Journal of Environmental Psychology 36 (2013) 9–17

Contents lists available at SciVerse ScienceDirect

Journal of Environmental Psychology

journal homepage: www.elsevier.com/locate/jep

# The Environmental Symptom-Attribution Scale: Metric properties and normative data

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ARTICLE INFO

*Article history:*
Available online 29 June 2013

*Keywords:*
Electromagnetic fields
Environmental hypersensitivity
Idiopathic environmental intolerance
Multiple chemical sensitivity
Noise sensitivity
Nonspecific building-related symptoms

ABSTRACT

The objective was to develop, metrically evaluate and establish normative data for the Environmental Symptom-Attribution Scale (ESAS), which is a questionnaire-based instrument for quantifying degree to which health symptoms are attributed to specific environmental exposures and sources. Data were used from 3406 individuals who took part in the Västerbotten Environmental Health Study in Sweden. The responders constitute a random sample, aged 18–79 years. They responded to the ESAS and to questions about physician-based diagnoses for evaluation of concurrent validity of the ESAS. Four dimensions of the ESAS were identified, constituting subscales: the Odorous/Pungent, Building-Related, Sound, and Electromagnetic Field Subscales. A Global Scale is available as well. In general, the distributions of the scores on the scales were positively skewed and leptokurtic in shape. The results demonstrate good reliability and concurrent validity of all five ESAS scales. Percentiles were obtained as normative data. Examples of use of the ESAS applied on individuals are provided. The favorable metric properties of the ESAS and its rapid administration suggest that it is useful for assessment in clinical and epidemiological settings.



## 1. Introduction

Environmental intolerance is a common condition in the general population. Data from a Swedish population-based survey show that as many as 21.6% of the general population report intolerance attributed to at least one of the four environmental exposures: odorous/pungent chemicals, visits in certain buildings, everyday sounds, and electromagnetic fields (EMFs; Nordin et al., 2012). Clinical cases with these intolerances can be referred to as multiple chemical sensitivity (MCS; Labarge & McCaffrey, 2000), nonspecific building-related symptoms (Hodgson & Addorisio, 2005), sensitivity to sounds (Baguley, 2003), and idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF; Genuis & Lipp, 2012).

Several circumstances contribute to make this research field problematic: no identified dose–response relationship, no characteristic symptom pattern, and no generally agreed on physiological markers. This highlights the need for an individually-based rather than group-based approach as well as a subjective rather than an objective approach. In accordance with these approaches, questionnaire-based instruments have been developed that have good metric properties for assessment of environmental intolerances. These include assessment of affective reactions to and behavioral disruptions by odorous/pungent chemicals, sounds and EMFs (Nordin, Bende, & Millqvist, 2004; Nordin, Millqvist, Löwhagen, & Bende, 2003, 2004; Nordin, Palmquist, Bende, & Millqvist, 2012; Nordin, Palmquist, & Claeson, 2012; Weinstein, 1978); symptom reactions to chemical exposure (Bailer, Witthöft, & Rist, 2006; Miller & Prihoda, 1999); IEI symptomology (Andersson, Andersson, Bende, Millqvist, & Nordin, 2009; Miller & Prihoda, 1999); and impact on quality of life in MCS (Miller & Prihoda, 1999).

Apart from general symptoms (e.g., fatigue) that are very common in environmental intolerances, certain symptoms may be relatively common in a certain type of intolerance. For example, airway symptoms dominate in MCS (Andersson et al., 2009), mucosae and skin symptoms among nonspecific building-related symptoms (Edvardsson et al., 2008), attentional and emotional symptoms in sound sensitivity (Andersson, Lindvall, Hursti, & Carlbring, 2002), and skin symptoms in IEI-EMF (Hillert Berglind, Arnetz, & Bellander, 2002). The adverse impact on quality of life is considerable among severe cases of environmental intolerance (e.g., Söderholm, Söderberg, & Nordin, 2011).

Although several risk factors have been identified and underlying mechanisms have been proposed, environmental intolerances are at large considered as medically unexplained symptoms.

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http://dx.doi.org/10.1016/j.jenvp.2013.06.006

The mechanisms underlying MCS appear not to be referred to toxicity (Das-Munshi, Rubin, & Wessely, 2006) or allergens (Millqvist, 2008). Apart from effects of microbial volatile organic compounds on eye and upper-airway irritation at relatively high concentrations, it has not been possible to demonstrate that nonspecific building-related symptoms are caused by organic compounds at concentrations measured indoors (Korpi, Järnberg, & Pasanen, 2009). Regarding sound sensitivity, mechanical damage to the auditory system it typically not the cause (Baguley, 2003). Furthermore, there is no evidence for health effects from EMF exposure per se at those low levels to which individuals with IEI-EMF typically attribute their symptoms. Instead there is support for a nocebo effect in triggering acute health effects in IEI-EMF (Rubin, Nieto-Hernandez, & Wessely, 2010). This review highlights the importance of the individual's attribution of symptoms to environmental factors.

A few validated questionnaire instruments are available for quantifying degree to which the afflicted person experiences that specific odorous/pungent chemicals have a negative impact on health. Kipen, Hallman, Kelly McNeil, and Fiedler (1995) developed a scale of chemical sensitivity based on ratings of subjective reactions to 122 odorous/pungent chemicals. Partly due to its extensive time consumption, five of these chemicals were extracted to constitute the Chemical Odor Intolerance Index (Szarek, Bell, & Schwartz, 1997). For each odorous/pungent chemical, the respondent rates on a 5-point scale the frequency of feeling ill from the substance. The Quick Environmental Exposure and Sensitivity Inventory was subsequently developed by Miller and Prihoda (1999), and includes a subscale for quantifying the impact of ten odorous/pungent chemicals on health, to be rated on an 11-point scale.

Instruments for assessment of specific environmental exposures and sources to which symptoms are attributed are limited to odorous/pungent chemicals. Since it is common to have symptoms attributed to several types of environmental exposure (odorous/pungent chemicals, certain buildings, sounds and EMFs; Carlsson, Karlsson, Orbaek, Österberg, & Östergren, 2005; Hillert et al., 2002; Nordin et al., 2012), it would be of considerable value to have a questionnaire instrument that can assess symptoms attributed to all these factors. Although not assessing symptoms per se, a broad environmental approach was taken in the late 1980s by Schmidt and Gifford (1989) who developed the Environmental Appraisal Inventory. This inventory was designed to measure appraisal of (i) environmental threat to self, (ii) threat to the environment posed by environmental hazards, and (iii) perceived control over environmental hazards. Some of its items (e.g., chemical dumps, noise and fluorescent lighting) refer to environments of direct relevance for environmental intolerance.

An objective of the present work was to develop a questionnaire-based instrument, called the Environmental Symptom-Attribution Scale (ESAS), for quantifying extent to which symptoms are attributed to environmental exposures and sources of relevance for environmental intolerances. Other objectives were to evaluate its metric properties, and to provide normative data. Examples of application of the ESAS on single individuals are given as well. The ESAS is intended as an inexpensive and time-efficient ($\leq$5 min) instrument to be used in clinical and epidemiological settings for quantifying degree to which health symptoms are attributed to specific environmental exposures. These exposures refer to (i) odorous/pungent chemicals, (ii) environmental aspects related to buildings, (iii) sounds, and (iv) EMF sources. Factor analysis was performed to identify subscales for different types of symptom-attributing factors. In addition to subscales, the ESAS was aimed at providing a global measure of health symptoms attributed to environmental exposures.

The psychometric evaluation was performed with respect to the scales' frequency distribution of scores, reliability (internal consistency), and concurrent validity. The concurrent validity was represented by the ability of the ESAS to differentiate groups of persons with a physician-based diagnosis of environmental intolerance from referents (persons without these diagnoses). In addition to normative data for a general population, reference data were obtained for combinations of specific age groups and gender. Finally, two intolerant individuals are given as examples to illustrate how the ESAS can be used to identify specific environmental exposures to which the individual attributes his/her health symptoms. This was conducted by means of a population-based study, the Västerbotten Environmental Health Study.

## 2. Methods

### 2.1. Study population and sample

The Västerbotten Environmental Health Study is an embracing name for different investigations on the same general population regarding various forms of environmental intolerance in Sweden. The study population, inhabitants in the county of Västerbotten in Northern Sweden, has an age and gender distribution that is very similar to that of Sweden in general (Statistics Sweden, 2012). A random sample, drawn from the municipal register, of 8520 individuals aged 18–79 years was invited to participate. The sample was stratified for age and gender according to the following age strata: 18–29, 30–39, 40–49, 50–59, 60–69, and 70–79 years. Of the 8520 individuals, 3406 (40.0%) participated. Age and gender distributions for the sample are given in Table 1. The highest non-response rate is found among men aged 18–29 years. The sample is further described in Table 2 with respect to demographic, environmental and health issues of relevance to environmental intolerance.

### 2.2. The Environmental Symptom-Attribution Scale

The items of the ESAS are forty environments and sources to which persons with MCS, nonspecific building-related symptoms, sound sensitivity, and IEI-EMF often attribute their health symptoms (e.g., Andersson et al., 2002; Hansson Mild, 2006; Miller, 2001; Norbäck, 2009). The ESAS items and their relative order are presented in Table 3. The general instruction for the ESAS is "Rate to what extent the following environments/sources bother you." Each environment is rated on the Environmental Annoyance Scale, which is a category scale with seven semantic descriptors: "Not at all (0)", "a little (1)", "partly (2)", "pretty much (3)", "rather much (4)", "to a large extent (5)", and "extremely much (6)". It has ratio-scale properties and good reliability and validity (Nordin, Lidén, & Gidlöf-Gunnarsson, 2009).

### 2.3. Additional questions

A questionnaire was used that included questions on background information pertaining to the demographic, environmental and health issues (Table 2). The questions about diagnoses were

**Table 1**
Numbers of responders (and response percentages) across age and gender strata.

| Age strata (years) | Women | Men |
|---|---|---|
| 18–29 | 307 (32.7%) | 179 (17.7%) |
| 30–39 | 266 (40.9%) | 177 (25.2%) |
| 40–49 | 288 (40.7%) | 230 (31.3%) |
| 50–59 | 367 (51.0%) | 295 (39.7%) |
| 60–69 | 405 (58.6%) | 356 (50.7%) |
| 70–79 | 265 (53.8%) | 271 (63.9%) |
| 18–79 | 1898 (45.2%) | 1508 (34.9%) |