



Relationship between the use of electronic devices and susceptibility to multiple sclerosis

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Abstract

Multiple sclerosis (MS) is an autoimmune condition influenced by both genetic and environmental factors. Dirty electricity generated by electronic equipment is one of the environmental factors that may directly or indirectly impact MS susceptibility. The current Study aimed to evaluate the relationship between the usage time of electronic equipment and susceptibility to MS in North–West Iranian people. This approach was carried out upon 471 MS-diagnosed patients and 453 healthy participants as control group in East Province of Azerbaijan. By utilizing structured questionnaires, the information of all participants about usage status of some electronic devices was obtained. Data were analyzed by IBM SPSS Statistics version 18.0 and the quantitative variables were analyzed by Chi Square and Independent sample *t* tests. *P* values below or equal to 0.05 were considered as significant. Among the evaluated items in this approach, the utilization of cell phones and satellite television dishes were significantly higher in MS patients ($p < 0.001$, $p = 0.07$). Furthermore, a correlation was observed between sleeping with cell phone and/or laptop under the pillow ($p = 0.011$) and MS disease; however, there was no significant differences between MS patients and controls in computer using and television watching. Our study reinforces the concept that the utilization of some electronic devices and the continuous exposure to dirty electricity would increase the risk of MS disease thereupon by enhancing the cognizance of adverse effects of dirty electricity and reducing the time spent over electronic devices during adolescence and adulthood the occurrence probability of MS could be declined.

Keywords Multiple sclerosis · Electronic instrumentation · Neurodegenerative disease

Introduction

Multiple Sclerosis is the chronic inflammatory disorder of the autoimmune system, which affects the central nervous system and is also one of the most prevalent causes of

neurological impairments among young people (Browne et al. 2014). Annually, It affects approximately 2.5 million people worldwide (Tullman 2013). Previously, the prevalence of MS was thought to be low in Iran; however, recent investigations have demonstrated that Iran has a moderate

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to high MS prevalence rate, which rises sharply. The major reasons for such increase are environmental conditions (Moghtaderi et al. 2013; Izadi et al. 2014, 2015). This significant increase puts Iran amongst the countries with highest MS prevalence in Asia and the Pacific. The expanding pattern in the prevalence of MS may have several reasons such as alterations in personal lifestyle and the continuous enhancement in using technology (Moghtaderi et al. 2013; Izadi et al. 2014). The etiology of MS is still unknown despite ample studies trying to explain it (Milo and Kahana 2010); however, Scientists believe that interaction of genetic and various environmental factors might be implicated. (Milo and Kahana 2010; Ascherio 2013). As emphasized by various studies, differences in geographic patterns of occurrence, changed sex ratios, and population migration are among the pivotal environmental factors in MS mortalities (Tullman 2013; Berg-Hansen and Celius 2015).

Dirty electricity has been considered as technological progress, which serves as environmental factors of MS disease that is among the causes of constantly increasing incidence of MS in developing countries (Havas 2006).

A new form of pollution namely dirty electricity has been emerged from today's modern technology, which creates high frequent voltage. It is generated by poor power quality devices such as: Televisions (TVs), cell phones, microwave ovens, Personal Computers (PCs), satellites, television broadcasts, etc. (De Vocht 2010).

Public and scientific interest in this field is focused on the possibility of enhancement in the risk of certain cancers and/or other diseases from exposure to dirty electricity generated by electronic devices and applications. This fast-paced interest will be strengthened worldwide by such technologies (Stein et al. 2015). Dr. Milham's study has revealed that people who do not use electricity have lower rates of diabetes, cardiovascular disorders, cancer, and suicide, as well as negligible levels of neurological diseases than electricity users (Milham 2012) as In addition, some studies have reported the probable impact of electromagnetic radiation on some organs, especially brain (Krause et al. 2000; Chellappa et al. 2013; Sirav and Seyhan 2016). Researchers exhibited that there is a correlation between dirty electricity and various types of physical, emotional, and cognitive health problems; additionally, they propose that dirty electricity may contribute to the development of neurological disorders such as amyotrophic lateral sclerosis (ALS), Alzheimer's, and Parkinson, as well as Lou Gehrig's diseases, which urges more the researchers who has focused on these correlations. Studies also demonstrated that environmental exposure in childhood and adolescence is of paramount importance for the risk of MS disease (Gianfrancesco et al. 2014; Gustavsen et al. 2014). Due to the differences between the bone intensity and the amount

of fluid in the brain of children and adults, children's brains have more and deeper absorption of dirty energy; moreover, there is an increasing rate of electronic device utilization like cell phones in children therefore, the identification of these environmental factors is very important due to their potential preventability (Yıldız et al. 2006; Atay et al. 2009).

The correlation between dirty electricity and MS has not yet been investigated in Iran, although there was an increase in the use of electronic devices among young Iranians and the prevalence of MS in this decade. Therefore, in the current study we aimed to investigate the association between the utilization of some electronic equipment and susceptibility of MS in East Azerbaijan region (North–West of Iran) in order to assist the organization of prevention policy in this region.

Methods

Participants

The participants of this study have been selected according to license of Regional Committee of Ethics and by completing the written consent form. Being homogeneous in terms of age and gender the subjects were divided into 2 groups of 471 MS Patients (234 male and 237 female) and 453 controls (230 male and 223 female) includes individuals without any neurological, non-neurological and metabolic diseases etc. Between “2014 and 2015” regarding Moral Committee Agreement. All involved patients are registered in MS Society of East Azerbaijan province. Last diagnosis of MS was performed by a team of neurologists. Patients were reconfirmed for MS disease by previous criteria such as Poser, former Schumacher criteria, and McDonald criteria that was based on 2013 McDonald's revised criteria. The study protocol was approved by Medicine Research and Ethics Committee of Tabriz University of Medical Sciences, Tabriz, Iran.

Procedure

All patients were referred by their physician to Neurosciences Research Center (NSRC) of Tabriz University of Medical sciences, Tabriz, Iran. Participants read detailed information about study procedure before signing consent and filling the comprehensive questionnaires. Patients in this study were included only if they were satisfied of certain identification criteria. After obtaining informed consent from patients, neurologists examined all participants and assessed their physical disability degreed by levels. Neurological information was gathered from

patients and included before any debate of the events. Structured questionnaire was used to collect data and incorporated demographic features and questions that guided this study and before starting the disease period considered in this study.

The section of electronic devices usage in the questionnaire has five questions: the spent time using 1-cell phone, 2-computer, 3-satellite television dishes, 4-other electronic devices, 5-watching television, and 6-sleeping with cell phone and/or laptop.

For the current study, watching TV also included watching videos or video games, and using computers included the time spent for internet and computer games by computers.

Statistical analysis

We utilized SPSS version 18.0 software (SPSS Inc., Chicago, IL) to perform statistical analysis Kolmogorov–Smirnov test (K–S test) was applied to evaluate normality. Descriptive statistics were expressed as mean \pm SD. The data were analyzed based on Chi Square and independent sample *t* Test. *P* values below or equal to 0.05 were considered as significant.

Results

Data from 471 MS-diagnosed and 453 healthy participants as control group were collected. Information about electronic equipment usage were collected prospectively by questionnaires and then analyzed. Characteristics of MS patients and controls were compared in Table 1. The mean age of MS patients was 31.41 ± 7.41 years and for healthy controls were 27.77 ± 7.50 . The mean age of disease onset was 24.02 ± 4.97 years. As Table 1 show, most of the MS-diagnosed patients and controls had graduate and post graduate education grades.

As Table 2 shows, there was significant differences in cell phone ($p < 0.001$) and television satellite dish usage ($p = 0.001$) among MS and control groups. MS patients had a mean of 69.90 min cell phone and 85.28 min television satellite dishes use per day. These two variables were significantly higher in MS group than control group. We could not find any meaningful difference between MS patients and healthy controls in computer usage and television watching; however, computer use and television watching were higher in MS patients compared to controls.

According to Table 3 and based on the results of the Chi square test, the frequency of sleeping with cell phone or placing electronic device near the head at sleeping time was significantly different in MS patients than healthy

Table 1 Frequency and percentage of demographic characteristics of MS patients (n = 471) and controls (n = 453)

Variables	MS patient	Control
No.	471 (51.0%)	453 (49.0%)
Age (years)	31.41 ± 7.41	27.77 ± 7.50
Age at disease onset (years)	24.02 ± 4.97	
<i>Education level</i>		
Under diploma	50 (10.8%)	8 (1.8%)
Diploma	77 (16.6%)	118 (26.3%)
Associate's degree	97 (20.9%)	127 (28.3%)
Bachelor's degree	207 (44.5%)	172 (38.3%)
Master's degree	33 (7.1%)	21 (4.7%)
Doctorate	1 (0.2%)	3 (0.7%)

Data were expressed as number (Percentage) or mean \pm SD (Standard deviation)

controls. Most of MS patients had placed electronic devices near their head at sleeping time ($p = 0.01$).

Discussion

The important role of environmental factors in etiology of multiple sclerosis has been substantiated by various epidemiological studies (Ebers 2008). The ubiquitous dirty electricity in the environment is created by electrical appliances and might be one of several effective environmental factors in MS pathogenesis (Havas 2006). The results of this study show that increasing utilization of electronic devices especially cell phones could be an independent risk factor for MS progress. According to our results, MS patients spent moderately 69.9 min per day using cell phone and 85.28 min per day using television satellite dish. Furthermore, 246 of 471 MS patients confessed that they had slept with cell phone or placed their cell phone and/or laptop near their heads at sleeping time. As mentioned above, most of the involved people in this study were educated. Previous studies have suggested a positive association between “higher education” and “MS risk” (Beebe et al. 1967; Russell 1971; Kurtzke and Page 1997). Typically, people with higher education more than other people utilize electronic equipment especially personal computers and cell phones for their academic work. According to our results, most of the MS patients had higher graduate education level and their cell phone utilization was significantly high thereupon it could be proposed that the greater incidence rate of MS among individuals with higher education could be related to use of electronic appliances (Patti et al. 2007).

Due to lifestyle conditions for more than one century it is believed that the disease is more prevalent in urban areas; however, the analysis of death records in early 1900s

Table 2 The results of *t* test comparing the some electronic devices use daily (in minute) with MS patients and controls

Variables	MS patient (mean ± SD)	Control (mean ± SD)	<i>t</i> test	<i>p</i> value
Cell phone use (min)	69.90 ± 48.6	52.73 ± 41.8	5.75	0.00
Television watching (min)	87.84 ± 71.7	82.80 ± 80.8	1.00	0.31
Computer use (min)	81.58 ± 47.09	75.80 ± 49.62	1.80	0.07
Television satellite dish use (min)	85.28 ± 54.5	74.82 ± 43.5	3.22	0.001

SD Standard deviation

Table 3 Frequency and percentage of sleeping with cell phone or placing electronic devices near the head in MS patients and controls

Variable	MS patient (% of patients)	Control (% of control)	<i>p</i> value
Sleeping with cell phone or placing electronic devices near the head	246 (52.8%)	196 (44.2%)	0.010

in rural places with or without electricity demonstrated that the most “diseases of civilization” are potentially correlated with electrification (Milham 2010).

After checking out the health dating demographic data in early twentieth century, it was revealed that the populations without electricity less likely suffered from MS disease compared to urban areas with electricity. Milham also exhibited that most of the rural mortality rates were correlated with higher levels of electrical service (Milham 2012). Moreover, it was shown that MS disease was common in developing countries and living in the countryside is a potentially protective factor for MS thus higher MS prevalence in urban centers may be correlated with the electricity exposure in urban areas (Seiskari et al. 2007; von Mutius 2007). Studies on neurological disorders and mortality in developing countries from 1997 to 2010 showed a sharp increase in the rate of dementia. These variations can be attributed to many environmental and social variations during last 30 years including sharp raises in the use of electronic devices especially television and cell phones (Pritchard et al. 2013). These data suggest that electronic technology and electronic device usage could affect body organs particularly brain and lead to neurological disorders such as MS. Studies expressed possible effects of exposure to dirty electricity on energy metabolism, balance in neurotransmitter excretion, permeability of blood–brain barrier, cognition, and sleep physiology, as well as some other neuronal disorders (Krause et al. 2004; Chellappa et al. 2013; Sirav and Seyhan 2016). In almost all studies, which describe the effect of dirty electricity on MS, the exposure assessment is extremely poor and those that already exist were about improving the symptoms of MS patients (Milham 2012; Ascherio 2013; Tullman 2013). A pivotal cohort study conducted at Denmark examined the risk, prognosis, and symptoms of MS among cell phone users (Poulsen et al. 2012). Similar to our results, there was little evidence of the relationship

between cell phone usage and MS risk or MS-related death in the patients. This study shows higher incidence of symptoms and MS diagnosis among long-term female partners. The main concern with cell phones is that they usually hold it near the head, which causes the exposure of the brain and other tissues to dirty electricity mainly at the side of the head where the phone is usually located. The battery of the mobile phone is warmed up in operation and this heating could calls for symptoms of MS (Awadalla 2013). Radiations exhaled from cell phones has been reported to alter the brain’s blood flow and glucose metabolism (Aalto et al. 2006; Volkow et al. 2011). A fundamental approach on the biological effects of dirty electricity particularly on MS, revealed that the status of MS patients was significantly enhanced by installing “Graham/Stetzer Filters” that produce a clean electromagnetic environment (Havas 2006). In another similar approach a case–control study was carried out on a 43-year old female with multiple sclerosis, which demonstrated that dirty electricity may exacerbate the symptoms of MS. Studies also exhibited that the utilization of filters and other instruments could contribute to the reduction of dirty electricity substantially and eliminate MS symptoms (Havas and Stetzer 2004; Havas 2006). Some studies have presented and authenticated various possible mechanisms such as the breaks in DNA strand in neurons (Lai and Singh 2004), and/or alteration in cytokine production (Salehi et al. 2013). Electricity may change the balance of TH1/TH2/TH17 of the immune system toward down-regulation of TH1-type response and up-regulation of TH17-type response. Cytokines may cause chronic inflammation and be correlated with cancer, heart disease, and autoimmune diseases, as well as diabetes and neurological diseases. In addition, most scientists agree that continuous dirty electricity exposure increases blood–brain barrier permeability in vitro and in vivo (de Gannes et al. 2009; Kalantari et al. 2015; Kaplan et al. 2016; Sirav and Seyhan

2016). Pathophysiology of MS is arisen from outflows in blood brain barrier. A Swedish research team observed outflows in blood brain barrier in rats exposed to a 900 MHz field of a GSM phone (de Gannes et al. 2009). Elevated porosity leads to leakage of big molecules and toxins from blood to the brain, which damage neurons. Another possibility is that dirty electricity may increase cortisol concentration in the body, which could lead to depressed immunity, autoimmune diseases and neurological problems (Ghaly and Teplitz 2004; Karasek and Woldanska-Okonska 2004). As if the risk is greater for children, we need to find the ways to safely use contemporary technology and learn to control the balance between risks and benefits. With increasing utilization of technology and electronic devices, people and especially children should be informed of adverse effects of dirty electricity and reduce their exposure as much as possible. The relationship between electrical pollution and multiple sclerosis should be analyzed and the percentage of individuals who are sensitive to this type of energy should be determined because understanding the role and mechanisms of the effects of exposure to environmental dirty electricity in MS is of paramount importance as they could prevented easily.

Conclusion

Our results exhibited a higher frequency in the utilization of some electronic devices among MS-diagnosed patients and exposure to excessive dirty electricity is implicated in etiology of MS; therefore, these observations merit further attention and more elaborated studies.

Limitations

In this research, the study was conducted on some electronic devices like TVs, cell phones, and personal computers but not on others such as microwave oven, cell tower, and others. According to immigration studies, age of about 15 is the critical age for MS disease. Furthermore, exposure to environmental dirty electricity in childhood and adolescence ages is of paramount importance in the risk of the disease.

Therefore, the evaluation of this study's variables before age 15 will lead to better understanding and conclusion. The aforementioned limitations necessitate the importance of complementary studies.

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Compliance with ethical standards

Conflicts in interest There were no conflicts in interest.

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