General health status of residents nearby high voltage substations in Tehran, Iran

Parvin Nassiri, Mehdi Asghari, Ehsan Farvaresh, Hossein Safari, Mohammad Reza Monazzam and Navid Ghaemian

Department of Occupational Health, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

Department of Health Management and Economics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

Department of Occupational Health, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

ABSTRACT

Objective and background: Modern styles of living have caused human beings to expose various chemical and physical factors which can cause adverse effects on the health and welfare of individuals in different levels. This study is aimed to assess general health status of residents nearby high voltage substations in Tehran in 2011. Materials and Methods: This is a descriptive and cross-sectional study which was performed on 400 randomly selected residents over 18-year-old nearby high voltage substations. Electric and magnetic fields adjacent to these substations were measured by Holaday HI 3604 Electromagnetic Meter and general health status of residents in the vicinity of mentioned substations were evaluated using a verified questionnaire. Findings: Mean of measured electric fields’ strength and magnetic flux density around the 400 KV high voltage substation lines was 3610 V/m and 275 mG, respectively, and it was higher than other electric substations. Furthermore, results of general health status of residents nearby high voltage substations showed that; the highest frequency percentage was attributed to mental disorders. Physical, anxiety and depression disorders were in the second grade, though. On the other hand, the lowest frequency percentage was related to social dysfunction. Conclusion: Most of the studied population (64.8%) was suspected to have mental disorders. Considering the effects of other factors except electromagnetic waves on the general health of individuals, therefore, more and valuable studies are needed in this regard.

Key words: High voltage-power substation, GHQ, Electromagnetic field, Mental disorders, Depression.

Introduction

For a long time, modern styles of living have caused human beings to expose various chemical and physical factors as a result of major industrial developments and technological changes. However, some of these factors are new and were created by science, but some others such as electromagnetic waves have been the consonant components of environment and many people are facing with these waves unintentionally [1]. Electricity production has been started nearly 100 years ago and transmission of radio waves has been launched for 70 years. 50 years ago, radar was used for the first time and in fact after 1950, substantial amounts of electromagnetic energy have been entered into human’s life [2].

Today’s living on the earth planet is, indeed, kind of immersion in a sea of natural electromagnetic fields. Recent decades, this natural environment has been completely changed due to the broad spectrum of developing artificial electromagnetic fields. Daily applications of electromagnetic fields in communication era (ground and aerial), military affairs, navigation and as well in industry (such as electromagnetic usage in metals melting process, steel-making …), household uses and medical fields cause people expose to more electromagnetic fields than before. Effects of low frequency electromagnetic fields differ from those with high frequency, so, the current voltage in low frequency fields is higher than high frequency considering circumstances that cause living organisms expose to these waves freely and without any protection. Thus,
it seems that in recent years, researchers are paying more attention to extremely Low electric and magnetic frequencies, particularly regarding power frequencies (50-60 Hertz) [3]. However, as result of widespread use of electric devices, the energy transmission lines, high voltage substation and established power plants, people are facing more severely to electromagnetic waves [4].

So far, many studies have been carried out on human and other living organisms to evaluate the effects of electromagnetic waves. In this case there are some reports on various mental disorders, cardiovascular, digestive and nervous system problems among workers in charge of power distribution and transmission substation [5]. Nancy Vert-Haimer and Adliper pointed out that; children whose homes are close to high voltage power transmission lines, inflict to leukemia more than the others [6].

Michinery Kabuto in 2006 showed an increased risk of leukemia, especially acute lymphoblastic leukemia, among children exposing to high magnetic waves [7,8]. Furthermore, Uosefi pointed out that; exposure to magnetic field causes depression, practical and mental obsession, sensitivity in interpersonal relationship, anxiety, aggression, phobia and psychosis among those expose to these fields [9]. Nowadays, electromagnetic waves with various frequencies and high intensity are as an important factor in the environment and fear of emersion of unknown diseases, blood component changes, its effect on nervous systems, mutation and incidence of diseases such as growth of cancer cells has increased general concern and has stimulated scientific centers around the world [10].

In addition, Karipidis et al have done a study on the relationship between extremely low frequency electromagnetic waves with advent of malignant brain tumors which ultimately it didn’t show any significant correlation between them [11]. Given the location of these centers close to urban and residential areas, medical centers, training centers and public places which people are travelling or working around and so exposing to these waves, it is necessary to identify these harmful sources and evaluate their effects on people in order to find a way for solving these problems. This study is aimed to assess general health status of residents nearby high voltage-power substation whom were exposed to extremely low frequency Electromagnetic fields.

Materials and Methods

This descriptive and cross-sectional study was performed on residents aged >18 years in the vicinity of high voltage power substation lines in Tehran in 2011. An initial pilot study was carried out for selecting samples and then, 400 samples were selected with a %95 confidence level. The position of high voltage power substations (230 and 63 kV) and ultra-high voltage power substation (400kv) were determined and then some of those were selected randomly. Magnetic and electric intensity was measured using HI-3604 machine and IEEE2 std 644-1994 standard method in four main directions and at the intervals of less than 50 meters from the sources [12] (fig.1, 2 and 3).

In fact, samples were selected based on the objective based method from residents in the vicinity of high voltage power substations who more likely were exposed to electromagnetic waves. A verified four-scaled questionnaire including 28-question was used for data collection. The questionnaire is used for detecting inabilities in normal functions and existence of disturbing factors in social life. It includes four measures including 7 questions and it measures four categories of non-psychotic disorders, including physical, anxiety, social dysfunction and depression scales [13]. This questionnaire was used in other studies and its validity and reliability was certified beforehand [14,15]. Studies carried out in Iran have determined its reliability 0.84 to 0.93 [16,17]. The 6 cut-off score (called traditional grading) method was used in this study. The maximum score would be 28 with this method. Grading in this way is as follows: score 1 is considered for first option of questions 1, 15 and 17 to 21; third and fourth options of questions 2 to 14and 16 and for second, third and fourth options of questions 22 to 28and zero for the rest of the questions. Individuals who had score 2 or more out of total score of 7 questions were recognized having disorders. Also, individuals who had got score 6 or more out of total score of 28 questions were considered with disorders.

Results:

It is shown in table 1 that electric fields intensity and measured magnetic flux density around the high 400 kv voltage power substation lines were 3610(V/m) and 275(m G), respectively, which were higher than the other substations, (table 1). Comparing measured fields intensity in studied areas showed a decreasing trend from 400 kv to 63 kv substations, respectively. Residents in the vicinity of 63 kv electric power substation of Beasaat area had the highest disorders in their general health in comparison to the residents around the other power substations. Considering the location of 63kv power substation line of Beasaat in south part of Tehran, which most of the people living there have low economic, welfare and living conditions level, it is predicted that their economic and living conditions problems are of the most important reasons for their high general health disorders compare to the other areas. Although, having compared the mean of electric fields intensity with mean of the measured magnetic flux density in 230 and 63kv high-voltage power lines and 400 kv ultra-voltage power line...
using one-way ANOVA showed that; there wasn’t any significant difference between 230kv and 400kv power substation line, but this difference was statistically significant among 63kv power substation (Pvalue<0.002). Also, among these substations, 63kv Beasaat substation had the highest difference statistically (Pvalue<0.001). Furthermore, the highest rate of mental disorders was among residents in the vicinity of 63 kV Tarasht power substation (table 2). Moreover, the lowest rate of reported mental disorders, anxiety and depression were applied for residents accommodating close to Gheitarieh 230 kV power substation line. It was estimated that good economic, social, cultural and welfare conditions are the reasons for low frequency of disorders among this group compare to the other areas. Comparing frequency percentage of observed disorders showed that mental and physical disorders, together, had the highest frequency percentage, respectively, and social disorders had the lowest one in this regard. According to the results, among total studied community (figure 4), 56.5 % was suffered from physical disorders and it was in the second grade after mental disorder (64.8%).

Fig. 1: Position of 63 kV substations in Tehran city.

Fig. 2: Position of 230kv substations in Tehran city.
Fig. 3: Position of 400 kV substations in Tehran city.

Table 1: Mean and intensity of magnetic and electric fields in each residence with consideration to power substation in Tehran.

<table>
<thead>
<tr>
<th>Areas under study</th>
<th>Substation type (kv)</th>
<th>Type of waves</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum electric field intensity(V/m)</td>
<td>Maximum measured magnetic flux density(mG)</td>
</tr>
<tr>
<td>Ghorkhaneh</td>
<td>63,230</td>
<td>1647</td>
</tr>
<tr>
<td>kon</td>
<td>400</td>
<td>3610</td>
</tr>
<tr>
<td>Gheitarieh</td>
<td>230</td>
<td>1607</td>
</tr>
<tr>
<td>Shoush</td>
<td>230</td>
<td>1645</td>
</tr>
<tr>
<td>Tarasht(Shahid Firouzi)</td>
<td>63</td>
<td>1421</td>
</tr>
<tr>
<td>Besat</td>
<td>63</td>
<td>1521</td>
</tr>
<tr>
<td>Alghadir</td>
<td>230</td>
<td>1638</td>
</tr>
</tbody>
</table>

Table 2: Frequency percentage of each general health index status in residences according to the type of mental disorder.

<table>
<thead>
<tr>
<th>Areas under study</th>
<th>Substation type (kv)</th>
<th>General health status (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mental disorders</td>
<td>Physical disorders</td>
</tr>
<tr>
<td>Ghorkhaneh</td>
<td>63,230</td>
<td>56.0</td>
</tr>
<tr>
<td>kon</td>
<td>400</td>
<td>56.7</td>
</tr>
<tr>
<td>Gheitarieh</td>
<td>230</td>
<td>56.0</td>
</tr>
<tr>
<td>Shoush</td>
<td>230</td>
<td>67.3</td>
</tr>
<tr>
<td>Tarasht</td>
<td>63</td>
<td>82</td>
</tr>
<tr>
<td>Besat</td>
<td>63</td>
<td>76.9</td>
</tr>
<tr>
<td>Alghadir</td>
<td>230</td>
<td>58.7</td>
</tr>
</tbody>
</table>

Fig. 4: Average general health status of total studied residents (n=400)
Discussion:

Study results indicate that significant proportions (%64.8) of studied residents exposed to electromagnetic waves were suspected to have mental disorders (fig 1). These results are in consistence with a study done by Zahra Zamanian et al on staff working in the Shiraz power station [18]. Also, in this study, reported disorders were 2.5 times more than those reported by epidemiological studies carried out in Iran [19]. The present study indicated that large number of studied populations was suffered from depression, which it is in consistence with study done by Wijngaarden, e.v et al [20]. Considering that electric and magnetic fields intensity didn’t change at the interval of more than 50 m, therefore, they were calculated at the intervals of less than 50 m of high-voltage power. Thus, the populations who were not exposed to this field omitted automatically and general health of those who were within the space was evaluated. According to the results, it can be said that electric and magnetic fields play a role in incidence of these disorders; however more researches are needed in this area. Considering the effect of various factors on the general health of population, wide range of individuals and different occupations and as the exposure of residents to high voltage power substation was in an controlled area, so discussing about the direct impact of electromagnetic fields on the general health of population or the protection against these waves should be done with more cautions. In a review study done by Mr. Francesco Gamberale on the biological and psychological effects of exposing to extremely low frequency electromagnetic fields, he pointed out that; according to the experiences, electric and magnetic fields related to the power transmission lines don’t make any physiological or mental disorder [21]. Also, in a study Mr. I.L. Beale et al carried out on the physiological effects of chronic exposure to electromagnetic fields on the residents in the vicinity of 50 Hz high voltage power lines, they pointed out that; there is a significant linear relationship between dose - response of a number of mental health and physiological variables and so, it can be said that; longer cumulative exposure is associated with adverse psychological symptoms [22]. Finally, according to this study and other studies done in this era, we can’t certainly conclude that exposure to electromagnetic waves affect general health of residents close to these resources of waves. Thus, more studies are needed to determine the effects of electromagnetic waves on the general health of population.

Acknowledgments

We gratefully thank Department of Environmental for its financial support and residents nearby high-voltage power substation for their sincere participation.

References

12. IEEE, IEEE standard procedures for measurement of power frequency electric and magnetic fields from AC power line.