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Effects of Electromagnetic Fields on Mental Health of the Staff Employed in Gas Power Plants, Shiraz, 2009

[1]Z. Zamanian, [1]S. Gharepoor and [2]M. Dehghani
[1]Department of Occupational Health,
[2]Department of Environmental Health, College of Health and Nutrition,
Shiraz University of Medical Sciences, Shiraz, Iran

Abstract: The aims of this study are to assess, in a power station in Shiraz, the effects of noise and electromagnetic field on psychological mood. By the great industrial and technological improvements human beings have been exposed to different types of physical and chemical factors. Some of these factors such as electromagnetism are known as the constant components of the environment. According to the studies carried out in one of the power stations in Shiraz, psychological disorders caused by jobs are among the most important problems of the workers. This study is performed to determine the presence or absence of these psychological disorders. This cross-sectional study is performed on these groups : (1) The gas power plant staff who were in contact with electromagnetic field and nose, (2) employees who were only exposed to noise and (3) a group of staff employed in the administrative parts of the Telecommunication companies who did not have any history of being exposed to electromagnetic field and sounds. The General Health Questionnaire (GHQ) is used in this study to recognize psychosomatic disorders. Measurements indicate that range of electromagnetic field varies from 0.087 micro Tesla in the phone homes to 30 micro Tesla in power stations. The results of this study has shown that a significant number of staff which were exposed to electromagnetic fields and noise (78.2%) were suspected to have a kind of mental disorders. The results obtained from this study which shows the prevalence of mental disorders among the suspected case is higher than the results of Noorbala and colleagues study in 2006.

Key words: Power station, mental disorder, GHQ, psychological mood, physical factor

INTRODUCTION

Because of the great industrial developments, technological changes and modernity of human life more and more exposures to various physical and chemical factors have been occurred. In the industrial world, almost everyone is unavoidably exposed to ambient electromagnetic field (EMF) generated from various technical and household appliances (Khaki *et al*., 2008).

Although, many of these factors are because of scientific improvements and they are new but some such as electromagnetic fields are in the category of constant environmental factors. Furthermore, due to several parameters, including the extreme usage of machines, the existence of power transmission lines and the establishment of high-voltage power plants electromagnetic fields are more and more involved in the privacy of human life (Zahir al-Din and Hezaveh, 2003). Electromagnetic field has a great influence on creatures, so its effects on the various aspects of vital systems are among the common issues that researchers are interested about. Based on the research results which emphasis on the adverse effects of electromagnetism especially on human beings, the anxiety about starting protective appliances has been raised, even among the government administrators. This increasing anxiety revolutionized some protective methods and health indexes. On the other hand, it made the researchers to find out some exact points about the human interaction with this natural phenomenon and also to provide some realistic solutions for the mentioned problem (Yousefie and Noori, 2005).

Although, scientific and technological improvements of the recent century provide a much more comfortable life for humans, but it is important to note that these improvements can cause harmful effects too. These threatening effects can be produced by several factors such as the harmful chemical, physical, microbiological or ergonomical factors. One of the physical harmful factors of the environment is electromagnetic fields. Electromagnetic field is created due to the passing of

Corresponding Author: Mansooreh Dehghani, Department of Environmental Health, College of Health, Shiraz University of Medical Sciences, Shiraz, Iran Tel: 0098(711) 6304059 Fax: 0098(711) 7260225

electricity in wires and high potential electrical systems such as the electric motors (generators), drilling machines and cables of transmission lines (Van Wijngaarden *et al*., 2000). Today due to the extreme usage of electrical equipments, exposure of humans to electromagnetic field has increased. Industrial workers such as the power station staff are affected by the electromagnetic radiations induced by electrical equipments and power transmission lines. The influence and effects of electromagnetic field produced by electrical equipments are significant, so these effects especially those which affect biological systems are discussed a lot in scientific circles. Although, electrical forces usually do not have much influence on creatures, the electromagnetic radiations which exist in the surroundings of electrical equipments, electricity transmission lines and electrical high voltage posts significantly affects vital systems. The symptoms which are proved to be caused by electromagnetic field in human are headache and fatigue and a direct relation between exposures of electromagnetic field and higher prevalence of cancer has been proved (Sobel *et al*., 1996). Although mental disorders cause less mortality rate than most of other diseases, but it is important to study them because of the following reasons.

- According to the past studies mental problems, caused by work, are acceptable as one of the most important problems of workers
- In some industrial units like electrical power stations, harmful agents that can cause neurological and psychological disorders are detectable. Physical factors such as sound and electromagnetic fields, mechanical factor and chemical agents are some examples for these harmful factors
- Patients with mental disorders not only can harm themselves, but also they can make dangerous situations for others, especially while they are working with machines
- The problems that workers have in their job can easily affect their family (Gamberala, 1990). Similar researches have been performed in many different countries. However, they have only determined the effects of the electromagnetic field or noise on their studies. For the first time, this study has been done to determine simultaneously the effects of noise and electromagnetic field on psychological mood in Shiraz power station

MATERIALS AND METHODS

This research project was conducted from July, 2008 to March, 2009 to assess job relation psychological changes affected from some hazard physical agents like noise and electromagnetic field. This cross-sectional study is performed on these groups:

- The gas power plant staff that were in contact with electromagnetic field and nose
- Employees who were only exposed to noise
- A group of staff employed in the administrative parts of the Telecommunication companies who did not have any history of being exposed to electromagnetic field and sounds

All employees of the gas power plant of Shiraz and all the communication company staff were participated in this study. All the participants were similar in employment condition, income, education and work time. In this study the general health questionnaire was used for data gathering. This auto run questionnaire has been designed for evaluating mental health and mental disorders in societies. It is also useful in recognizing functional disabilities and finding distributing factors in social and economical life of adults. This questionnaire is not diagnostic but it's valuable in screening mental disorders (Beale *et al*., 1997).

In general the usage of this updated psychological questionnaire is to identify individuals with mental disorders. It can distinguish mental disorders with less than 2 weeks duration and it is sensitive to transient disturbances. The questionnaire has four scales each consist of seven questions that can evaluate four categories of psychological disorders that are: (1) somatization syndrome, (2) anxiety and sleep disorders (3) social dysfunctions and (4) depression (Zamanian Ardekani *et al*., 2008; Zamanian *et al*., 2010). Studies show that the validity and reliability score of this test is 0.84 to 0.93 (Yousefie and Noorie, 2005 and 0.68 to 0.94) (Vicente *et al*., 2006; Fakhari *et al*., 1999). In this study the Likert scaling method is used for analyzing data's. We also use descriptive and inferential statics. Descriptive statics was used in two-dimensional tables and data analyzing. Inferential statics including Chi-square and one-way ANOVA was used when needed. Upon completion of field survey and data collection, data was coded and transferred into the computer for further analysis. Statistical analyses were performed using SPSS version 9 (SPSS 9.9.9; SPSS Inc, Chicago, Illinois, USA).

RESULTS

In modern society, humans are commonly exposed to electromagnetic field inducing extremely low frequency electromagnetic field, which is generally produced by

Table 1: Some personal details of workers who participated in the study (n = 165)

Contact with electromagnetic field	Values	Contact with noise	No contact
Age (years) (%)			
Upper 42/lower 42	29 (52.7) /26(47.3)	37 (67.3)/18(32.7)	28 (50.9)/27(49.1)
Job tenure (years) (%)			
Upper 16/lower 16	41 (30.6)/14(45.2)	49 (36.6)/6(19.4)	44 (32.81)/11(35.5)
Working schedule (%)			
Rotating shift/fixed daytime	32 (58.2)/23(41.8)	23 (41.8)/32(58.2)	0 (0)/55(100)
Smoking (%)			
Yes/No	16 (29.1)/39(70.9)	8 (14.5)/47(85.5)	8 (14.5)/47(85.5)
Education (%)			
Under diploma	21 (38.2)	9 (16.4)	10 (8.2)
Diploma	13 (23.6)	41 (74.5)	19 (34.5)
Associate degree	10 (18.2)	4 (7.3)	4 (7.3)
Bachelor of science	11 (20)	1 (1.8)	22 (40)

Table 2: Mental health status of workers

Contact with electromagnetic field	Values	Contact with noise	No contact
Mental disorders (%)			
Yes/No	43 (78.2)/12(21.8)	28 (50.1)/27(49.1)	20 (36.4) /35(63.6)
Anxiety symptoms (%)			
Yes/No	21 (38.2)/34(61.8)	26 (47.3)/29(52.7)	33 (60)/22(40)
Depression (%)			
Yes/No	45 (81.8)/10(18.2)	49 (89.1)/6(10.9)	1 (1.8)/54(98.2)
Social disfunction (%)			
Yes/No	52 (94.5)/3 (5.5)	45 (81.8)/10(18.2)	35 (45.5)/30(54.5)
Somatisation (%)			
Yes/No	30 (54.5)/25(45.5)	33 (60)/22(40)	8 (32.7)/27(67.3)

power lines and many kinds of electric appliances (Farkhad *et al*., 2007). Electromagnetic field measurements (Table 1) show a variable range: from 0.087 micro Teslas in phone center to 30 micro Teslas in power station. It is notable that the maximum amount is 11 times less than the allowed threshold (TLV) that is 60 micro Teslas.

Relationship between physical health, social dysfunction, anxiety, depression and work experience, smoking, having shift work, education was not meaningful ($p>0.05$). The only exception is the relation between social dysfunction, depression, having shift work and education which was significant ($p<0.05$). This study shows that the quality of mental health in groups which were exposed to ELE electromagnetic field is less than the unexposed groups. The health index among the office staff is 63.3% while it is 49.1% among the group which was exposed to sound. Note that the office staff and the group expose to sound are supposed as the electromagnetic unexposed group. The health index for the group which was exposed to electromagnetic field is estimated about 21.8%. Due to the epidemiologic studies the prevalence of mental disorders in Iranian norm society is about 11.9 to 23.8% (Noorbala *et al*., 2004) while it is 78.2% for staff in contact with electromagnetic field which is three times more than the society norm (Table 2).

DISCUSSION

The results of this study indicate that the prevalence of mental disorders among groups of staff which were exposed to electromagnetic field and noise is significant (78.2%) (Table 2). Due to the results obtained from the fourfold scaled questionnaire 94.5% of these people were suspected to have social dysfunctions too 61.8% of them showed symptoms of anxiety and sleep disorders 18.2% of them were depressed and 54.5% had complains about physical symptoms. Prevalence of 78.2% which is obtained from this study is higher than the results of Noorbala's research which was done in 2004 with the usage of General Health Questionnaire. According to Zahir al-Din and Hezaveh (2003) research the incidence of mental disorders is not correlated with factors such as marital status, age, work experience and shift working.

This study shows that 17% of cases in the exposed group and 32.7% of cases in the control (unexposed) group are suspected to have mental health disorders. Yousefi and Noorie (2005) research that is about the effects of electromagnetic field on mental health (shows that exposed cases) have symptoms of depressing, obsession (intellectually and practically) and anxiety. Average of the symptoms severity in the electromagnetic exposed group shows a meaningful difference with the control group. Because of the complex combination of biological, psychological and social factors that are contributed with mental health, we need more researches to find out the exact effects of electromagnetic fields. Not only being exposed to electromagnetic field is known as a risk factor for mental disorders but also mental health is related with job characteristics and mental fatigue. Gamberela (1990) studies show that among workers in high voltage electricity posts that were exposed to electromagnetic field there are cases with symptoms of depression, paranoid disease, obsession (intellectual and practical), anxiety and aggression. In another study

Table 3: Comparison of prevalence at health status in gas power plant workers and other study population

Gas power plant	Values	Iranian population	Ahamdinia's study
Mental disorders (%)	78.2	20.9	25.3
Anxiety symptoms (%)	61.8	20.8	47.8
Depression (%)	81.8	21.0	26.2
Social disfunction (%)	94.5	14.2	--
Somatisation (%)	54.5	17.9	--

carried out by Bethwaite *et al.* (2001) and colleagues it is shown that among inhabitants which live near electromagnetic fields of power transmission lines (50 Hz) and high voltage posts the prevalence of psychological disorders such as suicide, depression and lack of attention control is considerable. Yousefi and Noorie (2005) research indicates that electromagnetic field affects hematopoietic system. It also shows that the prevalence of symptoms of mental and behavioral disorders among people expose to electromagnetic field is significantly higher than the control group, but this higher prevalence is not correlated with field intensity and duration of contact. Also, Elhag *et al.* (2007) showed that electromagnetic field may affect biological systems by increasing free radicals, which appear mainly to enhance lipid peroxidation and by changing the antioxidase activities of human blood thus leading to oxidative stress. Van Wijngarden *et al.* (2000) study which was about electromagnetic field exposures shows that the rate of suicide among people employed in places with electromagnetic field exposures has increased which can be the result of the higher prevalence of depression among them. In the present study the effectiveness of electromagnetic fields on the nervous system was evaluated and the initial pre hypothesis, which indicates the negative role of electromagnetic field on mental health, was confirmed. In this study the measured incidence of depression, anxiety, physical health, social disorders and general health is meaningfully different from other researches (Table 3).

CONCLUSION

Due to the study results, the following items are recommended in order to prevent the risk factors which threat the general health of workers who are exposed to electromagnetic field.

- Examinations before employment and measuring physical and mental ability of workers are useful
- Periodic examinations and regular psychological counseling can lead to early diagnosis and treatment of mental disorders and is very important
- Providing consulting services and treatments can promote worker's health status. It can also cause positive individual, social and economical effects
- Optimizing work environment and controlling harmful factors such as heat, light, noise, vibration, etc. that can affect mental health of workers is recommended
- Set working hours and resting time properly in order to prevent fatigue in workers
- Encourage workers to exercise by providing sport halls in production centers
- Use dielectric or wave-absorbent clothes

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