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Jan Bergdahl · Lena Mårell · Maud Bergdahl · Hjördis Perris

Psychobiological personality dimensions in two environmental-illness patient groups

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Abstract The aim of the present study was to investigate the psychobiological personality dimensions in two subgroups of patients with environmental illness (EI). Fifty-nine patients, 34 women and 25 men (aged 32–69 years), were referred for symptoms allegedly caused by abnormal sensitivity to either dental fillings (DF; *n*=26) or electromagnetic fields (EMF; *n*=33). For the evaluation of personality, the Swedish 238-item version of the Temperament and Character Inventory (TCI) was used. Compared with a control group, the EMF group scored higher on the temperament dimension Persistence. The DF group scored higher on the TCI subscales Harm Avoidance (fatigability and asthenia) and Self-Directedness (self-acceptance). Women scored higher than men did on the Novelty Seeking and Reward Dependence (RD) dimensions in the DF group and on RD in the control group, indicating an inherited gender difference. No differences were found between men and women in the EMF group. Our results indicate that the high level of persistence found in the EMF group and the high level of fatigability and asthenia in combination with high self-acceptance found in the DF group represent vulnerable personalities. No significant differences were found between the two patient groups, indicating that these groups are quite similar regarding personality. This vulnerability can be expressed as various mental and somatic symptoms, which can be interpreted as EI symptoms by the affected individual.

J. Bergdahl (✉)
Department of Psychology, Umeå University,
Umeå, 901 87, Sweden
e-mail: jan.bergdahl@psy.umu.se
Tel.: +46-90-7866645
Fax: +46-90-7866692

L. Mårell · M. Bergdahl
Department of Odontology, Umeå University,
Umeå, 901 87, Sweden

H. Perris
Swedish Institute of Cognitive Psychotherapy,
Stockholm, Sweden

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Introduction

Environmental somatisation syndrome, multiple chemical sensitivity syndrome and environmental illness (EI) are various names of a syndrome described since the 1940s. This syndrome is characterised by patients' beliefs that their symptoms are caused by a very low level of exposure to environmental substances and, in the recent decade, to dental restorative materials and/or electricity and radiation from visual display units [19].

Four major views about the aetiology of EI have been proposed [23, 24]. The first view is that it is a physical or psychophysiologic reaction to multiple environmental chemicals. The second view is that symptoms may be precipitated by low-level environmental chemical exposures but the underlying increased sensitivity may be initiated by psychological stress. The third view suggests a misdiagnosis in that chemical exposures are not the cause of the symptoms. In this case symptoms may be due to misdiagnosed physical or psychological illness. The fourth view is that it is simply a belief system instilled by certain practitioners, the media, or other groups in the society.

Symptoms such as dizziness, fatigue, palpitations, headache, and pain, as well as sleep, concentration, and memory disturbances, are common [15]. Many patients report manifest somatic symptoms that are impossible to diagnose as being caused by any somatic disorder. In medical specialities, EI is described under various names that often reflect opportune aetiological hypotheses. Oral symptoms such as dry mouth and burning mouth are common, which often result in patients consulting dentists [2, 4]. The somatisation pattern often changes over time, and sometimes, patients change their explanation for the cause of their illness from, for example, exposure to mercury in amalgam filling materials to electromagnetic fields (EMF; [15]).

Many studies have focussed on the odontological aspects of the issue and have attempted to confirm or refute the theory that mercury in amalgam fillings is the cause of the illness [1]. Research on the toxic effects of mercury in dental fillings (DF) has failed to explain the clinical symptoms presented by the patients [6]. In a study that mapped the psychologic/psychiatric, odontological and medical aspects of patients with symptoms allegedly related to the side-effects of mercury in DF, the most striking result was the high prevalence of psychiatric disorders [1]. Nearly 50% had somatoform disorders, including "undifferentiated somatoform disorders". The patients also reported more symptoms indicating mental illness than did the controls, and they seemed to be in great need of professional help from the medical care service.

In a Swedish study, patients referred for health problems related to amalgam fillings were examined [17]. The prevalence of general symptoms was very high; many patients reported 20 or more symptoms. The psychological examination revealed a high prevalence of somatisation. In another study of the psychological factors of amalgam illness, patients were examined with regard to oral health, symptoms, as well as psychological and social health [18]. No difference was found in the symptoms between the subjects who had been exposed only to their own amalgam filling and those who had also been exposed occupationally. The psychological investigation indicated that the symptoms of amalgam illness were psychosomatic. All patients had experienced severe traumatic life events in close connection with the first appearance of symptoms. The conclusion was that they had not been able to handle the traumatic events adequately and therefore developed somatic reactions.

Clinically, it has been observed that patients with multiple systemic symptoms presumed to be caused by electricity may represent a special type of personality [25]. Regarding these patients with symptoms related to electricity, previous findings indicate that they have had negative childhood experience, are somatisation and anxiety prone, do not function well psychologically and are socially isolated, both in their private and occupational lives [5].

Patients with presumed EI have been labelled as anxious, stressed and depressed [3]. They suffer from oral complaints, which impact their lives negatively. EI patients have also reported to be unsatisfied with their work and showed elevated somatic anxiety, muscular tension and psychasthenia [5].

Cloninger [12] has developed a general psychobiological model of personality, which is based on twins and family studies as well as longitudinal development studies, by neuropharmacologic and neurobehavioural studies of learning and psychometric studies. This psychobiological model divides the personality into temperament and character dimensions. The temperament dimensions are considered to be heritable and manifested in early life. They are defined as individual differences in associative learning in response to novelty, danger or punishment and reward [10]. The character dimensions are defined in terms of aspects of self-concept such as humanistic, transpersonal and development factors [11]. The personality, according to the psychobiological model, is defined as the interaction of the temperament and character with various aspects of self-concept modifying the significance and salience of precepts regulated by temperament [10].

Considering that the major aetiological factors presented are of psychological origin, it would be of interest to study personality in two subgroups of EI patients. We have therefore conducted a study aimed at evaluating the psychobiological personality dimensions in patients with symptoms allegedly caused by exposure to DF or EMF.

Materials and methods

Subjects

The 59 patients included in the study, 34 women with a mean age of 49 years (range 33–69) and 25 men with a mean age of 47 years (range 32–64), were consecutively referred, within a 4-year period, to either the Department of Psychiatry or the Department of Odontology of Umeå University. They were examined by a psychologist or a dentist. All patients who fulfilled the inclusion criteria were asked to participate. To be included, the patients had to report symptoms that they assume to be caused by abnormal sensitivity to either DF or EMF. When the patients (n=18) associated their symptoms to both DF and EMF, the primary source that they related to their symptoms was chosen as the main diagnosis. This gave a DF sensitivity group (n=26) and an EMF sensitivity group (n=33). The DF group included 17 women (mean age 50 years; range 34–69) and 9 men (mean age 48 years; range 41–53). The EMF group included 17 women (mean age 47 years; range 33–59) and 16 men (mean age 47 years; range 32–64). The most commonly reported symptoms in the two patient groups were general problems such as joint and muscle problem, fatigue, and headache and also oral problems such as burning mouth, xerostomia and gustatory disturbance. Both groups reported general and oral symptoms, but the DF group reported more oral problems than the EMF group did, whilst the EMF group reported more general problems than the DF group did. A control group composed of 67 sex- and age-matched healthy subjects (38 women, mean age 48 years; 29 men, mean age 46 years) was randomly selected from a database including healthy subjects at the Department of Psychology, Umeå University. The control group was used to evaluate the psychobiological personality dimensions in the patient groups. All participants gave their informed consent.

Assessment of psychobiological personality dimensions

The Swedish 238-item version of the Temperament and Character Inventory (TCI) was used in the present study [9–11]. The TCI is a psychometric instrument designed to

assess personality dimensions and is based on the general psychobiological model of personality developed by Cloninger [12]. This psychobiological model divides the personality into a temperament and a character dimension. The temperament is considered to be mostly inherent and includes automatic emotional impulses, concrete operations and abstract deduction. The character, mostly psychosocially learned, includes intuition of basic cognitive schemas for organising experience [13, 14]. The TCI measures differences in seven basic dimensions of temperament and character [9]: Temperament consists of four dimensions, including Novelty Seeking (NS), Harm Avoidance (HA), Reward Dependence (RD), and Persistence (P), while the character dimensions are Self-Directedness (SD), Cooperativeness (C), and Self-Transcendence (ST). NS consists of four subscales that describe exploratory excitability vs stoic rigidity (NS1), impulsiveness vs reflection (NS2), extravagance vs reserve (NS3), and disorderliness vs regimentation (NS4). The four facets of HA are anticipatory worry and pessimism vs uninhibited optimism (HA1), fear of uncertain situations (HA2), shyness with strangers (HA3), and fatigability vs vigor (HA4). The RD subscales are sentimentality vs tough mindedness (RD1), attachment vs detachment (RD3), and dependence vs independence (RD4). Finally, the fourth temperament dimension, P, is a single trait describing industrious and hardworking vs inactive and indolent. The character dimension SD includes five subscales describing responsibility vs blaming (SD1), purposefulness vs lack of goal direction (SD2), resourcefulness vs inertia (SD3), self-acceptance vs self-striving (SD4), and congruent second nature vs bad habits (SD5). The five aspects of the C dimension are social acceptance vs social intolerance (C1), empathy vs social disinterest (C2), helpfulness vs egoistic and selfish (C3), compassion vs revengefulness (C4), and principled vs self-serving advantage (C5). Finally, ST includes three subscales that describe creative self-forgetfulness vs self-consciousness (ST1), transpersonal identification vs personal identification (ST2), and spiritual acceptance vs rational materialism (ST3).

The TCI is a comprehensive inventory with broad clinical and scientific applications and is proven useful in diagnosis, differential diagnosis and treatment planning of mental disorders such as personality disorders [26]. The Swedish version of the TCI has been validated, and normative data from a Swedish population are available, ranging from 20 to 80 years [8].

This study was approved by the Ethics Committee of Umeå University.

Statistical methods

Pearson's correlation coefficients were used to analyse the association between the TCI temperament and character dimensions. Variations between means were tested by a general linear model multivariate procedure. Comparing the DF and EMF groups, Bonferroni test for corrections of multiple comparisons was used. Analysis of variance (ANOVA) was preformed to compare the differences between men and women within the groups. *P* values of less than 0.05 were considered significant. Statistical routines from the SPSS for Windows were used.

Results

The correlation analysis of the TCI temperament and character dimensions in the two patient groups showed that the SD dimension was negatively correlated with HA (r=−0.52; p<0.05) and that the C dimension was positively correlated with RD (r=0.53; p<0.05).

Regarding the TCI higher order dimensions, it was found that the EMF group scored significantly higher on the temperament dimension P compared with the controls but not with the DF group (Table 1). Regarding the TCI subscales, the DF group scored significantly higher on the temperament dimension HA4 (fatigability and asthenia) and close to significance on the character dimension SD4 (self-acceptance) compared with the controls but not with the EMF group.

When comparing women and men in the groups, there were differences between the DF and control groups. In the DF group, the women scored higher than men did on NS (M=21.00, SD=5.01 vs M=16.44, SD=4.59, respectively; F=5.140, p=0.033) and on RD (M=17.35, SD=3.14 vs M=11.67, SD=4.39, respectively; F=14.642, p=0.001). In the control group, the women (M=16.32, SD=3.76) scored higher than the men did (M=13.97, SD=3.82; F=6.342, p=0.014) on RD. However, in the EMF group, there were no significant differences between women and men.

Discussion

The patients in the present study were referred to the Department of Psychiatry or Odontology at Umeå University for symptoms allegedly caused by environmental factors, either DF material or EMF, or both. Symptoms

Table 1 Multiple comparisons of the TCI temperament and character dimensions and subscales of patients with DF (n=26) and EMF sensitivity (n=33) and of the control group (n=67)

TCI dimensions and subscales	DF group[a] Mean±SD	EMF group[b] Mean±SD	Control group[c] Mean±SD	*F*	*P*	
Persistence (P)	4.15±1.87	4.61±1.77	3.66±1.69	3.37	0.038	b>c
Fatigability and asthenia (HA4)	4.85±2.24	3.79±2.67	2.72±1.82	9.75	<0.001	a>c
Self-acceptance (SD4)	9.27±2.09	8.70±2.24	8.00±2.36	3.19	0.052	a>c

Significant differences between the groups are presented. Bonferroni test for corrections of multiple comparisons was used

associated with EI have been suggested to be caused by interacting factors of both somatic and mental origin [23], which can explain why the patients were referred to either psychiatric or dental specialists. Many patients report manifest somatic symptoms that are impossible to diagnose as being caused by any somatic disorder.

The Swedish 238-item version of the TCI was used in this study to assess the psychobiological personality dimensions [9–11]. The correlations amongst the TCI dimensions in the EI patient group were congruent to both Swedish [8] and American [9] samples, indicating a similar factor structure of temperament and character. The TCI mean scores of the control group correspond well with the Swedish normative data presented by Brändström et al. [8], which shows that the control group in the present study was representative.

The patient group was divided into two groups, a DF and an EMF group, depending on what source the patients thought caused their symptoms. We found that there were personality differences between the two patient groups compared with the control group. The EMF group scored high on the TCI temperament dimension P, but it did not differ on any other temperament and character dimensions. Furthermore, the DF group scored high on the temperament subscale fatigability and asthenia (HA4) and the character subscale self-acceptance (SD4). Our result indicates, therefore, that inherent personality factors may be important in the development of symptoms allegedly caused by EMF whilst inherent and psychosocially learned personality factors may be important in the development of symptoms allegedly caused by DF [9].

The high P scores of the EMF group are congruent with the results in another study by our research group [16]. Individuals high in the inherent temperament dimension P are described as industrious, hard working and stable despite fatigue [9]. They are also described as eager to start work on any assigned duty and tend to perceive frustration and fatigue as a personal challenge. Furthermore, they do not give up easily and they work extra hard when criticized or confronted with mistakes in their work. These persons tend to be ambitious overachievers who are willing to make sacrifices to be a success. Thus highly persistent individuals tend to be perfectionists who push themselves far beyond what is necessary to get by. High persistence is an adaptive behavioural strategy when rewards are intermittent but contingencies remain stable. However, when the contingencies change rapidly, preservation becomes maladaptive [9]. Rapid changes, both in working and private lives, that characterise the modern society can be a challenge for individuals with high persistence to adjust or adapt, which may result in various symptoms, especially stress-related symptoms. Furthermore, high-persistence individuals probably have difficulty accepting their own limits and therefore may tend to blame external factors such as EMF to cause their symptoms (attribution).

The DF group scored high on the temperament subscale HA4 and can therefore be described as astenic, with less energy than most people do. Persons high on HA4 recover from minor illnesses or stress more slowly than others do. They have been described to have elevated depression and anxiety [21, 27]. The interpretation that high HA4 reflects depressive and anxious states is supported by Bergdahl and Bergdahl [3], who found that EI patients were depressed and anxious, and by Poonai et al. [22], who demonstrated anxiety-related symptoms and increased tendency to fear anxiety-related bodily sensations amongst these patients. The presence of depression, anxiety, stress and physical symptoms supports the view that DF patients should be labelled as having a somatic syndrome [3]. That is, they experience and communicate mental distress as a physical symptom and therefore experience that they need professional medical/odontological care.

High scorers on the psychosocially learned character subscale SD4, which we also found in the DF group, are described as being self-confident and are able to recognise and accept both their strengths and limitations [9]. They try to do the best they can without pretending to be something they are not. They are described as accepting and feeling comfortable with their mental and physical features, although they may try to improve these limitations by training and effort [9]. These findings suggest that DF patients may be self-confident and have an unrealistic view of their limitations and capacity, which can, in combination with fatigue and asthenia (HA4), result in an increased psychosocial vulnerability.

Regarding gender differences, women in both in the DF and the control groups scored higher than men did on the RD dimension, indicating that women are more tender-hearted, warm, dependent, sensitive and sociable. Brändström et al. [7] found differences between women and men in a study with samples from Sweden, Germany and USA. The women scored higher in all three samples on HA and RD as well as on C and ST. The authors concluded that these differences might not only reflect genetically determined influences for the HA and RD dimensions but also occur with rearing influences directed toward female and male behavioural stereotypes and the interaction of these factors during the life span. On the other hand, Brändström et al. [8], using the TCI in a study in Sweden, found negligible differences between men and women for higher order TCI dimensions and subscales. Cloninger et al. [10] studied the effect of gender, ethnicity, and age on the character dimensions. They found that women had higher scores on the C dimension and each of its components. Women, compared with men, also had higher scores on ST3, and there were no gender differences on SD or other aspects of ST.

The lack of significant gender differences in the HA, C and ST dimensions and subscales in the present study could be explained by the limited sample size or by the fact that the study focussed on patient groups with deviating personality.

Besides the RD dimension, in the DF group, women also scored higher compared with the men on the NS dimension. High scorers in NS are described as impulsive and disordered. Somatic anxiety has been found to be correlated with the NS dimension and refers to diverse bodily sensations, such as aches, pain and frequent autonomic disturbances [20]. Nylander et al. [20] found that the NS

dimension showed a slightly higher average in migraine patients compared with the controls, and they suggest an association between migraine and somatic anxiety. For the women in the DF group, the combination of high RD and NS may produce a vulnerable personality that is manifested in overinvolvement with other people, loss of objectivity (RD), impulsiveness and disorder (NS), which can result in increased somatic anxiety. The experience of this somatic anxiety might be attributed to the toxic effects of DF.

Our results do not indicate that EMF and DF patients have psychiatric diagnoses [9], but the high persistence demonstrated in the EMF patients and high self-acceptance in the DF patients seem to represent normal personalities that could be vulnerable in the demanding modern society.

We did not find any significant differences between the two patient groups on the TCI dimensions and subscales, indicating that these groups are quite similar regarding personality. This finding is congruent with our clinical experiences; that is, in the clinic we observe more psychological similarities than differences between the two patient groups, which is reflected in similar psychological treatment planning. Hence, in addition to the medical and odontological investigation, we suggest that these patient groups should be psychologically investigated. When psychological treatment is needed, we recommend cognitive psychotherapy.

Conclusions

The personality of the EMF patients was characterised mainly by high persistence, an inherent temperament dimension. The DF patients were characterised by inherent high fatigability and asthenia as well as psychosocially learned high self-acceptance. The high persistence demonstrated in the EMF patients and the high self-acceptance in the DF patients seem to represent personalities that could be vulnerable in the demanding modern society. This vulnerability can be expressed as various mental and somatic symptoms, which can be interpreted by the affected individual as EI-related symptoms.

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