Investigation of the Relation Between the Electromagnetic Radiation and the Cancer Cases in Bahrain

By W.E. Alnaser* and Y.E. Alnaser**

ABSTRACT

The relation between the electromagnetic radiation (or field) and the cancer cases in Bahrain was investigated. An empirical linear equation between the exposure to the electromagnetic radiation and the cancer crude death rate was found. The statistical analysis of cancer cases in Bahrain do not provide sufficient evidence to support the views expressed by other authors, viz, the presence of the magnetic flux density as a dominant factor for causing cancer.

Levy and Wegman [1] suggested that the electromagnetic radiation which resulted from the existence of the electric field, and hence the resulted magnetic field which is perpendicular to the electric particle's direction of movement, have an impact on health. Their evidence is that since electric currents which are indigenous within all organisms play crucial roles in a physiological process which is mentioned by Ketchen et al [2] such as neural activity, tissue growth and repair, glandular secretion and cell membrane function. Hence it is not hard to believe that an exposure to a high electromagnetic field would change the behaviour of such current. Ongoing research seems to indicate that electric and magnetic fields sufficient to affect health exist only near power lines or specialized industrial or research laboratories. This fact has made the Central Electricity Generating Board (CEGB – UK) to raise their budget to 1m. for research into the health effects of electricity, and particularly of people's exposure to magnetic field from electrical applicances in and around their homes and workplaces [3]. Wertheimer and Leeper [4] and Tomenius et al [5] had reported that environmental exposure to electromagnetic field arising from electricity transmission equipment may be associated with an increased risk of cancer.

In addition, several cases of cataracts alleged to have been caused by Video Display Terminals (VDT's) radiation have been reported by Zaret [6]. The large number of VDT's in use, estimated to be in the range of 5 to 10 million in the United States alone, which are known to produce several types of low level non-ionizing radiation including ultraviolet, visible and infrared, were accused to be the cause of symptoms in their operators. The symptoms are eye strain, visual deterioration, headache, dulling of tactile sensation, nausea, general fatigue and cataract formation. National Institute for Occupational Safety and Health (NIOSH – USA)[7], had reported that visual and musculoskeletal complaints and other problems were occuring more frequently than expected among workers using them. Moreover, Moss [8] had reported that there are two cases of cataracts among VDT users which supports the study of Zaret's[6]. He also reported eight cases of cataracts associated with cathode ray tube generated displays. It is evident that a correlation exist between the electromagnetic radiation and the cancer which led the authors to study such an effect in Bahrain. The States of Bahrain is a small island in the Arabian Gulf at a Longitude 51°E and Latitude 25° — 26°N and having an area of 226.40 km² with a total population of 238,420.

METHODS

In order to investigate the relation between the electromagnetic field and the cancer cases we had studied the electromagnetic field in terms of the

* Assistant Professor
Department of Physics
College of Arts and Science
University of Bahrain
State of Bahrain

** Head of Project and Research Department
Central Statistics Organisation
Council of Ministers
State of Bahrain

FIGURE 1

The location of Bahrain in the Arabian Gulf (right) and the distribution of the 12 regions of Bahrain (left).
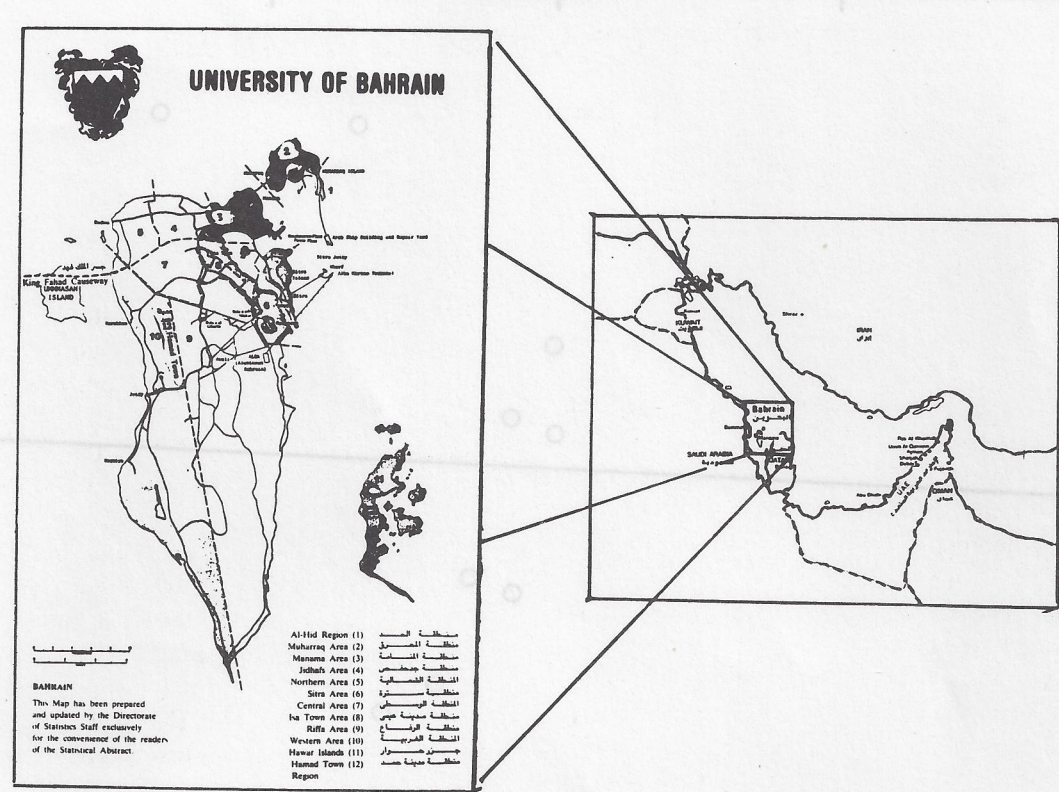

TABLE 1

Parameters Used to Study the Relation between the Electromagnetic Radiation and the Cancer Cases in Bahrain.

Region No.	No. of Deaths Due to Cancer	No. of Distribution Transformers (limit 1.65T)	No. of Power Transformers (limit 1.9T)	Total No. of Tesla	Region Area (km²)	Population	Crude Death Rate, D	Exposure, E (T/m²)
1	22	25	6	52.65	5.23	5535	0.00397	9.51×10^{-3}
2	124	243	8	416.15	15.23	47827	0.00253	8.70×10^{-3}
3	197	819	42	1431.15	23.47	58108	0.00339	24.6×10^{-3}
4	78	137	6	233.65	21.58	29747	0.00262	7.85×10^{-3}
5	34	176	6	301.8	36.84	16716	0.00203	18.05×10^{-3}
6	42	124	6	216	28.57	19472	0.0215	11.09×10^{-3}
7	28	123	2	206.75	35.20	12903	0.00217	16.02×10^{-3}
8	46	132	6	229.2	12.36	19957	0.00230	11.48×10^{-3}
9	40	206	12	362.7	291.64	14898	0.00268	24.3×10^{-3}
10	26	109	2	202.65	156.04	12945	0.0020	15.6×10^{-3}

FIGURE 2

The correlation between the exposure E, (T/m²) and the crude death rate D.

Crude Death Rate   D.
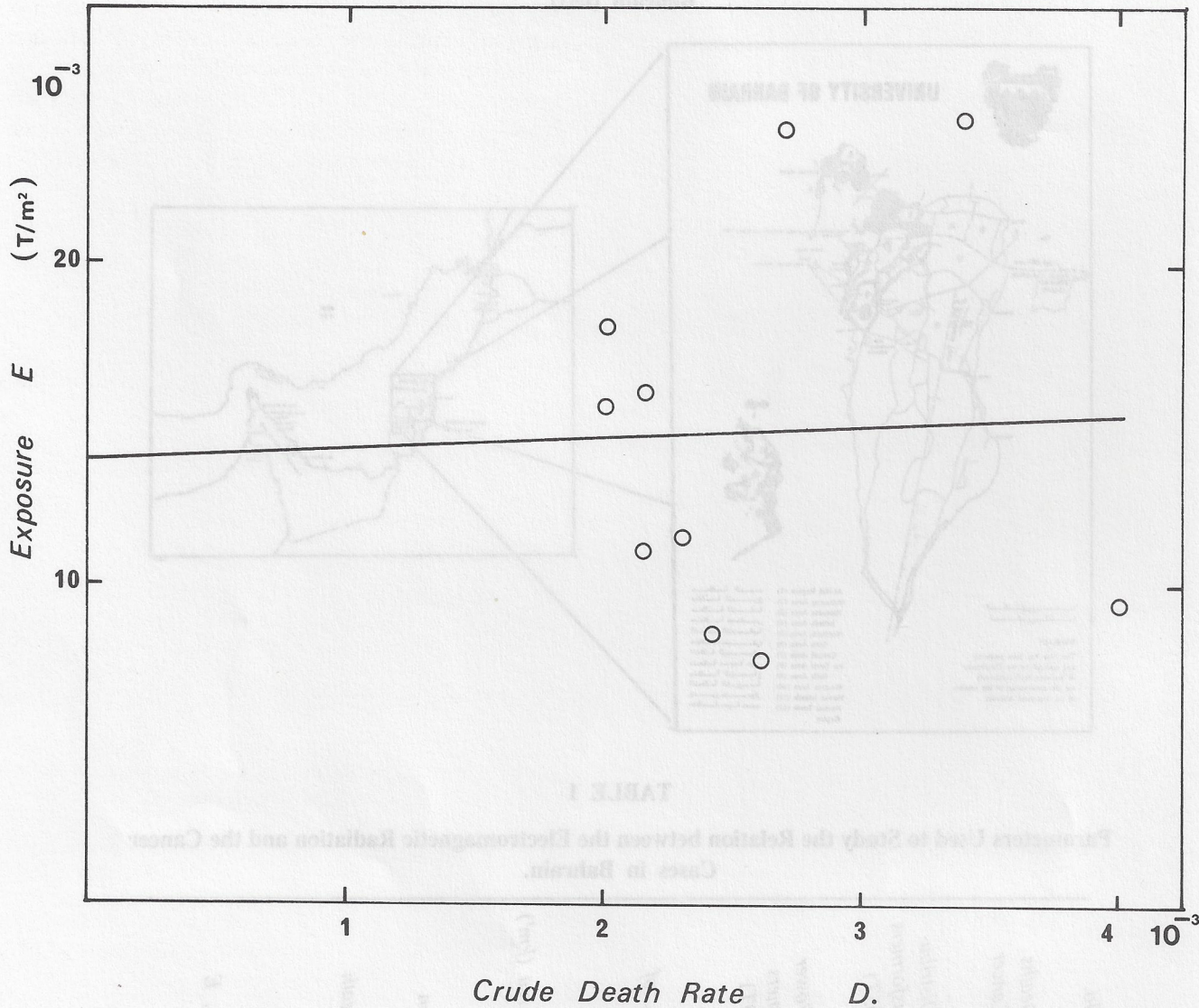
magnetic flux density (Weber per square meter) in Tesla's units. Data was obtained from the Ministry of Works, Power and Water concerning the number of distribution transformers. 11KV/415V, and power transformer, 66/11.33KV/11KV which is limited to be not more than 1.65 and 1.9 Tesla respectively, that was installed up to 1987 in each region in Bahrain (which is divided into 12 regions as shown in Fig. 1). In this work, region 11 and 12 are eliminated since the latter is a recently built area. In this area the residents have recently moved from other regions and the former is a restricted area. The number of death cases due to cancer from the year

1983 to 1987 was obtained from the annual report of public health 1987[9]. Table 1 shows data collected for this study which contains information about the number of cancer deaths, the number of power distribution transformers, magnitude of the magnetic flux in Tesla, area of each region, population[10], crude death rate (number of deaths divided by the population) and finally the exposure which represents the number of Tesla in each square meter.

RESULTS

The plot of the exposure E versus the crude death rate D is shown in Fig. 1. The straight line was drawn

by using the least square method. The slope of the line was found equal to 0.364. The standard error of the slope is ± 3.38 which is relatively very high and the correlation coefficient r is 0.038.

DISCUSSION

The plot of the exposure E, versus the crude death rate D, in Fig. 2 indicates that electromagnectic radiation induces cancer. However, the correlation coefficient and the standard error of the slope makes the previous conclusion invalid. This statistical result shows that the standard error of the slope is ± 3.38 which is very high and suggests that if the slope is negative the crude death rate increases as the exposure decreases! If it is positive then the electromagnetic radiation causes cancer. Moreover the correlation coefficient between the points in Fig. 2 was found to be 0.038 which is very low from the statistical point of view. The following equation which relates between the electromagnetic radiation E and the cancer crude death rate D is derived from the above statisical results.

$$E = 0.3577\ (\pm\ 3.38)\ x\ D + 0.0138\ (\pm\ 0.0065),\ r = 0.038\ ^1.$$

Although the number of deaths of the non-nationals due to cancer is known, their duration of stay in Bahrain prior to death is not known. Equation [1] will be modified if this number is provided in table 1. Moreover, the number of cancer death cases in Bahrain might be inaccurate because cancer register is not available in Bahrain, hence the number of cancer cases used in this analysis may not be accurate. This will reflect on the calculated value of the correlation coefficient. Our result does not agree with the work of Mc Dowall[11, 12], whereas in his study he took a group of people who were identified as living near electrical installations at a point in time and compared their mortality prospectively with that of the general population from which the individuals were drawn. The result of his investigation indicate that lung cancer is possible to be caused by electromagnetic field (or radiation). However, the work of Fultron et al [13] had failed to show an association between the exposure to the electromagnetic radiation and the cancer cases.

CONCLUSION

The present authors conclude that there is no significant or clear relation between the exposure and the cancer death cases. Meanwhile they believe that exposure to electromagnetic radiation has an impact on the health but in another form such as cataracts and other symptoms as mentioned previously, which is currently under investigation and will be reported in future.

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