–20) and 424 (10%, CI 9–11) individuals, respectively. Women reported more symptoms than men ($P < 0.001$, Mann–Whitney test).

Seven hundred and ninety individuals (19%, CI 17–20) reported at least one adjustment of behaviour due to symptoms (Table 4). At least one adjustment in social life or occupational conditions was reported by 141 individuals (3.3%, CI 2.8–3.9) while 20 individuals (0.5%, CI 0.3–0.7) reported at least one adjustment in social life together with at least one adjustment in occupational conditions. Women reported more adjustments of personal lifestyle than men ($P < 0.001$, Mann–Whitney test). In contrast, no difference was found between women and men in adjustments of social life or occupational conditions (odds ratio = 1.11, CI 0.79–1.56) or in adjustments of both social life and occupational conditions (odds ratio = 0.84, CI 0.35–2.03).

Age and sex standardised proportions using the total random sample as the reference by direct standardisation did not differ significantly from any of the proportions shown in Tables 2–4.

Individuals over 60 years of age reported fewer symptoms and adjustments of behaviour and were annoyed by fewer exposures than others (all $P < 0.001$, Kruskal–Wallis test). When the oldest group was excluded from the analyses, no effect of age was found (all $P > 0.10$, Kruskal–Wallis test).

A total of 499 respondents (12%, CI 11–13) reported asthma, and the prevalence of asthma increased with increasing number of reported exposures, symptoms, and adjustments of behaviour (all $P < 0.001$, logistic regression). However, only a minority of the respondents had asthma even among those most severely affected as defined by adjustments of social life or occupational conditions (where the prevalence of asthma was highest at 38%).

Overall, 79% (CI 78–80) of the reported exposures and symptoms in the primary questionnaire were confirmed in

Table 2 Prevalence of exposures related to symptoms

Have you ever experienced unpleasant reactions elicited by inhalation of odours or chemicals from?	All respondents % (*n*) total = 4,242	95% CI	Women % (*n*) total = 2,300	Men % (*n*) total = 1,942	*P*-value[a]
Other persons wearing of perfume, aftershave, or deodorant	15.0 (637)	14.0–16.1	19.5 (448)	9.7 (189)	<0.001
Motor vehicle exhaust	14.5 (616)	13.5–15.6	17.4 (401)	11.1 (215)	<0.001
Cleaning agents	14.3 (605)	13.2–15.3	18.2 (418)	9.6 (187)	<0.001
Freshly printed papers or magazines	10.2 (431)	9.3–11.1	13.0 (299)	6.8 (132)	<0.001
Smoke from wood burner	8.8 (373)	7.9–9.6	11.1 (255)	6.1 (118)	<0.001
Nail polish remover, glue, or markers	8.6 (366)	7.8–9.5	10.8 (248)	6.1 (118)	<0.001
New furniture	5.5 (234)	4.8–6.2	6.8 (156)	4.0 (78)	<0.001
Tar or wet asphalt	5.3 (224)	4.6–6.0	7.0 (161)	3.2 (63)	<0.001
Cooking fumes	5.2 (222)	4.6–5.9	7.0 (161)	3.1 (61)	<0.001
Soft plastic or rubber	2.9 (125)	2.4–3.5	4.0 (93)	1.6 (32)	<0.001
New electronic equipment	1.8 (75)	1.4–2.2	2.0 (47)	1.4 (28)	0.138
At least one exposure[b]	26.7 (1,134)	25.4–28.1	31.3 (721)	21.3 (413)	<0.001

[a] Between sexes (χ^2 two-tailed)

[b] Respondents reporting at least one of the 11 exposures above as related to symptoms

Table 3 Prevalence of symptoms associated with inhalation of airborne chemicals

Can inhalation of odours or chemicals elicit?	All respondents % (*n*) total = 4,242	95% CI	Women % (*n*) total = 2,300	Men % (*n*) total = 1,942	*P*-value[a]
Ocular and respiratory symptoms					
Nose	16.4 (694)	15.3–17.5	19.7 (453)	12.4 (241)	<0.001
Eyes	12.8 (544)	11.8–13.8	15.4 (355)	9.7 (189)	<0.001
Lungs	11.1 (469)	10.1–12.0	12.8 (294)	9.0 (175)	<0.001
Throat	8.6 (364)	7.7–9.4	11.0 (253)	5.7 (111)	<0.001
Mouth	3.0 (126)	2.5–3.5	3.5 (80)	2.4 (46)	0.034
Sinuses	2.1 (87)	1.6–2.5	2.6 (59)	1.4 (28)	0.010
Symptoms from the central nervous system					
Headache	16.6 (705)	15.5–17.7	21.4 (493)	10.9 (212)	<0.001
Dizziness	6.1 (258)	5.4–6.8	7.3 (167)	4.7 (91)	<0.001
Difficulty concentrating	3.8 (163)	3.3–4.4	4.3 (98)	3.3 (65)	0.123
Exhaustion	3.5 (148)	2.9–4.1	4.3 (100)	2.5 (48)	0.001
Grogginess	2.1 (90)	1.7–2.6	2.2 (51)	2.0 (39)	0.638
Panic attack	0.6 (26)	0.4–0.8	0.9 (20)	0.3 (6)	0.020
Symptoms from other organs					
Skin	6.4 (271)	5.7–7.1	8.0 (183)	4.5 (88)	<0.001
Heart/chest	2.9 (122)	2.4–3.4	3.0 (68)	2.8 (54)	0.733
Gastrointestinal tract	2.8 (117)	2.3–3.3	2.9 (67)	2.6 (50)	0.503
Joints	1.3 (57)	1.0–1.7	1.7 (39)	0.9 (18)	0.030
Muscles	1.0 (44)	0.7–1.3	1.3 (30)	0.7 (14)	0.062
Urinary tract	0.1 (6)	0.03–0.25	0.2 (4)	0.1 (2)	0.540

[a] Between sexes (χ^2 two-tailed)

Table 4 Prevalence of adjustments of behaviour due to symptoms related to inhalation of airborne chemicals

Have reactions elicited by inhalation of odours or chemicals caused?	All respondents % (*n*) total = 4,242	95% CI	Women % (*n*) total = 2,300	Men % (*n*) total = 1,942	*P*-value[a]
Adjustments of personal lifestyle					
Personal hygiene products	16.6 (705)	15.5–17.7	21.3 (490)	11.1 (215)	<0.001
Cleaning in the home	9.9 (422)	9.1–10.8	13.7 (315)	5.5 (107)	<0.001
Choice of shopping places	3.7 (159)	3.2–4.3	4.9 (112)	2.4 (47)	<0.001
Adjustments of social life					
Social functions in the private sphere	0.8 (34)	0.5–1.1	0.8 (18)	0.8 (16)	0.881
Gatherings in the public sphere	0.7 (31)	0.5–1.0	0.8 (19)	0.6 (12)	0.428
Public transportation	0.6 (25)	0.4–0.8	0.8 (18)	0.4 (7)	0.074
Adjustments of occupational conditions					
Sick leave from work or school	2.1 (87)	1.6–2.5	1.9 (44)	2.2 (43)	0.491
Left employment or school permanently	0.8 (34)	0.5–1.1	0.8 (19)	0.8 (15)	0.845
Inability to work	0.4 (15)	0.2–0.5	0.3 (7)	0.4 (8)	0.556

[a] Between sexes (χ^2 two-tailed)

the additional questionnaire, and 76% (CI 75–77) of the specific exposures and symptoms reported as not annoying and not present, respectively in the primary questionnaire were confirmed as not annoying and not present in the additional questionnaire. Of the 876 respondents to the additional questionnaire 98 (11%, CI 9–13) declined that they had ever experienced symptoms related to inhalation of airborne chemicals. These individuals were only included in the test–retest analyses above leaving 778 respondents for the following analyses.

When asked about the initial onset of the symptoms, 130 (17%, CI 14–19) reported a sudden onset, 312 (40%, CI 37–44) a gradual onset, 166 (21%, CI 18–24) reported that they had always reacted, whereas 164 (21%, CI 18–24) did not know, and 6 (1%) did not answer. Two hundred and twenty seven (29%, CI 26–32) could point to a least one circumstance that may have influenced the initial onset of their symptoms, and of those 96 (42%, CI 36–49) reported factors related to the indoor environment, 89 (39%, CI 33–46) reported exposure to organic solvents or paint, 75 (33%, CI 27–39) reported smoking or passive smoking, whereas 51 (22%, CI 17–28) reported stress in their job or private life.

Discussion

We found that 45% of the respondents reported to have been annoyed by at least one of the 11 exposures in the questionnaire, and 27% reported symptoms related to inhalation of airborne chemicals. Nineteen per cent of the respondents reported that the symptoms had caused them to make adjustments of behaviour, 3.3% had made adjustments of social life or occupational conditions as a consequence of their symptoms, whereas 0.5% had made adjustments of both social life and occupational conditions. These findings suggest that annoyance related to inhalation of airborne chemicals is frequent in the population, but only a minority is affected to a degree that imposes adjustments of social life or occupational conditions.

Population-based studies on symptoms related to inhalation of airborne chemicals are limited in number and have yielded quite different estimates of the prevalence of affected individuals depending on which case definition the authors have applied. Our estimate that 27% of the respondents were annoyed by inhalation of common airborne chemicals to a degree that produces specific symptoms is in accordance with the findings in North Carolina (33%) (Meggs et al. 1996), New South Wales (24.6%) (Centre For Epidemiology And Research 2003), and Skövde, Sweden (33%) (Johansson et al. 2005) where a comparable broad definition on chemical sensitivities were applied. Also, the 19% who reported that symptoms related to airborne chemicals have caused them to make adjustments of behaviour is consistent with the finding in Skövde of 19% (Johansson et al. 2005). We found that in 3.7% of the respondents symptoms influenced their choice of stores when shopping, and this corresponds well with the findings in California (3.3%) (Kreutzer et al. 1999), Atlanta, Georgia (4.0%) (Caress and Steinemann 2003), and USA as a whole (4.5%) (Caress and Steinemann 2004). In our study 0.8% had left employment or school permanently, a somewhat lower prevalence than the 1.4, 1.8, and 1.5% reported from California (Kreutzer et al. 1999), Atlanta, Georgia (Caress and Steinemann 2003), and USA, respectively (Caress and Steinemann 2004).

When our findings are generalised to the Danish population between 18 and 69 years of age of 3,653,194 on January 1, 2007, they suggest that almost one million individuals have symptoms related to inhalation of common airborne chemicals, and that approximately 17,000 individuals are annoyed to a degree that has made adjustments of both social life and occupational conditions necessary. The present study was performed in a suburban population and might not be representative for the whole population of Denmark. However, the New South Wales Health Survey Program suggests that people in rural and urban areas report sensitivity to chemical odours with similar prevalence (Centre For Epidemiology And Research 2003) and thereby lends credibility to the generalizability of our results to the total population of Denmark.

Women reported significantly more exposures as annoying than men as well as more symptoms and adjustments of personal lifestyle caused by inhalation of airborne chemicals. This effect of sex on self-reported chemical sensitivity has been found repeatedly in population-based studies on chemical sensitivities (Caress and Steinemann 2003; Caress and Steinemann 2004; Carlsson et al. 2005; Centre For Epidemiology And Research 2003; Hausteiner et al. 2005; Johansson et al. 2005; Kreutzer et al. 1999; Meggs et al. 1996) and may be attributed, in part, to the fact that women generally score higher than men on self-report scales, especially on minor, transient, and subjective health problems (van Wijk and Kolk 1997). Surprisingly, however, no difference was found between men and women when looking at adjustments of social life or occupational conditions. To our knowledge, the effect of sex on adjustments of behaviour has not been investigated before. The finding that a similar number of women and men are affected to a degree that causes them to make adjustments of social life or occupational conditions is interesting and calls for replication.

Individuals over 60 years of age reported fewer exposures as annoying as well as fewer symptoms and adjustments of behaviour caused by inhalation of airborne chemicals than any other age group. This finding is in accordance with earlier studies (Carlsson et al. 2005; Centre For Epidemiology And Research 2003; Meggs et al. 1996). This could suggest a true effect of age, a cohort effect, or possibly reflect the differences in lifestyle and stress experienced between senior citizens and others as well as the fact that it may be easier to control one's exposure to annoying airborne chemicals after retirement.

The association between asthma and self-reported chemical sensitivity is well known (Caress and Steinemann 2005; Elberling et al. 2005; Johansson et al. 2005; Kreutzer

et al. 1999; Meggs et al. 1996). We found a strong association between asthma and the reporting of an increasing number of exposures, symptoms, and adjustments of behaviour. However, even among those who reported adjustments of social life or occupational conditions, the respondents who reported asthma constituted a minority. Thus, even though asthma is associated with the symptomatology related to inhalation of airborne chemicals other explanations for these symptoms have to be sought as well even for those most severely affected.

Twenty-nine per cent related certain circumstances to the initiation of their symptoms. This number is in accordance with the finding of Caress and Steinemann in one study where 29.1% of their respondents with chemical hypersensitivity knew what caused their hypersensitivity (Caress and Steinemann 2004). In our study no single factor related to the initiation of the symptoms was reported by a majority of the respondents. This result, together with the finding that 57% reported a sudden or gradual onset whereas 43% reported that they had always reacted or did not know the temporal course of the onset of symptoms, describes a heterogeneous group in terms of perception of the initial onset of symptoms.

The reproducibility of the primary questionnaire was determined in the pilot group and yielded an average κ value of 0.86 indicating good reproducibility. The reliability of the questions on exposures and symptoms in a general population could be assessed by comparing the answers from the primary questionnaire with the ones given in the additional questionnaire. This indicated a fair concordance for both positive answers (79%) and negative answers (76%).

The estimated prevalence of chemical sensitivities may depend on both the questions asked and the definitions applied. In this study the adjustment of behaviour was used instead of self-reported severity to indicate the severity of the symptoms. The prevalence of adjustments of behaviour observed was comparable to that observed in earlier studies using similar questions, which supports the use of these variables as indicators of the severity of the symptoms. Furthermore, questions on adjustments of behaviour avoid the use of adjectives to describe the severity of the symptoms thereby minimising bias induced by interpretation of the questions.

In conclusion, symptoms related to inhalation of airborne chemicals were common in this general population sample, and a minority of individuals reported the symptoms to affect social life or occupational conditions. Women as compared to men reported more exposures as annoying, had more symptoms, and reported more adjustments of personal lifestyle due to the symptoms. Nevertheless, men were as likely as women to report adjustments of social life or occupational conditions.

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