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Reported functional impairments of electrohypersensitive Japanese: A questionnaire survey

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Abstract

An increasing number of people worldwide complain that they have become electromagnetic hypersensitive (EHS). We conducted a questionnaire survey of EHS persons in Japan. The aim was to identify electromagnetic fields (EMF) and plausible EMF sources that caused their symptoms. Postal questionnaires were distributed via a self-help group, and 75 participants (95% women) responded. Reported major complaints were "fatigue/tiredness" (85%), "headache", "concentration, memory, and thinking" difficulty (81%, respectively). Seventy-two per cent used some form of complementary/alternative therapy. The most plausible trigger of EHS onset was a mobile phone base station or personal handy-phone system (37%). Sixty-five percent experienced health problems to be due to the radiation from other passengers' mobile phones in trains or buses, and 12% reported that they could not use public transportation at all. Fifty-three percent had a job before the onset, but most had lost their work and/or experienced a decrease in income. Moreover, 85.3% had to take measures to protect themselves from EMF, such as moving to low EMF areas, or buying low EMF electric appliances. EHS persons were suffering not only from their symptoms, but also from economical and social problems.

Keywords: Electrohypersensitivity (EHS); Electromagnetic fields (EMF); Mobile phone base stations; Cell phones; Multiple chemical sensitivity (MCS)

1. Introduction

Use of wireless devices, such as mobile phones and WiFi, have spread remarkably during the last few decades. They have made life more convenient, but now many persons complain of various symptoms attributed to exposures to electromagnetic fields (EMF). Major symptoms include skin irritation, neurological and cardiac problems as well as digestive difficulties [1]. The World Health Organization (WHO) officially recognizes the existence of these people and electrohypersensitivity (EHS) as a new syndrome, but it denies the causal relationship between EHS and EMF [2].

People who self-report sensitivity to EMF have been described in western countries. In Sweden, the prevalence of EHS was initially estimated at 1.5% [3], but another newer estimation indicates that 230,000–290,000 (2.6–3.2%) report EMF sensitivity [4]. In Austria, the prevalence was estimated at less than 2% in 1994, but in 2001 it had increased to 3.5% [5]. In Switzerland, 5% of the population has been estimated as EHS [6]. In California, the prevalence of self-reported sensitivity to EMF was 3.2%, with 24.4% of those surveyed reporting sensitivity to chemicals [7].

There have been no estimations of EHS prevalence in Asian countries. Although there is no clear consensus for EHS diagnosis, seven EHS cases (6 women) were diagnosed, by a specialist of environmental medicine at Kitazato University Hospital in Japan, employing neurophysiological function tests, such as vegetative nerve function test by pupillary light reflex, smooth pursuit eye movement test, and brain oxygen content by EMF loading test. In the EMF loading test, a coil connected to an EMF generator was placed around the patient's neck, and oxygen contents on the brain surface were monitored using near-infrared spectroscopy (Hamamatsu Photonics Co. Ltd., Japan), by EMF exposure of 10 kHz, 100 kHz and 1 MHz [8]. One man and

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two of the women were also diagnosed with multiple chemical sensitivity (MCS). They exhibited a variety of symptoms, such as headache, tiredness, palpitation, dizziness and nausea. They reported that major EMF sources that caused their symptoms included mobile phones and their base stations, personal computers, power lines, fluorescent lights and electric appliances in homes. The persons were advised to avoid EMF exposures, to take antioxidants, and to try diet therapy, such as reducing sweeteners and increasing vegetables.

The prevalence of EHS in Japan, however, remains to be clarified along with major complaints and plausible EMF sources that cause subjective symptoms.

The aim of this survey was to study the subjective symptoms reported by Japanese persons complaining of sensitivity to EMF, plausible EMF sources that cause their symptoms and EHS onset, used medical care as well as complementary alternative medicine (CAM) therapies, and economical/social problems related to their health problems.

2. Subjects and methods

Postal questionnaires were distributed via a website and a bulletin of a self-help group for EHS and MCS people in Japan from June to October in 2009. The membership count of the group was about 200 and they were living throughout Japan. We received 83 responses, but eight responses were incompletely filed, thus the valid responses totaled 75 (71 females and 4 males) out of the population of 200 and their average age was 51.2 (19–81) years (40–49 years old 36.0%, 50–59 years 30.7%, and 60–69 years 18.7%). The medically diagnosed EHS was reported by 45.3% while 49.3% were self-diagnosed as EHS, and 5.3% considered themselves sensitive to EMF but not to be EHS (Table 1).

In the questionnaire, we asked their subjective symptoms attributed to EMF, suspected EMF sources that caused symptoms, and plausible EMF sources related to the onset. Furthermore the responders reported their therapies, CAM included and their satisfaction, costs of EMF measures, and concerns related to EMF, especially utilization of public transportation and the problems caused by other passengers' mobile phones.

To survey their subjective symptoms, a list of 43 types of symptoms including skin problems, neurological symptoms, and digestive difficulties was prepared by referring to symptoms in previous studies [8,9]. Participants checked all items that applied to themselves. However, we did not ask about the frequency or the strength of these symptoms.

As plausible EMF sources that caused subjective symptoms, 39 EMF sources, such as mobile phones, personal computers and power lines were listed. Regarding suspected EMF source that cause EHS onset, we asked the participants to fill in EMF sources that they regarded the most plausible. Often the EMF sources that caused complaints (daily triggers) differed from the suspected EMF sources related to the onset (initial triggers). Many people complained that environmental EMF sources had gradually increased in number and their health condition had become worse. Our aim, however, was to investigate what EMF sources were attributed to by the participants, not to prove a causal relationship between EMF exposure and symptoms.

Participants were asked what CAM they used, and how satisfied they were with it. CAM items included dietary therapy, acupuncture/moxibustion, aromatherapy, balneotherapy, chiropractic, energy healing, flower essence, herbs, homeopathy, Japanese herbal medicine, kinesiology, osteopathy, qigong, supplements and yoga. Acupuncture, moxibustion, and Japanese herbal medicine are covered by the public health insurance in Japan. Because these therapies are classified as CAM in western countries, we added them as CAM in this study. Participants' satisfaction was rated on a scale of 0–3. The questionnaire choice was scored as "none" or "unknown"=0, "little good" = 1, "so-so good" = 2, and "very good" = 3.

Previous studies have noted that people who complained of sensitivity to EMF had reduced income or were incapacitated for work due to their complaints [3,7,10]. The participants were asked about changes in monthly income, as well as the costs and kinds of EMF-reducing measures they had employed.

We also asked the participants about their daily problems attributed to EMF, such as experiences of bad health condition aboard public transportation due to other passengers' mobile phone radiation, and concerns about the construction of mobile phone base stations.

The Statistical Package for Biosciences (SPBS) was used for analysis. The results have been presented as means and S.D. Differences among groups were determined by the Scheffe test.

Table 1
Proportion of electromagnetically hypersensitive (EHS) and multiple chemical sensitive (MCS) Japanese persons studied ($n = 75$).

	EHS	MCS
Diagnosed	34 (45.3%)	37 (49.3%)
Concerned	37 (49.3%)	20 (26.7%)
Sensitive to EMF/chemical	4 (5.3%)	11 (14.7%)
Not to be MCS	–	7 (9.3%)
Total	75	75

3. Results

Every second responder had medically diagnosed MCS (49.3%) and self-diagnosed MCS had 26.7%. Those who were not MCS, but considered themselves sensitive to chemicals were 14.7%, and those reporting "not to be MCS" were only 9.3%. When the numbers in the "diagnosed as MCS" and "self-diagnosed as MCS" were compared with the corresponding EHS groups, 76.0% were found in both categories.

When asked who of the responders had self-diagnosed as EHS, why they did not seek hospital treatment, the reasons

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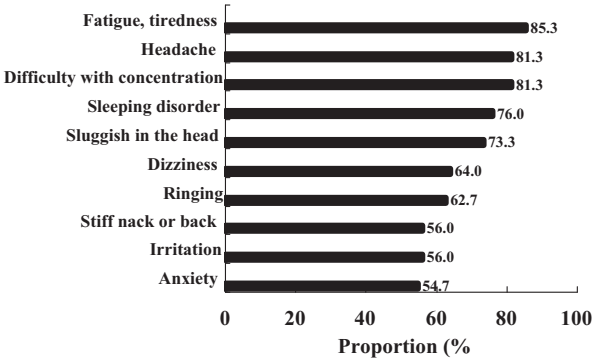

Fig. 1. Major subjective symptoms reported by Japanese electromagnetically hypersensitive persons ($n = 75$).

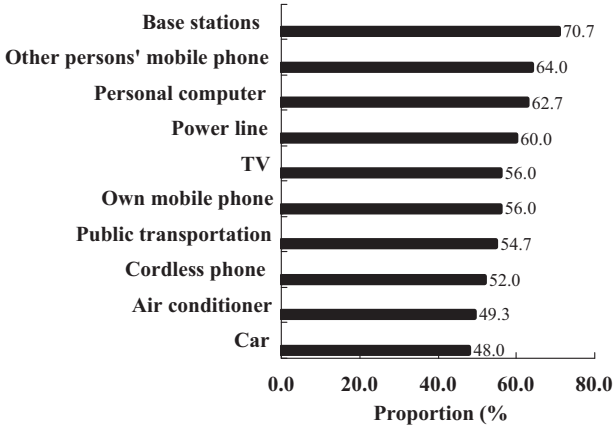

Fig. 2. Major suspected EMF source reported by Japanese electromagnetically hypersensitive persons ($n = 75$).

were "no hospital nearby" (51.4%)", "difficult to go out due to sensitivity" (21.6%), "no proper information about hospitals" (18.9%), "it did not seem to be an emergency" (10.8%), and/or "too little money for consultation" (5.4%). One person had succeeded to make an appointment for consultation at a specialist hospital, but she had to wait for six months.

Thirty-five responders (46.7%) had chronic diseases or allergies, such as hay fever (5), rhinitis (4), asthma (3) and high blood pressure (3), food allergy, atopic dermatitis, rheumatism, and benign uterine fibroid tumors (2, respectively).

3.1. Reported symptoms and sources

Major subjective symptoms reported among the EHS persons included "fatigue/tiredness", and "headache", "difficulty of concentration, remembering and thinking" (Fig. 1). The average number of symptoms was 20 in the medically diagnosed group, 17 in the self-diagnosed group, and 6.5 in the "sensitive to EMF" group (Table 2). When we compared the number of symptoms in the medically diagnosed group with those of the other two groups, we found it significantly higher ($p < 0.05$) than that of the "sensitive to EMF, but not being EHS" group. There was no significant difference between the medically diagnosed and the self-diagnosed groups.

As plausible EMF source that caused EHS symptoms, most (70.7%) of the responders reported mobile phone/personal handy-phone system (PHS) base station (Fig. 2). This was followed by other persons' mobile phones (64.0%), personal computers (62.7%), and power lines (60.0%). Although the number was small, 13.3% indicated "ultraviolet light (sunshine)" as an EMF source provoking symptoms (data not shown).

The most commonly suspected EMF source related to the onset of the EHS was mobile phone/PHS base station (37.3%) (Fig. 3). It was 1.9 times more frequently attributed to than personal computers (20.0%).

It should be noted that the health effects of radiation from medical equipment, such as magnetic resonance imagery (MRI), X-ray examination, computer tomography (CT), and echocardiography were also reported. As plausible EMF sources that caused symptoms, participant checked echocardiography (18.7%), X-ray (17.3%), and MRI (16.0%). Moreover, 7 participants (9.3%) reported that the radiation from various medical equipments had triggered the onset of their EHS. Four participants indicated MRI, and three mentioned X-rays. One of them was a nurse who had been working in a MRI room, and the remaining 6 had been exposed to those radiations as patients.

In Japan, the use of induction heating (IH) cookers and photovoltaic power generations in residences are rapidly spreading. Although the number is small, five participants (6.7%) believed that the cause of their EHS onset was EMF from IH cookers. Three participants experienced health problem near the photovoltaic power generation equipment, and

Table 2
Symptom numbers reported by the Japanese study population ($n = 75$).

Group	Number of symptoms Mean (SD)	p-value (95%CI) Scheff test
Diagnosed	20.3 (6.5)	–
Concerned	17.1 (10.2)	$p > 0.05$ (−1.8–8.3)
Sensitive to EMF	6.5 (5.1)	$p < 0.05$ (2.6–25.1)

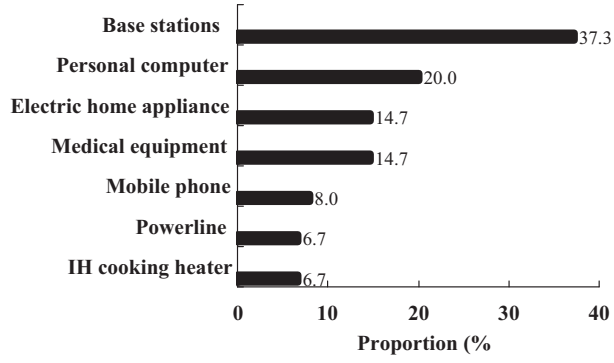

Fig. 3. Suspected EMF source of EHS onset reported by Japanese electromagnetically hypersensitive persons ($n = 75$).

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two participants believed EMF from the equipment was the cause of EHS onset.

3.2. Medical treatment and cost

The medically diagnosed EHS participants had received treatment or took medical advice from physicians. Nearly two thirds, (61.7%) were advised to undertake dietary therapy and an equal number to avoid EMF when possible. They were followed by to take supplements (55.9%), to remove metallic restoration materials from teeth (32.3%), to take vitamins (such as vitamin C and B12) (26.4%), to try kinesiology (23.5%), and/or balneotherapy (14.7%).

Many studies have shown that oxidative stress is induced by exposure to extremely low frequency (ELF) EMF and radiofrequency radiation from mobile phones, and that this oxidative stress was decreased by antioxidants [11–14]. Therefore, diagnosed persons had been advised to take antioxidants, such as vitamin C, zinc and selenium. They were also advised to take calcium and magnesium.

Most responders (72.0%) used CAM such as food supplements (46.3%), kinesiology (38.9%), balneotherapy (35.2%), dietary therapy (35.2%), and/or homeopathy (33.3%). The average number of CAM therapies used was 4 among the women, and 2 among the men.

We also asked the participants about their sense of satisfaction with each CAM therapy, and made them – in a questionnaire – assign numerical values to their satisfaction as "none" or "unknown" = 0, "little good" = 1, "so-so good" = 2, and "very good" = 3. We totaled the satisfaction values for each CAM user and averaged them. Higher estimations of two points, or more, were chiropractic, energy healing, and kinesiology.

Regarding the cost of medical treatment including CAM per year, 41.3% paid 100,000–300,000 yen (=1300–3900 USD), and 24.0% paid less than 100,000 yen (=1300 USD).

3.3. Base stations and residence

The participants reported "concerns with construction of base stations" (68.0%), "no information on EMF from electric home appliance" (54.7%), and "no indication of the location of base station" (24.0%). 85.3% had invested in various EMF-reducing measures. 53.3% had bought shielding cloth to reduce the electromagnetic radiation. 24.0% had moved to a low EMF area, or bought a new house in a "safer" area.

Of the participants, 65.3% indicated they experienced symptoms attributable to radiation from other passengers' mobile phones on board public transportation, and 12.0% said they could not use any public transportation due to their serious health symptoms.

Major symptoms attributed to mobile phone radiation on board public transportation were headache (49.0%), palpitation (24.5%), dizziness or ringing (20.4%), fatigue/tiredness, and dermatitis symptoms (18.4%, respectively), and nausea/vomiting (16.3%).

Participants took various measures to avoid radiation from mobile phones on board public transportation. Among the participants, 46.7% limited the time spent out, 37.3% rather used the bicycle or walked, 30.7% avoided the rush hours, and 14.7% asked passengers to switch off their mobile phones.

Although 40 of the participants (53.3%) had previously been working in offices (23.1%) or as educators (19.2%) and in health care as medical personnel (19.2%), every second had lost their jobs.

4. Discussion

To our knowledge this is the first study of this kind in Japan and also in Asia. The postal questionnaires were carried out through the website and bulletin of a self-help group for people with EHS and MCS in Japan. We got most responses from women. The proportion of women has been higher than men also in several previous EHS studies [3,5,7,9]. As in the self-help group that distributed the questionnaires, women accounted for an overwhelming majority, it cannot be ruled out that this sex ratio might have affected the present results.

In this survey, half of responders had medical EHS diagnosis and about half were self-diagnosed as EHS. It is a serious public health problem that half of the participants could not even receive a medical consultation.

Forty-nine of the participants had also been diagnosed as MCS, and 26.7% considered themselves MCS. The result suggests that persons who experience health problems attributed to EMF may also react to chemicals.

Mobile phone/PHS base stations were reported as the cause of their EHS onset (37%), and also as the cause of their symptoms (70%). Base stations were also most often suspected as the cause of the health problem by persons in the Switzerland survey [15]. Several epidemiological studies have suggested a relationship between health problems and exposure to radiation from base stations [16–20]. The symptoms reported near base stations include sleeping disorders, headache, concentration difficulties, and tiredness, and they are very similar to the reported EHS symptoms. Obviously it is necessary to clarify more the potential health risk of sum irradiations from mobile phone base stations especially in home areas. It might prevent further onset of long-term health problems.

EMF sources that were suspected to cause the subjective symptoms, included the passive exposures to other persons' mobile phones (64.0%), personal computers (62.7%), power lines (60.0%), ultraviolet light (13.3%), and/or X-rays (17.3%). This suggests that the participants might be affected by various frequencies from ELF to ionizing radiation in accordance with a classical generalized radiation damage.

Medically diagnosed persons were treated or took advice to undertake dietary therapy, avoid EMF, take mineral and vitamin supplements, and to remove metallic fillings from

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teeth. Relying on their judgment, 72.0% of participants choose also to try CAM therapies, especially kinesiology, chiropractic, and energy healing.

People who had used CAM during the previous years have been estimated at 42.1% in the USA [21], 6.6–20% in the UK [22–24], and 68.9% in Australia [25]. In Japan this figure is 65.6% [26], thus, the present 72.0% we found in this survey was somewhat higher. Most of the participants (76.0%) reported sensitivity to chemicals, therefore it is possible that they usually avoid pharmaceutical drugs and prefer to use CAM therapies. Further research must be performed to confirm the validity of CAM to help sensitive people.

Our survey indicates that persons who complain of EMF sensitivity confront many problems in their daily lives. On board public transportation, 65.3% of participants experienced health problems attributed to irradiation from other persons' mobile phones, and 12.0% even reported that they could not use public transportation at all.

Regarding employment, 53.3% of participants had a job before the EHS onset and 65.0% of them lost their work or experienced a decreased income after the onset. Moreover, 85.3% had invested in EMF-reducing measures to protect their residence from radiation, such as moving to low EMR areas, building reduced-EMR housing, and buying low emission electric home appliances. The total cost for the present group rose to about 168 million yen (about 2.2 million US dollars).

The present results showed clearly that EHS persons in Japan suffer from various symptoms, they may lose their jobs, and furthermore, the have to pay for protection from EMF. Their functional impairment thus act as an actual barrier that disturbs their social participation and well-being.

In Sweden, EHS is recognized as a functional impairment, and therefore, EHS persons can receive assistance and service in accordance with the Swedish Act concerning Support and Service for Persons with Certain Functional Impairments ("LSS-lagen") and the Swedish Social Services Act ("Socialtjänstlagen") [4].

The European Parliament has published a report that requires information about the locations of EMF sources, such as mobile phone base stations and power lines, to recognize EHS persons and to grant them adequate protection [27]. The report indicates 29 counter-measures such as the above-mentioned items, including its bullet point no. 9. "Calls on Member States to make available to the public, jointly with the operators in the sector, maps showing exposure to high-voltage power lines, radiofrequencies and microwaves, and especially those generated by telecommunication masts, radio repeaters and telephone antennas.", and no. 28. "Calls on Member States to follow the example of Sweden and to recognize persons that suffer from electrohypersensitivity as being disabled so as to grant adequate protection as well as equal opportunities".

In the USA, the Architectural and Transportation Barriers Compliance Board has stated EHS and MCS to be considered as disabilities under the Americans With Disabilities Act [28]. Furthermore, the National Institute of Building Sciences, in the USA, has recommended to provide rooms with low chemical and EMF levels in commercial and public buildings. The purpose is to ensure accessibility for MCS and EHS persons [29].

The Canadian Human Rights Commission reported that approximately 3% of Canadians have been diagnosed with environmental sensitivities, including chemicals and EMF in their environment [30]. In the report, the author recommended improving the environmental quality in work places.

5. Conclusion

The results obtained in the present study showed that Japanese electromagnetically sensitive persons report similar health problems as people in other parts of the world. Obviously it is necessary to take a precautionary approach and to provide social support, as well as to conduct further research to understand the relationship between health symptoms and EMF exposures.

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