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Physical and chemical trigger factors in environmental intolerance

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ABSTRACT

Background: Individuals with environmental intolerance (EI) react to exposure from different environmental sources at levels tolerated by most people and that are below established toxicological and hazardous thresholds. The main aim of this study was to determine the prevalence of attributing symptoms to chemical and physical sources in the environment among individuals with different forms of self-reported EI and in referents.

Methods: Cross-sectional data from a population-based study, the Västerbotten Environmental Health Study (n = 3406), were used and individuals with self-reported EI to chemicals, buildings, electromagnetic fields and sounds as well as a group with multiple EIs were identified. The Environmental-Symptom Attribution Scale was used to quantify degree to which health symptoms are attributed to 40 specific environmental exposures and sources, with subscales referring to the four types of EI.

Results: All EI groups, except the group with building related intolerance (BRI), reported more symptoms from the expected sources compared to the referents. In addition, individuals with chemical and sound intolerance reported symptoms from building related trigger factors, and individuals with electromagnetic hypersensitivity reported symptoms from chemical trigger factors.

Conclusions: The study suggests that individuals with BRI react to fewer and more specific trigger factors than do individuals with other EIs, and that it is important to ask about different sources since three of the EI groups attribute their symptoms to a wide variety of sources in addition to the sources to which their EI implicates.

1. Introduction

Environmental intolerance (EI) refers to reactions to exposure from different environmental sources at levels tolerated by most people and that are below established toxicological and hazardous thresholds. The different EIs are defined by the particular source reported to be the cause. In EI attributed to chemicals, here referred to as chemical intolerance (CI), symptoms are reported from low-level exposure to commonly encountered environmental odorous chemicals such as perfume and cleaning products (Berg et al., 2008). In EI attributed to certain buildings, building related intolerance (BRI), the trigger factors are usually various volatile organic compounds due to, for example, insufficient ventilation, dampness and mold growth (Norbäck, 2009). Individuals with EI attributed to electromagnetic fields, electromagnetic hypersensitivity (EHS), commonly attribute their symptoms to exposure to mobile phones, mobile phone base stations, power lines and WiFi (Hansson Mild et al., 2006). Individuals with intolerance attributed to everyday sounds, sound intolerance (SI), often report symptoms attributed to, for example, mechanical and monotonous sounds and clatter (Andersson et al., 2002).

Earlier studies indicate that once a person has developed a certain EI he/she may with time develop reactions to a broader range of trigger factors (Winder, 2002). Consequently, there is large comorbidity between EIs (Palmquist et al., 2014) and overlap in symptomatology, in particular regarding general symptoms (e.g. headache, fatigue and concentration difficulties). In addition to overlap between EIs, there is considerable overlap in EIs with other functional somatic syndromes (Jason et al., 2000; Paulin et al., 2016; Ståhlberg et al., 2016). With 37 unexplained symptoms from 13 different functional somatic syndromes included in a model, 30% of the total variance could be explained by a single factor, which has evoked the question of similar underlying mechanisms (Nimnuan et al., 2001). Indeed, it is possible that different types of EI may share the mechanisms of neurogenic inflammation (Meggs, 1999), classical conditioning (Van den Bergh et al., 2001), symptom misattribution (Rubin et al., 2014), neural sensitization (Bell et al., 2001) and nocebo effect (Rubin et al., 2010). Information about trigger factors in EI may be considerably valuable in identifying possible subgroups which could be of importance for understanding these suggested underlying mechanisms.

Despite overlap in symptoms between EIs, certain symptoms are more commonly reported in certain EIs, such as mucosal symptoms in CI and BRI (Andersson et al., 2009; World Health Organization, 1983),

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Table 1
Description of groups with self-reported environmental intolerance and F-values from results from group comparisons by χ2.

	Chemical intolerance (n = 249)	Building related intolerance (n = 49)	Electromagnetic hypersensitivity (n = 38)	Sound intolerance (n = 203)	Multiple environmental intolerance (n = 197)	Referents (n = 2670)	Overall analysis χ2/ F-value
Sex (% women)	64	65	55	68	74	52	60.3***
Age (years; mean ± SD)	53.5 ± 16.0	51.0 ± 14.4	44.8 ± 16.0	47.5 ± 15.3	53.2 ± 15.1	51.3 ± 17.2	4.4***
Duration of intolerance (years; mean ± SD)							
Chemical intolerance	17.7 ± 13.7	–	–	–	17.0 ± 12.2	–	0.3ns
Building related intolerance	–	10.5 ± 10.8	–	–	16.3 ± 13.0	–	6.6**
Electromagnetic hypersensitivity	–	–	8.8 ± 8.5	–	11.7 ± 8.0	–	2.3ns
Sound intolerance	–	–	–	10.5 ± 9.5	12.2 ± 8.6	–	2.1ns
Symptoms (%)							
Airway	57.4	57.1	57.9	52.7	52.0	55.0	1.8ns
Eye	24.9	30.6	36.8	18.2	20.3	21.6	10.5ns
Skin	31.7	24.4	52.6	30.0	34.5	28.2	15.3**
Head related	51.4	57.1	73.7	48.7	54.8	50.4	10.6ns
Gastrointestinal	42.2	44.9	47.4	37.9	42.1	40.0	2.5ns
Cognitive or affective	65.9	73.5	71.1	63.1	65.0	62.5	4.8ns
Physician-based diagnosis (%)							
MCS/SHR[a,b]	16.9	4.1	2.6	0.5	26.4	0.5	318.3***
Non-specific BRI[a,c]	2.4	14.3	2.6	0	12.7	0.3	132.5***
Sound Intolerance	1.6	0	0	21.2	13.2	0.9	368.6***
IEI-EMF[d]	0.4	0	18.4	0	3.6	0	336.7***
Asthma/allergy	34.9	28.6	10.5	15.3	40.1	11.8	197.3***
Chronic sinusitis[a]	1.6	6.1	2.6	0.5	3.0	0.4	28.1***
Migraine[a]	7.6	12.2	7.9	8.4	7.1	3.4	29.0***
Tinnitus[a]	6.4	6.1	0	27.1	16.8	5.6	109.7***
Reumatism (back, joint, muscle)	26.5	22.4	18.4	18.2	32.5	15.0	57.5***
Fibromyalgia[a]	5.6	2.0	2.6	3.0	6.1	1.5	27.9***
IBS[a,e]	4.4	6.1	0	3.9	5.6	1.8	20.4***
Depression	3.6	6.1	2.6	13.2	16.2	3.7	68.3***
Burnout syndrome[a]	6.4	2.0	5.3	11.3	13.2	2.8	62.4***
Chronic fatigue syndrome[a]	0.8	0	2.6	2.0	4.1	0.3	31.1***
Anxiety/panic disorder[a]	1.6	0	0	2.0	4.1	1.3	26.7***

[a] Fishers exact test due to cell frequency < 5.
[b] Multiple chemical sensitivity/Sensory hyperreactivity.
[c] Non-specific building related intolerance.
[d] Idiopathic environmental intolerance attributed to electromagnetic fields.
[e] Irritable bowel syndrome.
** p < 0.01.
*** p < 0.001.
[ns] non-significant.

skin symptoms in EHS (Edvardsson et al., 2008), and emotional symptoms in SI (Andersson et al., 2002). About 22% of the general population in Sweden report having at least one of these EIs, and 6% report having been given such a diagnosis by a physician (Palmquist et al., 2014).

EIs have strong impact on quality of life in the afflicted person, partly due to avoidance of the exposure and thereby to withdrawal from society (Bailer et al., 2008; Söderholm et al., 2016,2011). To increase the understanding for and to help the individual with EI, and also to prevent development of EI it is important to identify risk factors. Identification of exposure risk factors may help increase focus on more valid exposures. An early detection and intervention including minimizing exposure to the specific triggers might result in improved outcomes, for example in EI attributed to certain buildings (Edvardsson et al., 2008). However, in severe cases of EI, minimizing the exposure might in a long-term perspective have the opposite effect (Edvardsson et al., 2008; Winder, 2002). The absence of tools to identify a relationship between environmental factors and health effects makes it important also to identify reported trigger factors since this might be a useful tool for identifying strategies for measurement in certain environments.

The aim of this study was to test the hypothesis that individuals with one of the self-reported EIs, thus CI, BRI, EHS and SI, and individuals with multiple EI (MEI) rate higher than individuals without any EI (referents) on scales investigating (i) attribution of symptoms to various chemicals and physical sources and (ii) behavioral disruptions and affective reactions to environments with odorous/pungent sources, sounds and electromagnetic fields. We also hypothesized that individuals with a certain EI rate particularly high on trigger factors related to their intolerance (e.g. a group with CI rates higher than the other EI groups on the Odourous/Pungent subscale). Data used for this study were obtained from the Västerbotten Environmental Health Study.

2. Materials and methods

2.1. Study population and sample

The Västerbotten Environmental Health Study is an embracing name for investigations regarding environmental health matters in Sweden. To obtain a representative sample of the general population, 8600 adults (aged 18–79 years) from the county of Västerbotten, Sweden were randomly selected from the population registry after stratification for sex and six age strata: 18–29, 30–39, 40–49, 50–59, 60–69 and 70–79 years. The county of Västerbotten in Northern Sweden, has an age and sex distribution that is very similar to that of

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