MENTAL HEALTH STATUS OF EMPLOYEES IN SUBSTATIONS OF ELECTROMAGNETIC FIELDS AT EXTREMELY LOW FREQUENCY IN TEHRAN

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ABSTRACT

With regard to the relationship between exposure to electromagnetic fields and development of potential biological system impairments and increasing number of these fields, the current research was conducted in 2004 on 101 employees of high voltage centers to determine the role of working in these fields on mental health. One hundred and one employees were exposed to electromagnetic field at 50 Hz found from 230 kV current. We used SCL-90-R test and compared the subjects with the control group. Data analysis showed that the mean scores of the case group in Global Severity Index and Positive Symptom Total with significant difference were higher than that of the control group ($P<0.022$ and $P<0.049$). Positive Symptom Distress Index showed no significant difference between the two groups. Cases had also higher scores in all subscales in comparison with the control group. It was statistically significant for subscales of somatization, depression, anxiety, hostility and phobia. For psychoticism with $P>0.05$ it tended not to be significant. No correlation was found between age, marital status and split-shift working with GSI scores. Employment in electromagnetic fields at extremely low frequency can lead to the development of mental disorders. However, the results need confirmation by other controlled trials.

Key words: Mental health, electromagnetic fields at extremely low frequency, high voltage centers, SCL-90-R test

INTRODUCTION

Today with the industrialization of communities, electromagnetic fields have much more intensively entered to human life and work place. Increasing number of these fields may account for studying the potential development of biological system impairments much more robustly than before. The impacts of unwanted exposures to such fields have been addressed in the literature, but studying on the effects of long-term and protected exposure have recently been considered. However, existing data especially in human studies are rare. Clinical experiments in all over the world have shown that different physiological processes including fertility, insemination, equilibrium of neuroendocrine and some cardio-respiratory systems may be affected by this environmental factor and lead to different abnormalities (Golestani Daryani, 1993).

Nordstrom reported that the children whose fathers had been working in electromagnetic field stations had considerable congenital malformations comparing to the control group (Nordstrom *et al*, 1989). The risk for the development of Alzheimer's disease among workers in medium to high electromagnetic field exposures was reported high (Sobel *et al*, 1996). According to a study conducted on workers in 400 to 500 kV areas, neurasthenia, mild headache, fatigue, tremor, irregular heart rate, and fluctuations of blood pressure have been reported (Ghiasseddin, 1996). An investigation on rats showed altered operant behavior of adult rats after perinatal expoxure to a 60-Hz. Adult rats that were exposed perinatally to a 60-Hz electromagnetic fields, 22 days in uterus and the first 8 days postpartum for 20 hours a day, responded at significantly lower rates than did the controls in operant conditioning, experimental extinction, suspension of conditioning, and reconditioning (Slazenger *et al*, 1990). The field using 50 or 60 Hz currents has been suggested as an environmental factor for developing brain

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tumors (Doll and Peto, 1996). The only research which had different results in reviewing available literatures concluded that the workers exposed to electromagnetic fields of moderate strength did not show alteration in their health status (assessing nervous, cardiovascular and haematopoietic systems)(Baroncelli *et al*, 1986). In another research on employees of 63 and 132 kV posts, the amounts of polymorphonuclear cells (PMNs) and body serum iron level had a significant difference compared to the control group. Boy/girl ratio of children among two groups was significantly different and problems like vertigo, tinnitus, sleep disturbance and fatigue in the case group have been reported more than controls which was statistically significant (Bahreini Toossi, 1998). A study on employees in 63, 230, and 400 kV areas in Iran showed a decrease in the number of red blood cells (RBCs) and lymphocytes, as well as an increase in the rate of neutrophil and leukocyte stimulation. Although, the rate of psychiatric problems among the workers was significantly higher than that of the controls, there was no significant relationship between the intensity of the field and duration of the exposure. It has also been indicated that increasing symptoms of depression, anxiety, paranoia and obsession in these people may be related to their work conditions and mental exhaustion (Yousefi Rizi, 1997). The relationship between ambient electromagnetic fields and human mood and behavior is of great public health interest. Perturbations in ambient electromagnetic field activity impact behavior in a clinically meaningful manner (Berk, 2006). With regard to the growing number of electromagnetic fields and their impacts on various body systems as well as inadequate investigations on associated mental problems, the current study was conducted in 2004 in high voltage centers of Tehran to determine the relationship between occupation in electromagnetic fields at extremely low frequency and mental health status.

MATERIALS AND METHODS

The study is a historical cohort one with a convenience sampling method. The case group was consisted of 101 employees of power stations who were at 50 Hz electromagnetic exposure found from 220 kV currents. The control group was consisted of 101 employees working in the administrative section that:

- Were not at the exposure of these fields (away enough not to be exposed).
- Did not have the past history of working in power stations.
- Were matched to the case group in employment conditions and accordingly income rate, education and work hours. Age, marital status, split-shift and length of service were also registered.

The Symptom Check-List-90-Revised (SCL-90-R) consisting of 90-item self-report questionnaire was used to assess mental status .Nine different subscales including somatization, obsession and compulsion, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism are measured. Score rating based on a 5-point scale evaluates the individual mental status during the last week (0=none, 1=a little, 2=to some extent, 3=much, 4=very much) (Blacker, 2000). Scoring and interpretation of results are achieved according to three indices: Global Severity Index (GSI), Positive Symptom Distress Index (PSDI), and Positive Symptom Total (PST). GSI shows the level or severity of disorder and gives information about the number of symptoms and severity of distress. PSD simply measures the number of symptoms that are reported positive by the examinee. PSDI is pure measurement of distress severity. It should be mentioned that GSI is the best general scoring which can be used for representing the global distress level and reliably indicate the degree of an individual distress in comparison with a normal population. Additional information about answers and the number of symptoms (the data obtained from PSDI and PST) can also help in making decision about the clinical situation. However, the most emphasis is on GSI (Mirzaii, 1980). Several studies on the reliability and validity of SCL-90- R test indicate that it can be successfully used as a tool for screening in epidemiological studies (Bagheri Yazdi *et al*, 1994).

RESULTS

The study was conducted on 202 men over 18

years old (including 101 cases and 101 controls) . Two individuals from the case group and three from the controls refused to fill out the questionnaire. In psychoticism subscale, one in the control group answered the questions incompletely, so this subscale was omitted for him. The mean age of the control and case groups was 38. 4± 11 and 42.1 ± 7.2 years, respectively, between which the difference was statistically significant (P<0.001). Seven cases and 22 controls were single (P<0.001). This study was based on three indices of SCL-90-R including GSI, PSDI and PST, while the two groups were also compared regarding nine subscales. Table 1 shows the mean of the indices in both groups. There are significant statistical differences in GSI (P = 0.022) and PST (P = 0.049) of the two groups in comparison, but no significant difference in PSDI. Moreover, GSI

mean score was not meaningful from the marital status (92 married vs 7 singles, P = 0.782) and fix/ split working (48/51 respectively, P = 0.634) points of view in the case group. Fifty one out of 99 individuals in the case group and 8 out of 98 controls were split-shift employees (P<0.001). There is, however, no statistically significant relationship between PSDI / GSI scores and age, length of service in high voltage centers, marital status and split-shift working in the case group. Cases had also higher scores in all subscales in comparison with the control group. Difference was statistically significant for subscales of somatization (P = 0.037), depression (P = 0.034), anxiety (P = 0.043), hostility (P = 0.042) and phobia (P = 0.001). For psychoticism with P>0.05, it tended not to be significant (Table 2).

Table 1: Comparison of the mean of GSI, PSDI and PST in case and control groups

SCL-90-R	Group	Number	Mean	Standard deviation	t	df	p
GSI	Case	99	0.67	0.70	2.307	195	0.022
	Control	98	0.47	0.45			
PSDI	Case	99	1.59	0.50	1.851	193	0.066
	Control	96	1.46	0.41			
PST	Case	99	33.72	24.95	1.980	195	0.049
	control	98	27.36	19.81			

Table 2: Comparison of the mean of SCL-90-R nine subscales in cases and controls

SCL-90-R Subscales	Group	Number	Mean	Standard deviation	t	df	p
Somatization (SOM)	Case	99	0.64	0.72	2.104	195	0.037
	Control	98	0.46	0.46			
Depression (DEP)	Case	99	0.64	0.71	2.141	195	0.034
	Control	98	0.44	0.55			
Anxiety (ANX)	Case	99	0.55	0.73	2.036	195	0.043
	Control	98	0.37	0.51			
Hostility (HOS)	Case	99	0.73	0.79	2.043	195	0.042
	Control	98	0.52	0.63			
Phobic anxiety (PHOB)	Case	99	0.49	0.71	3.518	195	0.001
	Control	98	0.20	0.38			
Obsession-Compulsion (O-C)	Case	99	0.88	0.75	1.571	195	0.118
	Control	98	0.72	0.64			
Interpersonal Sensitivity (INT)	Case	99	0.70	0.81	1.846	195	0.066
	Control	98	0.52	0.53			
Paranoid Ideation (PAR)	Case	99	0.90	0.80	1.781	195	0.066
	Control	98	0.71	0.67			
Psychoticism (PSY)	Case	99	0.47	0.68	1.967	194	0.051
	Control	97	0.31	0.41			

DISCUSSION

The validity of several published investigations of the possibility that exposures to electromagnetic fields might cause adverse psychological effects may have been limited by inadequate controlling for confounders or inadequate measurement of exposures in which many controversial issues are raised.

According the present study, working in electromagnetic fields at extremely low frequency

can lead to the development of mental disorder. Yousefi in Iran (1997) investigated the impacts of these fields on mental health,and reported that the symptoms of depression, anxiety, paranoid ideation and obsession-compulsion in the case group (79 workers in high voltage centers) were high and there was no significant relationship between field intensity, duration of exposure and related disorders. These findings have partly been replicated through the present study; however, it must be noted that 86 persons in our case group (85.1%) had job experience of more than 10 years. Five hundred forty adults living near transmission lines in New Zealand completed neuropsychological tests in major domains of memory and attentional functioning, mental health rating scales and other questionnaires. Performance on most memory and attention measures was unrelated to exposure, but significant linear dose-response relationships were found between exposure and some psychological and mental health variables. In particular, higher time-integrated exposure was associated with poorer coding-test performance and more adverse psychiatric symptomatology. These associations were found to be independent of participants' beliefs about effects of electromagnetic fields (Beale IL, 1997). All the employees in this study had the same exposure condition. Factors like as distance that can affect the intensity of the fields were controlled. Yamazaki and the colleagues examined the association between residential proximity to 60 Hz high voltage (22-500 kV) overhead transmission lines (HVOTLs) and mental health in Japan and concluded that mental health status was not significantly associated with the distance between the subject's residence and the closest HVOTL (Yamazaki *et al*, 2006).

The mean score of GSI in the case group (0.67) was significantly higher than their counterparts among the controls (0.47) (P< 0.022).This is a valuable finding with regard to the importance of GSI in this test. In addition, PST (the number of questions to which examinees responded positive) also was significantly higher in the case group (P<0.049). Although PSDI (total examinees' scores) was higher in the case group, no significant difference between the two groups was found

because of greater PST scores in the case group and therefore greater outlet for PSDI fraction. In other words, a few questions reported positive in the control group, but each positive question was given a higher score. No significant difference was found in PSDI between the two groups.

In all nine subscales, the case group had higher mean scores than the control group and there were significant differences in somatization, depression, anxiety, hostility and phobia. In inter-group assessment, the mean scores of obsession-compulsion, paranoid ideation, and interpersonal sensitivity were close to each other, as the mean scores of depression and somatization were. This has been mentioned in the literature too. Higher mean scores in the case group were belonged to paranoid ideation, obsession-compulsion, interpersonal sensitivity, hostility, depression, somatization and anxiety, respectively. Phobia and psychoticism had the least scores. The impacts of electromagnetic fields on mental health status were considered and the pre-assumption of adverse effects on mental health was confirmed through the study. Since the controls were selected amongst the male staff of administrative sections and the individuals with the history of working in power stations were excluded, both the case and control groups were matched regarding employment conditions, gender, salary, work hours and education; but they were different for age, marital status, and split-shift working. There was no statistically significant relationship between these factors and examinees' scores; however, it may be considered as a limitation of the study.

Other limitation is lacking of clinical interview. Although SCL-90-R test is a valid and reliable tool, the results could be confirmed further through an interview.To the best of our knowledge, this is the first step in exclusively studying the effects of electromagnetic fields at extremely low frequency on mental health in Iran. However, the results need confirmation by other controlled trials.

As well-being is an important requirement for a good performance in work places, it would be of great benefit to consider, screen and timely manage the likely mental health problems. To offer consultation and treatment services in these centers could also be effective in the promotion

of mental health status, and improvement of workers' occupational and social functioning with many positive outcomes.

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