**HEALTH AND SAFETY RISK ASSESMENT WITH ELECTROMAGNETIC FIELD EXPOSURE FOR CALL CENTER WORKERS**

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**Abstract**

Today, in parallel with the development of technology, companies communicate with each other and with their costumers by means of call centers. Call centers are defined as stressful because of their uncertain working hours, inadequate relief time, performance based system and heavy workload. In literature, this sector is defined as risky as mining sector by means of health and safety and unfortunately in terms of health and safety, the problem has not been comprehended enugh in Turkey. The collection of data for this study had been completed during April-May 2015 for the two selected call centers in different places of Turkey. The applied question poll contains 39 questions which mostly investigates the health condition of call center workers. Electromagnetic field measurements were completed at the same time with applying the question poll to the employee. The ratio of employee accessibility in poll application noted as 73% for the first call center and 87% for the second. The results of electromagnetic field measurements were recorded as between 371 V/m-32 V/m for the first location and between 370 V/m-61 V/m for the second. The general complaints of the employees for both workplaces can be counted as; inadequate relief time, inadequate air conditioning, disturbance, poor thermal conditions, inadequate or extreme lighting. Furthermore, musculoskeletal discomfort, stress, ear and eye discomfort are main health problems of employees that they complain about. At the end of this survey, a risk map of workplace was prepared in terms of safety and health at work in general and some suggestions for resolution were provided.

**Keywords:** call center, health and safety, electromagnetic field, risk map

**Introduction**

To sustain the relationship between companies with each other and companies with the others call centers play an important role. The term of call center was first originated in 1960s in USA. Nowadays, the greatest employment rate is occured in India and Southeast Asia. The working environment of a call center is open office system and this office consists of cubic style sitting areas, computers with monitors, telephones with cables or cordless ones.

In literature, call centers are counted as risky in terms health and safety. The first and the most dominant reason is that work type is stressful. The system endures performance based, so the more worker works, the more he/she earns. Harsh working conditions make people unhappy and depressive. All these factors cause stress load on workers.

Some of the health and safety risks at call centers counted in literature are listed below:

1. Continuity is the most important factor playing in the work system of call centers. Rest time of employees are too short.
2. Shift work negatively effects employees. Because of irregular mealtimes they have gastronomic problems. Working under artificial light cause some other health problems also such as sleeping problems, metabolic problems and cardiovascular health complaints (Waterhouse et al, 2003).
3. Work stress can prevent work continuity (House, 1981).
4. Charging of workers depends on performance of the workers so a worker may feel pressure on him for answering more calls. This causes work stress on workers (Keser, 2006).
5. Shift work may also cause some problems in human social relationships.
6. Sitting long hours while working, repetitive motions, non-ergonomic working conditions, work stress can cause musculoskeletal complaints of workers (Crawford et al, 2008).
7. Inactive life style during work time can also entail weight problems (Ming and Zaproudina, 2003).
8. In terms of health and safety, women workers are defined as fragile groups. A great deal of workers in call centers comprise of women. These workers need more care for health and safety perspective (Call Center Corporation/Turkey,2015).
9. Due to long hours usage of their voices, some health complaints can be seen in vocal cords of workers. (Piwowarczyk et al, 2006).
10. Continious headphone usage (direct noise) and ambient noise may cause hearing problems among employess. (Raimo and Kataja, 2002).
11. Most calls include anger or insult. Thus, this may evoke stress on the workers (Tuten ve Neidermeyer 2004).
12. Contagious diseases and infections are great threaten for workers who are working in crowded open office environments (Cosar, 2012).
13. There are so many electronical office devices like laser printers and photocopy machines in the call centers. They also release volatile organic compounds that negatively affect the health of employees.
14. The magnetic field released from the electronic devices composes a risk factor for the employees who are exposed to densely. (Barger and Culver-Schultz, 2011).
15. Working with computers without using screen protective equipment may cause eye problems on the employees.
16. The newly formed call center sector unfortunately does not have any standards that regulate the health and safety conditions in the working area.
17. Due to all these conditions that are counted as, the investigations show that the 50% of employees employed in call center, are not satisfied with their jobs (Girolama and Kivitovs, 2011).

Also there are limited number of detailed researches that investigate the health and safety conditions at call centers.

Health problems mostly seen among call center workers

Long time sitting with less motion during working time can easily cause musculoskeletal complaints and disorders (Bernard et al., 1994; Ferreira et al., 1997; Rocha et al., 2005). The risk of musculoskeletal disorders is 12 times higher for long-time sitting office workers than other employees (Shackleton et al., 1997). Also physiological factors affect the risk of musculoskeletal diseases (NIOSH, 1997). Long time working with computers may cause eye problems. Using headphones, self-voices, answering calls, during working time can cause hearing-speaking problems. Shift works can cause mainly gastronomic problems and other physical and physiological problems.

These health problems also may differ according to/ gender. According to the research studies; musculoskeletal complaints, hoarseness, eye discomfort are seen on women more than men. The psychology of employees is negatively affected by aggressive calls. This situation directly affects the health problems of employees. Performance based work type, the pressure of employer on the employees, open office working systems all affect the psychology of an employee negatively (Juster and Lupien, 2012). Long time shift works can cause diabetes, mostly due to irregular eating habits (Morikawa et.al, 2005). Sleep problems also occur due to shift work (Kesavachandran et.al, 2006).

Electromagnetic field exposure is the other risk factor for the call center workers. The wireless systems, cordless telephones, electrical devices are all sources of electromagnetic field in call centers. Table.1 shows the negative health effects of electromagnetic field exposure on human.

Table.1 Negative health effects on electromagnetic field on human (Kaplan, 2000)

|  |  |
| --- | --- |
| Short Term Effects | Long Term Effects |
| * Stress
 | * Damage on brain cells
 |
| * Risk of impairment of pacemaker
 | * Cancer risk of white cells
 |
| * Feeling of tiredness
 | * Heart discomforts
 |
| * Concentration problems
 | * Weakness of memory
 |
| * Headache
 | * Damage on embryo growth
 |
| * Dizziness
 | * İncrease of miscarriage
 |

Measurement of electromagnetic field

The measurements of electromagnetic field are generally carried by EMF meters, SDF meters of gaussmeters. Technically measurements should be taken 90 cm higher than floor. (Riley, 1995).

Aim of the study

Parallel with the technological developments, the development of call centers is inevitable. The formation of call centers are new, so the prevention methods due to health and safety have not developed completely yet.

Although there is a great deal of importance on the commercial relations between companies-companies or companies-customers, the call centers hold too many risks in the perspective of health and safety. However these risks are ignored both by employees and employers.

The aim of this study is electromagnetic field measurement at call centers, evaluation of its personal exposure and preparing a risk map of health and safety. After preparation of that map, some recommendations will be given in order to enhance current situation.

**Materials and Methods**

This study was carried at two call centers in Turkey (one is in Central Anatolia and the other is in Southeast Anatolia) which were chosen as representative. The determination criteria was accessibility to call centers. Call center’s other categorization is location.

The first location is 1250 m2 (all closed area) with entresol and ground floor. There are 86 male and 125 female workers were employed. There are also eight physically disabled employees. There is not any window opened to outdoor at this location. Ventilation system is automatic. There is a small rest area located in the first location. The average number of calls an employee answers is between 80 and 100. There is a 55 cm separator between two employees that the duty is to isolate the sound. There are not any standards for these separators. The separators are made by fiberboard. The tables where operators work are 120 cm wide.

Second location has 4500 m2 closed and 500 m2 open area. It has ground and first floors. There are 83 male and 121 female employees in here. All people included in this study work in the ground floor. Eight physically disabled people are employed in this location. There are windows opened outside and forced draught blowers at this location. There are 110 cm wide and 50 cm high separators between two workers. These separators are made by glass wool.

The electromagnetic field measurements were carried by SPECTRAN (1Hz - 1MHz, 10 MHz – 6 GHz) low-high and point frequency measurement device.

This study which was carried in 2015, is cross-sectional type. Parallel with electromagnetic field measurements, a question poll that consist 39 questions was applied to employees. 73% of employees in the first location and 87% of them in the second participated the questionnaire. All the employees who were at the location in that time when questionnaire was applied, participated it. The questionnaire investigated general health and safety conditions and health complaints of employees.

Hypothesis of this study

The hypothesis of this study are listed below:

* Long time sitting may cause musculoskeletal complaints among call center workers
* Call center workers use their voices densely and this cause voice complaints
* Electromagnetic field exposure may cause allergic diseases, kidney problems, heart diseases, diabetes, hypertension, cancer, infertility and migraine.
* Stress is the main risk factor and the source of many diseases at call centers.
* Tendency to obesity because of shift work and longtime sit.
* Ambient noise and using head phones may cause hearing problems among call center workers.
* So many workers exist at the same place, so this cause infections.
* Working with monitors for long hours may cause eye problems among call center workers.

The permission of ethics had been taken from The Ethic Council of Keçiören Training and Research Hospital (Ankara) on the date of 08/04/2015 with the number of 775 in order to conduct the survey. .

The samples of electromagnetic field were taken near from sources (exactly 1-2 cm far away), while workers were sitting near the head level above 90 cm from ground (Riley, 1995) and from some strategic positions where the electromagnetic field emission possibility. Also samples were taken from outside of the building. In order to verify the measurement results binary samples were taken from the similar points.

Analysis

The analysis of the study was carried out by using IBM SPSS Statistics 23 and Modeler 17. In statistical comparisons Mann-Whitney U test, t test and variance analysis used for quantifiable variances; chi-square test and Fisher test were used for quality variances. Besides, for evaluating the data results, artificial neural networks, decision tree (multilayer) method and regression analysis were used. p<0,05 was accepted as statistically different. These analyses are usable for categoric variables. In this research, the data are (questionnaire) mostly categorical.

Although it is not remarkable, in the analysis results, there are some lost values. This is considered as affect the results.

The electromagnetic field measurements and questionnaire application were carried on April-May 2015. The data analysis were completed during September 2015.

Electromagnetic field measurement results

For the first location, the maximum value of electromagnetic field was found as 371 V/m where minimum value was 32 V/m. The maximum value was found around the metal detector which existed in front of the main door. A security person is employed full time in here. The other higher values were found near system room, cable connections and cash machine. Of course when a call came the measured electromagnetic field became higher around the head of the worker. The values became smaller when mowed away from the building.

For the second location, the maximum value was found as 370 V/m and the minimum value was 61 V/m. The maximum values were found around the sources and dropped when moved away from the source as first location. Generally, the electromagnetic field values in second location were higher than the first location.

Table.2 shows some measurement results for similar places in first and second locations.

Table.2 First and second locations electromagnetic field measurement results

|  |  |  |
| --- | --- | --- |
| Measurement place (around) | First location (V/m)  | Second location (V/m) |
| Electric panel | 80 | 116 |
| Main door of the building | 45 | 65 |
| Cash machine  | 117 | - |
| Metal detector | 371 | 370 |
| Out of the building (near building) | 130 | 265 |
| Out of the building (far away from the building) | 50 | 89 |
| Operation center entrance | 49 | 68 |
| Respiration zone of worker without call  | 32 | 61 |
| Respiration zone of worker with call | 360 | 369 |
| Computer case and cables | 100 | 248 |
| The middle area | 52 | 86 |

The values shown in Table.2 were shown as some examples of the measurement results of the similar places for two locations. For similar places, similar results were obtained. Higher values such as 371 V/m, 369 V/m and 265 V/m are drawn as risky.

The physiologic properties of workers

The 55,62% of first location employees are male and 44,38% of them are female at the first location. The 43,14% of second location employees are male while 56,86% of them female. The age averages for the first location is (28,6 ± 6,3) and (29,4 ± 7,9) for the second one.

The educational information of employees were also analyzed. For the first location, 46,6% of employees were found as bachelors degree where it was found as 40,5% for the second location. Also masters degree workers were found in both locations. This means that workers of call centers are well educated. When examined in literature, it is seen that employers now prefer high educated people at call centers (Friginal, 2013). 63,5% of workers were married in the first location where 38,3% were married in the second one. In the perspective of duties, the higher percentage was seen on call center operators. The other duties also exist like psychologist, technician, interpreter, specialist and so on.

The results of analysis

The statistic analysis of data for both locations was done by IBM SPSS Statistics 23 and Modeler 17.

Cross tables

For both locations questions were asked to the employees by the question pool, in order to understand the health complaints of employees whether sourced from working environment or not also there were questions about the type of their chronic diseases and how long these diseases continue. After obtaining data, cross tables were prepared.

Chronic diseases were correlated with health complaints for both locations. For the first location, it was found that 47 employees with chronic diseases had also health complaints. With chronic disease but without health complaint the number of employees is only two. This number is relatively small when compared to 47. The result of chi-square test was found as 0,242. This is statistically significant on 95% confidence level. Chi-square test result for the second location was found as 0,185. This result is parallel with the first location results.

Smoking habits of employees were also analyzed. It can be said that the smoking tendency decreases with increasing education for both locations. Male employees were recorded as more subject to smoking than females.

For the first location, according to the Levene Test results, in the view of months the duration of elbow pain complaints, weakness and hearing scarcity of male workers were recorded as longer than female workers. Van Wijk and others found similar results according to their research study (Van et al.,1999).

For both locations, the relationship between electromagnetic field exposure and the time duration of stomach pain, hear loss, chronic diseases and neck pain were investigated. According to the results, for the first location it can be said as; there is a significant relationship between electromagnetic field exposure between stomach pain on the level of 0,165; hear loss on the level of 0,212 and chronic diseases frequency on the level of 0,387. For the second location; the relationship between electromagnetic field exposure and neck pain was found as 0,188 in the 90% of confidence bounds.

For nearly 35 years, researches have been searching for the negative health effects of 50-60 Hz frequency band electromagnetic field. According to the epidemiologic researches; electromagnetic field may cause impediments on reproductive system, abnormalities on birth and also cancer especially leukemia (Slusky et.al, 2014).

For the second location, the relationship between anger in calls and health complaints of employees were analyzed. According to the chi-square test, the Pearson coefficient was found as 0,02. This means that in the 95% confidence bound, there is a significant relationship between anger content of calls and health complaints of employees. The physiologic responses of employees to the calls with anger can be faint, spasm and some types ofcramps(http://www.slideshare.net/CCMGSA/health-safety-ccmg). WHO reported in 2001 that there is a strong relationship between physical and physiologic health (Brundtland, 2001). There are some other reserarches in literature which put forward stress related health complaints among employees (Fido and Ghali, 2008).

For both locations, on the basis of months, the relationship between working time in the workplace and health complaints of workers were investigated. In the perspective of first location, there is a significant relationship between working time in the work place and elbow pain on the level of 0,238; backache on the level of 0,174; knee pain on the level of 0,167; palpitation on the level of 0,145 and shortness of breath on the level of 0,205. Smith et al. found that working stress cause health complaints among workers (Smith et al.,2001). For the second location, there is a significant relationship between working time in the work place and elbow pain on the level of 0,238; wrist pain on the level of 0,174; back pain on the level of 0,167; knee pain on the level of 0,162 and shoulder pain on the level of 0,310. In general it can be said that if working time increases, musculoskeletal complaints increase too. Armstrong et al. found that using computer and keyboard during working time, employees complain about musculoskeletal pains (Armstrong et.al, 1993).

Daily working time with computer also affects various types of health complaints of employees. There is a significant relationship on the level of 0,146 between working time duration with computer by means of hours and anger of workers by means of months duration in the first location. For the second location; there is a significant relationship between daily working time with computer and headache on the level of 0,185. According to a study carried by Sato et al. in Japan; headache health complaints were seen on employees who work 35-45 hours in a week. 301 of 701 employees complained about headache in that study. If physical inactivity is added to the long hours work, the percentage of employees suffering from headache will increase (Sato et al., 2012).

Continuous use of voice while answering calls may cause hoarseness among workers. For the first location, a significant relationship between answered call number by workers and health complaints duration (in terms of months) about hoarseness on the level of 0,167. This relationship was found on the level as 0,233 for the second location.

According to a study carried by Piwowarcyzk in Brazil, call center employees who use their voices continuously during working time, have voice problems 6 times higher than employees who do not use their voices as much as call center employees (Piwowarczyk et al., 2012).

A significant relationship was found between temper of calls answered by female employees with menstrual irregularity for the first location. Stress may increase corticorpin hormone of a woman and this can entail menstrual irregularity (Sood et al., 2012).

Because of limited motion, working with computers for long hours can cause obesity. For the second location, the relationship between time-period with computers and obesity and chronic diseases were investigated. There found a significant relationship on the level of 0,408 between time-period (daily hours based) working with computers and obesity. The study results of Luckhaupt et al (2010) shows that the prevalence of obesity is higher for the employees working with computers by sitting on a desk more than 40 hours in a week (Luckhaupt et al., 2014).

The correlation of health complaints between themselves were also analyzed. For the first location, there found a significant relationship between ear problems and hear loss on the level of 0,366. Kenneth et al pointed out that the problems on the inner ear can cause hear loss in the following years (Kenneth et.al, 2000).

For the first location, there found a significant relationship between shoulder, elbow, back and knee pain. Again for the first location, the pain of elbow, carpus, neck between back pain were investigated and significant relationships were found between them. Because the employees sit in front of the computers for long hours without enough motion, the musculoskeletal complaints among them is an expected condition.

For the upper extremity, problem with one point can affect the related other points according to a prospective study carried by Brink et al between 2010-2011(Brink et al. 2015). Neck and shoulder complaints are mostly seen among office workers who work with computers (Sauter et al., 1991).

In this study, we also found that the overweight of workers affects some health complaints of employees such as elbow, carpus, back pain and palpitation with shortness of breath.

After correlations had been completed, the association analysis was done in order to evaluate health complaints of call center employees in detail. At this point, the purpose is to determine the affiliations in the huge data set. The input of the analysis is all variables whereas the output is only associated variables. For the first location, according to the results of association analysis; the pain of the corpus, elbow, neck, back, head, stomach and amnesia, nervosity, hoarseness, ear problems, chronic diseases, faintness, eye complaints are related to each other. In the specific association analysis; the more related between each other health complaints were investigated. In this analyses, back-lower pain, headache, shoulder pain and weakness were found as more related with each other. Sjgögren et al completed a study carried on office workers founded that 53 of 41 workers complain about headache, 37 workers neck pain and 41 of them have shoulder pain. It was discovered that the workers who take regular physical activity, have less head and neck aches. The complaints of neck ache and headache were seen as parallel to each other (Sjögrena et al., 2005). For the second location, according to the special association analysis, headache, weakness back pain are close related to each other.

Artificial neural network is an another method to analyze the question poll and electromagnetic field results. The working principle of it depends on human brain system. The neurons constitute the network. The artificial neural network put the variables which will explain the target variable into the model while it shuts out the variables that have the low percent of explanationvariables(http://ube.ege.edu.tr/~cinsdiki/UBI521/ Chapter-1/cinsdikici-neural-net-entry.pdf). For the modelling of artificial neural network of this study, Multilayer Perceptron adviser was used (<http://pages.cs.wisc.edu/~bolo/shipyard/neural/local.html>).

For the first location, the artificial neural network was constituted with the factors of health complaints which effect the employees. The health complaints of employees were selected as target variable. Explanatory variables were selected as; physical and demographic characteristics, sourced from working environment that negatively affect health of employees. In this manner all the variables were put into model that affect the health complaintments of employees. The target variable was named as health complaints, whereas descriptive variables were grouped as; gender, age, marital status, time of work in the department (in terms of months), smoking habit, existence of chronic disease, number of answered calls per day, duration of work in a week, duration of working with computer in a day (in terms of hours) and anger in answered calls. The accuracy level of the model was found as 79,9%. The most important variable was found as duration of work in a week (in terms of hours), the least one was founded as existence of chronic diseases. The accurate predict level of the model was noted as 80,5%.

For the second location, the target variable was selected as the duration time (in terms of months) of backache that workers suffer. The descriptive variables were grouped as; age, weight, height, duty in the department, duration of work (in terms of months) in the department, duration of work in a week (in terms of hours), number of answered calls in a day, time duration of working with computers in a day, some ergonomic complaints like elbow, back, waist, carpus pain. The most important factor that effects the backache was noted as duration of work time in the department. Neck and shoulder pains are also affect the back pain.

The last analysis method was selected as decision tree. The shoulder and back pain were the most seen complaints among first location employees according to the association analysis. In order to decide factors that affect these two complaints, classification and regression tree (CRT) algorithm were used. According to the analysis result, the level of anger in the answered calls mostly affect the shoulder and back pain. The time period of working in the department increases anger level of answered calls. Alhasan et al. carried a study in a university hospital on employees who work in the radiology department. According to this study some clues were found that the stress factor increases the musculoskeletal complaints mainly back pain (Alhasan et al., 2014). The detailed decision tree method shows that time period of the department is the main factor that effects shoulder and back pain.

For the second location, the association analysis results were taken as basis, then decision tree method was modelled. According to the association analysis, back pain, weakness and had ache are the most seen health complaints among workers. These complaints were modelled between themselves via decision tree method. Depending on the decision tree method for second location, 77% of employees who have health complaints, smoke so much and daily answered calls are higher than 95 have weakness and headache complaints.

Regression analyisis is used for numerical variables. From this research, there exist some numerical variables, so regression analiysis also was applied to the data set.

For the first location, all the numerical variables were taken as target value (explanatory variables), then these values were investigated of which variables they have relationship. All the variables in this study were identified by anger of employees. Anger of employees were found significant as the result. Among the regression analysis, for the second location, the target variable was taken as anger of employees that last long in terms of months. For the second location, the target variable was taken as anger of employees, then regression analysis were made. From the analysis, the most important variable that affects the anger of employees was found as how long they suffer from backache in terms of months. ANNOVA table has been used in order to measure the significance of the model. Because Sig.<0,005, model can be said as significant. The Sig. value of all the coefficients in the model was found smaller than 0,005, so all the coefficients can be said as significant.

**Discussion**

We faced some difficulties during the evaluation of electromagnetic field exposure and negative health effects and the general health and safety conditions of call centers because there are limited studies exist which investigate the counted situations. The accomplished studies have carried on general health and safety conditions at call centers. Most studies were carried on the former studies which were published in literature and they are not detailed publishings (Yasar et al., 2016). Also some studies were carried on some specific issues. Ben and his friends carried a study that investigates the deformation of call center employees’ voices and related health complaints (Ben-David and Icht, 2016). Rameshbabu et al. carried a study that investigates shift workers at call centers whose have insufficient sleep and work stress (Rameshbabu et al., 2013).

For both locations, the electromagnetic field value was found around 370V/m near metal dedector machine. This value is higher than the permissible limit values pointed at in legislations. Also in literature, the measurements were found near cordless telephones between 100-200 V/m (Baltrėnas and Buckus, 2013).

**Conclusion**

In this study, the two call centers were chosen as pilot practice with the aim of measuring electromagnetic field and negative side health effects of it. Also the general health and safety conditions of call center were analysed and a risk map has been prepared.

For both locations from the question poll, demographic properties, education levels, responsibilities in the work environment of employees were revealed. The result of electromagnetic field measurements were found between 32-371 V/m where for the second place that values were found between 61-371 V/m. The places where an employee does not get any call found having minimum electromagnetic field values. The maximum amounts were found around metal dedector device and the respiration level of worker when a call came.

In order to find how environmental conditions effect health of employees some correlations have been made. The electromagnetic field exposure increases stomach complaints, hearing loss and prevelance of chronic diseases among employees. For the second location, the electromagnetic field exposure was found to increase neck pain. The indirect effects of electromagnetic field exposure for the first location can be shortness of breath, amnesia, palpitation and anger of employees. For the second location, this effect is headache. For both locations the chronic diseases increase health complaints. For both locations, males smoke more than females. The more the anger level increases in the answered calls, the more health complaints of second location employees increase. The negative ergonomic conditions give rise to the elbow, back, knee, waist, neck, carpus and shoulder pains of employees. The increase of the daily answered calls also increase the hoarseness of workers. For the first location, with the increase of anger in calls the disorder of mensturation periods increase amog female workers, too. The smoking habits increase with increasing anger level of answered calls in the second location. The time period of working with computers (in means of hours) increases the weight of second location workers. There exists a significant relationship between back pain and shortness of breath for the first location employees. A significant relationship has been found between hear loss and ear complaints for the first location workers. Also a significant relationship has been found between first location workers’ health complaints such as shoulder, elbow, back, carpus, knee, neck. A significant relationship has been found between weight of first location workers and elbow, carpus, back pain, palpitation and dyspnea. For the first location, health complaints of male workers were found much more than female workers.

After correlation analysis, the association analysis has been made in order to determine which health complaints are strongly related to each other. For the first location; there found a close relationship between back pain, headache, shoulder pain and weakness. For the second location, headache, back pain and weakness complaints were found in close relationship. The completed artificial neural network made for the categorical variables. For the first location, health complaints and for the second location, back pain were investigated from which variables they were effected. By the determination tree, for the first location the factors investigated, which affects shoulder and back pain; for the second location weakness, back and headaches factors investigated.

At last, for both locations, in the regression analysis the target variable was taken as anger of employees and the explanotary variables were investigated.

After completion of picking up the data and the analysis the risks in terms of health and safety were revealed out to point on the risk map. Stress was the main risk defined for call centers. Electromagnetic field exposure, use of voice in densely, environmental noise are the other risk factor seen in call center work environments. Because of negative ergonomic conditions, the musculoskeletal system can be seen among the call center employees.

What should be done

Shielding is a method that can protect from the negative effects of electromagnetic field exposure. Shielding can be paint for the walls or textile products. Shielding can protect up to 99% (Lu et.al, 2010). In addition to this, some attention will take important position while using electrical devices. Regular physical examination will help to early diagnosis.

Regular physical exercise and some improvings on ergonomic conditions can prevent the workers’ musculoskeletal complaints. The ambient noise and the noise sourced from headphones may cause some health problems related to ears. Regular health controls, measurement of ambient noise and using ergonomic/proper headphones can prevent negative health problems about workers’ ears. Continuous work with computers may cause some problems about eyes. Screen savers will play preventable role at this point. Also regular diagnosis of workers’ eyes is important.

Another work ambient complaint among workers is insufficient ventilation. At this situation, suitable air conditioning, regular maintenance/control plays important role on prevention. Some periodical sound therapies will be a cure for employees who have hoarseness.

Employing so many workers in the same work environment may give rise to reproduce bacteria or microorganisms. This can also cause some contagious diseases. To prevent this situation, providing the ambient hygiene and hygiene education is important.

Eliminating the risk at source is the most important prevention factor for health and safety issues. Protective shelter is more important than the personal protectives. In this perspective the existing risks should be minimized by the control of a safety specialist. Awereness of the health and safety risks among employees are another prevention methods.

Unfortunately there is no legislation which regulates the electromagnetic field exposure and negative health effects on employees. There isn’t any legislation whichregulates the working conditions of employees at call centers in terms of health and safety, either. This gap of the legislation should be filled in order to prevent employees from the negative health and safety conditions.

This research was done with the aim of drawing the broad risk map of call centers in terms of health and safety. Also one of the most important aims of the study is to guide for the following similar studies. The scope of the research may be extended by including much more ambient measurements, reaching much more call centers and employees. With this in mind, the health and safety risk map of call centers will be broadened.

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